



Office of the City Manager

CONSENT CALENDAR  
February 8, 2022

To: Honorable Mayor and Members of the City Council  
 From: Dee Williams-Ridley, City Manager  
 Submitted by: Abraham Roman, Fire Chief  
 Subject: Contract - O2X for Public Safety Wellness Programming

RECOMMENDATION

Adopt a Resolution authorizing the City Manager to execute a contract and any amendments with O2X Human Performance LLC (Contractor) to provide a physical and mental wellness program for the Berkeley Fire & Police Departments (Departments) for a four (4) year base contract period that starts February 9, 2022 and ends on February 8, 2026 in an amount not to exceed \$2,712,145 with an option to extend for up to six (6) additional years in two (2) year increments for a total of ten (10) years and not to exceed a total contract amount of \$7,948,612.

FISCAL IMPACTS OF RECOMMENDATION

The base term of this contract is from February 9, 2022 to February 8, 2026 in the amount of \$2,712,145. There is an option to extend for three additional two (2) year terms for a total term of ten (10) years with cost escalations of 2.5% annually. Funding for the employee wellness program is already budgeted annually in the Fire Department budget: 147-72-742-835-0000-000-422-612410

CURRENT SITUATION AND ITS EFFECTS

The Departments currently have internal wellness programs that are provided by firefighters and police officers that endeavor to conduct employee wellness activities during work and non-work hours. While an essential component of a wellness program, peer-based programs do not provide adequate resources for the magnitude of the challenge that exists within the first responder community.

BACKGROUND

First responders higher rates of chronic medical and psychological injury and illness than the general population. These issues are often directly correlated to shift work, traumatic experiences and stress, and exposure to carcinogens (Daniels, 2013) (Sritharan, 2017). Until recently there has been a stigma associated with coming forward with admission of psychological or medical conditions related to the work, thereby the data has been grossly under reported. Along with more funding dedicated to

scientific research over the past several decades on these topics, it is now widely accepted that there are direct correlations from these disease processes to public safety work. Establishing and maintaining a complete annual physical and wellness program is critical in reducing lost time, mental illness, substance abuse and prevention or early detection of long-term chronic health conditions including cancer and heart disease within the first responder population.

### Impacts of Shift Work

First responders routinely work shifts that cause disruption of the normal sleep/wake cycle. Nocturnal melatonin suppression and circadian rhythm disruption caused by night shift work function as carcinogens that increase the incidents of malignant tumors (Daniels, 2013) (Tsai, 2016). In addition to cancer, shift work has been associated with higher rates of Type II diabetes, heart disease, stroke, metabolic disorders, sleep disorders, increased risk for reproductive issues, such as irregular menstrual cycles, miscarriage, and preterm birth, chronic stress and depression (Smith, Cardiovascular Strain of Firefighting and the Risk of, 2016). Circadian disruption can harm biologic systems that help prevent cancer. For example, in addition to promoting sleep, melatonin can also inhibit tumor growth and protect against the spread of cancer cells.

### Increase Risk of Cancer & Prevention

Research spanning decades, continents, and more than 80,000 firefighters validates the connection between firefighting and occupational cancer. Cancer is the most dangerous threat to firefighter health and safety today.

- Cancer caused 66 percent of the career firefighter line-of-duty deaths from 2002 to 2019, according to data from the International Association of Fire Fighters (IAFF). Heart disease caused 18 percent of career LODDs for the same period.
- Cancer caused 70 percent of the line-of-duty deaths for career firefighters in 2016 (Smith, Cardiovascular Strain of Firefighting and the Risk of, 2016).
- Firefighters have a 9 percent higher risk of being diagnosed with cancer and a 14 percent higher risk of dying from cancer than the general U.S. population, according to research by the CDC/National Institute for Occupational Health and Safety (NIOSH).

Firefighters' risks are significantly higher for some types of cancer than the general population, these include:

- testicular cancer – 2.02 times the risk (100% = double = 2 times);
- mesothelioma – 2.0 times greater risk;
- multiple myeloma -1.53 times greater risk;
- non-Hodgkin's lymphoma – 1.51 times greater risk;
- skin cancer – 1.39 times greater risk;
- malignant melanoma – 1.31 times greater risk;

- brain cancer -1.31 times greater risk;
- prostate cancer – 1.28 times greater risk;
- colon cancer -1.21 times great risk; and
- leukemia – 1.14 times greater risk (Daniels, 2013).

Continual and early screening is key to early detection and better health outcomes. Screening is done when employees have no signs or symptoms. These tests help detect cancer at an early stage, before symptoms appear. When abnormal tissue or cancer is found early, it is often easier to treat or cure. By the time signs and symptoms appear, the cancer may have grown and spread making it more difficult, costly, or impossible to treat or cure.

### Mental Health

First responders are more likely to die by suicide than in the line of duty. In 2017, there were at least 103 firefighter suicides and 140 police officer suicides in the US. In contrast, 93 firefighters and 129 police officers died in the line of duty. Suicide is a result of mental illness, including depression and PTSD, which stems from constant exposure to death and destruction.

There are a number of factors contributing to mental health issues among first responders and what leads to their elevated rate of suicide. One study found that on average, police officers witness 188 'critical incidents' during their careers. This exposure to trauma can lead to several forms of mental illness. For example, PTSD and depression rates among firefighters and police officers have been found to be as much as 5 times higher than the rates within the civilian population, which causes these first responders to commit suicide at a considerably higher rate (firefighters: 18/100,000; police officers: 17/100,000; general population 13/100,000). Even when suicide does not occur, untreated mental illness can lead to poor physical health and impaired decision-making.

In addition, the Firefighter Behavioral Health Alliance (FBHA) estimates that approximately 40% of firefighter suicides are reported. If these estimates are accurate, the actual number of 2017 suicides would be approximately 257, which is more than twice the number of firefighters who died in the line of duty.

Wellness programs have reduced healthcare and workers compensation costs associated with injuries and illness. Additionally, responders that are healthy (medically and psychiatrically) are more resilient, make better decisions and are more likely to be at work. The Contractor will provide services that include but are not limited to, one-on-one consultations, managing wellness/fitness initiatives, coordinating awareness and motivational campaigns, mental and health related training, long-term data collection and analysis, and educational seminars. All of these services increase job performance, support healthy lifestyles and increase the resilience of our emergency responders.

### ENVIRONMENTAL SUSTAINABILITY AND CLIMATE IMPACTS

There are no identifiable environmental effects or opportunities associated with the action requested in this report.

### RATIONALE FOR RECOMMENDATION

The City conducted a competitive bid process and 02X Human Performance LLC successfully met the bid requirements and ranked highest among all bidders. The pricing is deemed to be fair and reasonable.

The contract with 02X Human Performance LLC will benefit the City by affording a long-term relationship with a vendor that is committed to providing high quality physical and mental wellness programming that has been proven to prevent acute and chronic conditions that may otherwise go unidentified by internal peer-based programs or vendors that have less specialized experience with fire, police and emergency services personnel. 02X Human Performance LLC provides wellness services to a wide variety of emergency services providers across the United States. 02X Human Performance LLC will also be providing all of these services within the City of Berkeley so responders will not have to leave the City.

### ALTERNATIVE ACTIONS CONSIDERED

None.

### CONTACT PERSONS

Abraham Roman, Interim Fire Chief, (510) 981-3473

### Attachments:

1. Resolution
2. Community Oriented Policing Services, U. D. (n.d.). Building and Sustaining an Officer Wellness Program.
3. Daniels, a. a. (2013). Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950– 2009). *Occupational & Environmental Medicine*.
4. Lynn Hancock, M. (2017). *Law Enforcement Fitness Policies in Relation to Job*. Walden Dissertations and Doctoral Studies.
5. Nord, e. a. (2011). Accuracy of peak VO2 assessments in career. *Journal of Occupational Medicine and Toxicology*.
6. Pinnacle. (2018). Evidence that Wellness Programs Reduce Worker's Compensation Costs for Police Departments.
7. Poplin, e. a. (2013). The Association of Aerobic Fitness With Injuries in the Fire Service. *American Journal of Epidemiology*.
8. Smith, e. a. (2011). Firefighter Fitness: Improving Performance. *Current Sports Medicine Reports*.



9. Smith, e. a. (2016). Cardiovascular Strain of Firefighting and the Risk of. *Exercise and Sport Sciences Reviews*.
10. Sritharan, e. a. (2017). Prostate cancer in firefighting and police. *Environmental Health*.
11. Tsai, e. a. (2016). Risk of Cancer Among Firefighters in California, 1988–2007. *Am J Ind Med*.

RESOLUTION NO. ##,###-N.S.

Contract: 02X Human Performance LLC for physical and mental wellness program for the Berkeley Fire & Police Departments.

WHEREAS, first responders have a higher rate of chronic medical and psychological injury and illness that has been directly correlated to shift work, traumatic experiences and stress, and exposure to carcinogens, and

WHEREAS, shift work has been associated with higher rates of certain types of cancer, type II diabetes, heart disease, stroke, metabolic disorders, sleep disorders, increased risk for reproductive issues, such as irregular menstrual cycles, miscarriage, and preterm birth, chronic stress and depression, and

WHEREAS, cancer caused 66 percent of the career firefighter line-of-duty deaths from 2002 to 2019, according to data from the International Association of Fire Fighters (IAFF), and

WHEREAS, firefighters have a 9 percent higher risk of being diagnosed with cancer and a 14 percent higher risk of dying from cancer than the general U.S. population, and

WHEREAS, PTSD and depression rates among firefighters and police officers have been found to be as much as 5 times higher than the rates within the civilian population, which causes these first responders to commit suicide at a considerably higher rate (firefighters: 18/100,000; police officers: 17/100,000; general population 13/100,000), and

WHEREAS, wellness programs have been proven to reduce healthcare and workers compensation costs associated with injuries and illness, and

WHEREAS, first responders that are healthy (medically and psychiatrically) are more resilient, make better decisions and are more likely to be at work.

NOW THEREFORE, BE IT RESOLVED by the Council of the City of Berkeley that the City Manager is authorized to execute a contract and any amendments with 02X Human Performance LLC (Contractor) to provide a physical and mental wellness program for the Berkeley Fire & Police Departments (Departments) for a four (4) year base contract period that starts February 9, 2022 and ends on February 8, 2026 in an amount not to exceed \$2,712,145 with an option to extend for up to six (6) additional years in two (2) year increments for a total of ten (10) years and not to exceed a total contract amount of \$7,948,612.

# Building and Sustaining an Officer Wellness Program

## Lessons from the San Diego Police Department



**COPS**  
Community Oriented Policing Services  
U.S. Department of Justice



POLICE EXECUTIVE  
RESEARCH FORUM

This project was supported, in whole or in part, by cooperative agreement number 2016-CK-WXK-030 awarded by the U.S. Department of Justice, Office of Community Oriented Policing Services. The opinions contained herein are those of the author(s) or contributor(s) and do not necessarily represent the official position or policies of the U.S. Department of Justice. References to specific individuals, agencies, companies, products, or services should not be considered an endorsement by the author(s) or the U.S. Department of Justice. Rather, the references are illustrations to supplement discussion of the issues.

The Internet references cited in this publication were valid as of the date of publication. Given that URLs and websites are in constant flux, neither the author(s) nor the COPS Office can vouch for their current validity.

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Published 2018

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# Letter from the Director of the COPS Office

Colleagues:

The men and women who make up our police departments and sheriffs' offices face situations every day that endanger their health and safety and even their lives. The dangers are often mental and emotional as well as physical—and seeking help for that type of illness or injury can be harder than getting treatment for something more observable like a wound that needs stitching up or a broken bone. But officers' and deputies' mental state is just as important as their physical condition, and they need to be well and healthy in both areas to be able to carry out their law enforcement responsibilities.

Agencies around the country are recognizing the importance of monitoring and tending to employees' health and wellness, and this publication discusses the establishment and operation of a dedicated unit at the San Diego Police Department (SDPD) with the goal of promoting a department-wide culture of wellness, providing support and services when they are needed, and keeping the department healthy. More broadly, working toward these goals will also help the department better serve its community.

In addition to an in-depth examination of the SDPD's Wellness Unit, this publication includes a literature review on officer safety and wellness and law enforcement agencies' organizational health. The lessons learned, resources identified, and training and recommendations developed by the Police Executive Research Forum in their observation of the SDPD, will help guide other local agencies that may be interested in setting up similar programs.

Sincerely,

A handwritten signature in black ink that reads "Phil Keith". The signature is written in a cursive style with a long, sweeping tail on the letter "K".

Phil Keith  
Director  
Office of Community Oriented Policing Services



# Letter from the Executive Director of PERF

Dear colleagues,

Policing is a rewarding career, but these rewards can come at a high cost to our nation's officers. When they put on their uniforms, they commit to taking on the physical, mental, and emotional challenges that each shift presents.

Over time, the stressful nature of police work can take a toll on an officer's well-being. Though this stress may strain officer's physical and mental health, many officers are reluctant to come forward and ask for help. Seeking assistance may carry a stigma, and officers may even be concerned that their careers may be derailed if they seek assistance.

The implications of ignoring these issues are well known. Research indicates that when officers' physical and mental health issues go unmanaged, job performance decreases,<sup>1</sup> decision-making abilities are impaired, and agency costs increase.<sup>2</sup> Everyone has a stake in promoting police officers' wellness, because it has a direct impact on officers' abilities to effectively serve their communities.

In recognition of the critical role that officer wellness plays in police work, law enforcement agencies across the country have created programs aimed at preserving and promoting officers' physical and emotional health.<sup>3</sup> These initiatives have been broadly referred to as officer safety and wellness programs. Many programs have been expanded to include civilian employees as well as sworn officers.

In April and August 2017, Police Executive Research Forum (PERF) staff members conducted site visits to the San Diego (California) Police Department (SDPD) to observe its officer wellness program, which is considered one of the top programs in the country.<sup>4</sup> During the two site visits, PERF staff members interviewed key stakeholders from all of the SDPD's wellness program components. This included Wellness Unit staff (past and present), "help services" providers (police chaplains and members of the counseling team), command staff, peer support members, and members of the department who have used wellness services. PERF also attended wellness-related trainings offered to department members. Through these observations and discussions, PERF identified promising practices, lessons learned, and model policies for other agencies to consider when implementing their own wellness initiatives.

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<sup>1</sup> Fox et al., "Mental-Health Conditions."

<sup>2</sup> Andersen et al., "Mental Preparedness."

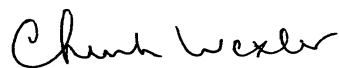
<sup>3</sup> Kuhns, Maguire, and Leach, *Health, Safety, and Wellness Program Case Studies*.

<sup>4</sup> Destination Zero, "2016 Officer Wellness Winner: San Diego (CA) Police Department."

While there are clear benefits to creating comprehensive officer safety and wellness initiatives, many departments remain unsure of where to start. This publication outlines a set of policy and programmatic recommendations based on lessons from the SDPD's wellness initiatives. The purpose of this report is to provide guidance to agencies across the country that are looking to implement wellness programs or to improve upon existing initiatives.

We are incredibly grateful to the COPS Office for their support of this project and its continued leadership on officer safety and wellness issues. This includes its stewardship of the National Officer Safety and Wellness (OSW) Group, which it co-created with the Bureau of Justice Assistance in 2011. The COPS Office creates critical opportunities for law enforcement agencies and researchers to engage with each other on officer safety and wellness issues and provides needed resources and information on promising practices to law enforcement organizations across the country.<sup>5</sup> Most recently, the COPS Office published *Improving Law Enforcement Resilience: Lessons and Recommendations*,<sup>6</sup> which discusses the unique stressors that officers face and strategies for building their resilience.

Preserving officers' physical and mental health plays an integral role in keeping our police and communities safe. Together, we must commit to embedding wellness into the culture of our nation's police agencies.



Chuck Wexler  
Executive Director

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<sup>5</sup> COPS Office, "National Officer Safety and Wellness Group."

<sup>6</sup> Spence, *Improving Law Enforcement Resilience*.

# Acknowledgments

The Police Executive Research Forum (PERF) would like to thank the COPS Office for supporting this examination of the San Diego (California) Police Department's (SDPD) wellness unit development and operations. The COPS Office deserves credit for recognizing the importance of officer safety and wellness programs in law enforcement agencies; in particular, program manager Nazmia Comrie, provided encouragement and guidance throughout the project.

We are also grateful to San Diego Police Chief Shelly Zimmerman for providing access to the SDPD during our April and August 2017 site visits. Special thanks go to Assistant Chief Sandra Albrektsen and retired Assistant Chief Sarah Creighton, who provided important insights into creating and sustaining a wellness program from a command perspective. We are also thankful for the efforts of Sergeant Ed Zwibel and Sergeant Carmelin Rivera, who connected us with many people involved in the SDPD's wellness initiatives to ensure that we had a well-rounded view of the program. We also thank Ms. Deanna Dotta and Officer Marnie Minton, who have served full-time in the Wellness Unit and who shared their thoughts and experiences with us. All of the practitioners we interviewed for this project were generous with their time and expertise. Their insights shaped our understanding of the wellness-related issues that many law enforcement agencies are facing as well as the promising practices that are captured in this report.

Finally, credit is due to PERF staff members who conducted the site visits, interviewed practitioners, and helped write and edit this publication, including Director of Technical Assistance Jessica Toliver, Senior Research Associate Elizabeth Miller, Senior Research Assistants Madeline Sloan and Adam Kemerer, and Director of Communications Craig Fischer.



# Introduction

In 2011, the San Diego Police Department (SDPD) faced a crisis unlike any other in the agency's history.

Between February and August, 10 SDPD officers were investigated for offenses ranging from rape and sexual battery to driving under the influence. Six of the 10 officers were arrested.<sup>7</sup>

As incidents of criminal misconduct mounted, a number of tragic incidents also occurred. On July 18, an SDPD detective and her daughter were killed by the detective's son. In the weeks that followed, the SDPD lost four more of its own, including Officer Jeremy Henwood, who was shot in his patrol car while stopped at an intersection.

The combination of seeing the reputation of the agency and its officers jeopardized by the actions of a few and the traumatic loss of so many of their colleagues in such a short time placed a tremendous amount of stress on the department. In response, the SDPD took action to provide comprehensive support to department members. The Wellness Unit, created in July 2011, was one of the programs that resulted from those efforts. Staffed full time by members of the department, its sole purpose is to provide for the wellness needs of SDPD personnel.

## Meeting the challenge

Wellness became a key part of the SDPD's strategy after the department discovered that the officers under investigation had experienced major challenges that had gone unaddressed.<sup>8</sup> They included substance abuse, divorce, and financial strain.<sup>9</sup> The urgent need for a more comprehensive approach to wellness was underscored by the series of officer deaths that began in July 2011 and its impact on members of the department.

While the department had long offered wellness-related programs such as peer support, psychologists, police chaplains, and stress management training, these services were decentralized. There were no members of the SDPD whose full-time job was attending to the wellness of the SDPD's officers and staff.

This all changed with the Wellness Unit. Its members serve as a resource by coordinating the delivery of help services and developing wellness programming to respond to department members' needs. This is all in service of the Wellness Unit's larger goal: to create and sustain a robust culture of wellness that prioritizes the physical and emotional health of the SDPD's members. Today, the SDPD's wellness initiative is considered one of the best in the country,<sup>10</sup> and its programs are regarded as models for other agencies.

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<sup>7</sup> PERF, *Police Accountability*.

<sup>8</sup> San Diego Police Department, *Changing Organizational Culture*.

<sup>9</sup> San Diego Police Department, *Changing Organizational Culture*.

<sup>10</sup> Destination Zero, "2016 Officer Wellness Winner: San Diego (CA) Police Department."

## Conducting a case study of the SDPD's wellness program

In 2016, the Police Executive Research Forum (PERF) entered into a cooperative agreement with the U.S. Department of Justice's Office of Community Oriented Policing Services (COPS Office) to conduct a case study of the SDPD's officer wellness program. This case study, detailed in this report, included the following research tasks:

- A review of existing literature on the relationship between officer wellness and officer performance and health
- A review of the SDPD's wellness-related materials (such as brochures, newsletters, and survey results) and operations manual
- Two multiday site visits (detailed in the following sections)

During the site visits, PERF's project team observed three trainings: (1) the Wellness module of Advanced Officer Training, (2) Emotional Survival II Training, and (3) Effective Interactions Training. PERF also interviewed many stakeholders, including current and former Wellness Unit staff members, psychology professionals who work with the SDPD, peer support officers, civilian peer supporters, department chaplains, and members of the department who have used help services.

## This report: A toolkit for building individualized wellness programs

This publication is the result of that research. It describes the SDPD's program and the department's promising practices and lessons learned. Its purpose is to help other agencies implement their own successful wellness programs by providing promising practices derived from PERF's study of the SDPD's wellness initiatives.

This goal of this publication is not to propose that all agencies—regardless of size, location, or budget—replicate the SDPD's wellness program in its totality. Rather, we describe the SDPD's program components and outline the benefits of each, so that agencies can replicate parts of this program or otherwise tailor it to their own needs and resources.

The SDPD's wellness program is built on three pillars:

1. The full-time staff in the Wellness Unit
2. Other help services providers and programs (such as peer supporters, psychological services, and issue-specific programs and partnerships)
3. A multi-level training program

This publication largely mirrors that structure, with a literature review followed by a section on each of the three pillars.



# Literature Review: Why Wellness Matters

Policing is a difficult and stressful job, with higher physical and mental health risks than many other professions.<sup>11</sup> Studies have shown that when officers' physical and mental health issues go unaddressed, job performance decreases,<sup>12</sup> decision-making abilities are impaired, and agency costs increase.<sup>13</sup> In other words, everyone should be invested in maintaining police officers' wellness, because it has a direct impact on their ability to be effective. In recognition of the critical role that officer wellness plays in police work, law enforcement agencies across the country have created programs aimed at preserving and promoting officers' physical and emotional health.<sup>14</sup> Early evaluations of wellness programs have produced promising results, including increased participation in exercise,<sup>15</sup> healthier eating habits,<sup>16</sup> and reductions in officer stress.<sup>17</sup>

## Physical health concerns

Law enforcement officers have a dangerous job. With every shift, officers may encounter a situation that poses a threat to their safety. Many departments have worked to reduce these risks to officers by adopting policies barring unnecessarily dangerous vehicle pursuits or foot pursuits<sup>18</sup> and by teaching officers to de-escalate, slow down, and protect themselves in certain types of potentially dangerous incidents that could end in use of force.<sup>19</sup> Many law enforcement agencies also strive to reduce risks to officers by requiring the use of motor vehicle seat belts<sup>20</sup> and effective body armor.<sup>21</sup>

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<sup>11</sup> Hartley et al., "Health Disparities in Police Officers."

<sup>12</sup> Fox et al., "Mental-Health Conditions;" Rajaratnam et al., "Sleep Disorders, Health, and Safety in Police Officers;" Covey et al., "The Effects of Exposure to Traumatic Stressors;" Vila, Morrison, and Kenney, "Improving Shift Schedule and Work-Hour Policies."

<sup>13</sup> Andersen et al., "Mental Preparedness;" Fox et al., "Mental-Health Conditions."

<sup>14</sup> Kuhns, Maguire, and Leach, *Health, Safety, and Wellness Program Case Studies*; Church and Robertson, "How State Police Agencies Are Addressing the Issue of Wellness;" Garner, "Police Stress;" Fiedler, *Officer Safety and Wellness*.

<sup>15</sup> Kuhns, Maguire, and Leach, *Health, Safety, and Wellness Program Case Studies*.

<sup>16</sup> Kuehl et al., "The Safety and Health Improvement: Enhancing Law Enforcement Departments Study."

<sup>17</sup> Arnetz et al., "Trauma Resilience Training for Police;" Andersen et al., "Applying Resilience Promotion Training;" Chopko and Schwartz, "The Relation between Mindfulness and Posttraumatic Stress Symptoms;" Christopher et al., "A Pilot Study;" Garner, "Police Stress."

<sup>18</sup> Fiedler, *Officer Safety and Wellness*.

<sup>19</sup> President's Task Force on 21st Century Policing, *Final Report*; PERF, *ICAT*.

<sup>20</sup> von Kuenssberg Jehle et al., "Seat Belt Use by Police;" PERF, *Labor and Management*.

<sup>21</sup> Taylor et al., *A Practitioner's Guide*; PERF, *Labor and Management*.

While certain types of risks to officers can be reduced by such policies, further action is required by department leaders to more broadly support the physical well-being of agency personnel. A large proportion of officer injuries and deaths stem from poor physical health that must be addressed through the creation of additional services and wellness initiatives.<sup>22</sup>

Police officers are subject to a wide array of physical health risks, including sleep disorders and associated fatigue,<sup>23</sup> poor nutrition,<sup>24</sup> obesity,<sup>25</sup> heart disease,<sup>26</sup> and poor physical fitness.<sup>27</sup> These conditions put officers at an increased risk of heart disease, which accounts for 20 to 50 percent of early retirements.<sup>28</sup> In addition, poor physical health may be a direct cause of significantly lower average life expectancy in officers than in the general U.S. population.<sup>29</sup>

Officers also report sleep disorders at nearly twice the rate of the public,<sup>30</sup> which may be caused in part by shift-work scheduling practices.<sup>31</sup> In a national sample of officers, more than 40 percent screened positive for at least one sleep disorder.<sup>32</sup> Sleep disorders are associated with higher rates of other physical and mental health issues, such as diabetes, cardiovascular disease, and depression.<sup>33</sup>

## Mental health concerns

The stressful nature of police work can negatively impact officers' mental health. Officers endure long-term stress on the job caused by repeated exposure to high-stress incidents.<sup>34</sup> These stressors cause police officers to experience anxiety, depression, and post-traumatic stress disorder (PTSD) at disproportionately high rates.<sup>35</sup> High stress levels<sup>36</sup> and persistent hypervigilance<sup>37</sup> are linked to elevated levels of cortisol in the body.<sup>38</sup> Researchers estimate that approximately 10 to 17 percent of

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<sup>22</sup> President's Task Force on 21st Century Policing, *Final Report*.

<sup>23</sup> Violanti, *Shifts, Extended Work Hours, and Fatigue*; Rajaratnam et al., "Sleep Disorders."

<sup>24</sup> McCormick, Cohen, and Plecas, *Nutrition and General Duty Police Work*.

<sup>25</sup> Kuhns, McGuire, and Leach, *Health, Safety, and Wellness Program Case Studies*.

<sup>26</sup> Zimmerman, "Cardiovascular Disease and Risk Factors."

<sup>27</sup> Boni, *Exercise and Physical Fitness*; Fiedler, *Officer Safety and Wellness*; Kuhns, Maguire, and Leach, *Health, Safety, and Wellness Program Case Studies*.

<sup>28</sup> Zimmerman, "Cardiovascular Disease and Risk Factors."

<sup>29</sup> Violanti et al., "Life Expectancy in Police Officers."

<sup>30</sup> Charles et al., "Shift Work and Sleep."

<sup>31</sup> Pearsall, "Sleep Disorders."

<sup>32</sup> Rajaratnam et al., "Sleep Disorders."

<sup>33</sup> Rajaratnam et al., "Sleep Disorders."

<sup>34</sup> Piazza et al., "Affective Reactivity."

<sup>35</sup> Hartley et al., "Health Disparities in Police Officers."

<sup>36</sup> Toch, *Stress in Policing*.

<sup>37</sup> Gilmartin, *Emotional Survival*; Kimble, Fleming, and Bennion, "Contributors to Hypervigilance."

<sup>38</sup> Violanti et al., "Cortisol Patterns."

police officers in the United States demonstrate symptoms of PTSD.<sup>39</sup> This disorder may be especially prevalent in officers returning from military service or those who have experienced traumatic job-related incidents.<sup>40</sup>

Although police officers are exposed to many stressors, most identify interpersonal or organizational conflict as the most significant source of stress.<sup>41</sup> Organizational stress can stem from ineffective communication with supervisors,<sup>42</sup> from poor management practices,<sup>43</sup> and from higher workloads due to shrinking public budgets.<sup>44</sup> Stress induced by organizational factors may be a better predictor of officers' depression, anxiety, and traumatic stress than exposure to critical incidents.<sup>45</sup> The adverse effects of organizational stress are often magnified in officers who perceive a lack of support from their family members,<sup>46</sup> and family members themselves may exhibit higher stress levels as a result of negative public attitudes towards police officers or changed behavior of officers in the home.<sup>47</sup> Depression<sup>48</sup> and alcohol abuse<sup>49</sup> are also related to organizational stress among officers. Clinical depression and substance abuse may be the cause or the consequence of work-related stress. Low levels of emotional intelligence, which is associated with increased reactivity to workplace stress,<sup>50</sup> can also reduce officer perceptions of well-being and job satisfaction.<sup>51</sup>

A tragic outcome of the various mental stressors on police officers is officer suicide.<sup>52</sup> Officer deaths by suicide occur 2.4 times more frequently than deaths by homicide.<sup>53</sup> Approximately 25 percent of officers experience suicidal ideations, compared to 13.5 percent of the general population. This imbalance is strongly correlated to the prevalence of PTSD and depression symptoms among police officers.<sup>54</sup>

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<sup>39</sup> McCaslin et al., "The Impact of Personal Threat;" Carlier, Lamberts, and Gersons,"Risk Factors for Posttraumatic Stress Symptomatology."

<sup>40</sup> Gershon et al., "Mental, Physical, and Behavioral Outcomes;" Kuhns, Maguire, and Leach, *Health, Safety, and Wellness Program Case Studies*.

<sup>41</sup> Collins and Gibbs, "Stress in Police Officers;" Garner, "Police Stress."

<sup>42</sup> Andersen et al., "Mental Preparedness."

<sup>43</sup> Stinchcomb, "Searching for Stress in All the Wrong Places."

<sup>44</sup> Fiedler, *Officer Safety and Wellness*.

<sup>45</sup> Gershon et al., "Mental, Physical, and Behavioral Outcomes."

<sup>46</sup> Miller, "Stress in Policing."

<sup>47</sup> Karaffa et al., "Perceived Impact of Police Work on Marital Relationships."

<sup>48</sup> Amaranto et al. "Police Stress Interventions;" Gershon et al., "Mental, Physical, and Behavioral Outcomes."

<sup>49</sup> VanMeter, "Leading At-Risk Employees;" McCaslin et al., "The Impact of Personal Threat;" Fox et al., "Mental-Health Conditions."

<sup>50</sup> Nikolaou and Tsaousis, "Emotional Intelligence in the Workplace."

<sup>51</sup> Brunetto et al., "Emotional Intelligence, Job Satisfaction, Well-Being, and Engagement."

<sup>52</sup> IACP, *Breaking the Silence*; Violanti et al., "Shift-Work and Suicide Ideation."

<sup>53</sup> President's Task Force on 21st Century Policing, *Final Report*.

<sup>54</sup> Violanti et al., "Shift-Work and Suicide Ideation."

Traumatic experiences and lack of family or departmental support in responding to depression may contribute to high rates of suicide among officers.<sup>55</sup>

## Impact on officer performance and community relationships

The negative impact of poor mental health extends far beyond an individual officer. Police departments are also affected, as poor mental health can result in increased agency costs<sup>56</sup> and impaired decision-making.<sup>57</sup> High stress levels in officers can lead to absenteeism, increased use of workers' compensation and sick days, and increases in early retirement.<sup>58</sup> Officers with mental health conditions report lower levels of productivity than their peers. This estimated productivity loss costs agencies \$4,000 per year for each officer affected.<sup>59</sup>

In addition to administrative costs, mental health concerns may also impact officers' communication skills. Officers with mental health conditions experience a lack of cooperation among coworkers<sup>60</sup> and report greater difficulty than their peers in interacting with community members.<sup>61</sup> Job stress may also impair officers' decision-making abilities, particularly in use of force incidents. Officers with PTSD symptoms experience greater difficulty than officers without such symptoms in distinguishing important and unimportant factors in dangerous situations.<sup>62</sup> These issues pose serious concerns for officer safety, public safety, and overall agency performance.<sup>63</sup>

Sleep disorders are also a threat to officers' mental health.<sup>64</sup> Problems with sleep can contribute to decreased officer performance and poor police-community relations.<sup>65</sup> Officers suffering from sleep disorders report higher rates than officers with healthy sleep of serious administrative errors, falling asleep while driving, safety violations, and absenteeism.<sup>66</sup> Sleep-deprived officers have greater difficulty assessing risks<sup>67</sup> and appropriately judging emotionally charged actions.<sup>68</sup> Fatigued officers may also be a hindrance to strengthening relationships with community members. Officers with sleep disorders are

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<sup>55</sup> President's Task Force on 21st Century Policing, *Final Report*.

<sup>56</sup> Fox et al., "Mental-Health Conditions;" Andersen et al., "Mental Preparedness;" Garner, "Police Stress."

<sup>57</sup> Vila, *Tired Cops*; Rajaratnam et al., "Sleep Disorders;" Covey et al., "The Effects of Exposure to Traumatic Stressors."

<sup>58</sup> Andersen et al., "Mental Preparedness;" Garner, "Police Stress."

<sup>59</sup> Fox et al., "Mental-Health Conditions."

<sup>60</sup> Gershon et al., "Mental, Physical, and Behavioral Outcomes."

<sup>61</sup> Fox et al., "Mental-Health Conditions."

<sup>62</sup> Covey et al., "The Effects of Exposure to Traumatic Stressors."

<sup>63</sup> President's Task Force on 21st Century Policing, *Final Report*.

<sup>64</sup> Violanti, *Shifts, Extended Work Hours, and Fatigue*.

<sup>65</sup> Violanti, *Shifts, Extended Work Hours, and Fatigue*; Rajaratnam et al., "Sleep Disorders."

<sup>66</sup> Rajaratnam et al., "Sleep Disorders."

<sup>67</sup> Vila et al., "Improving Shift Schedule and Work-Hour Policies."

<sup>68</sup> Violanti, *Shifts, Extended Work Hours, and Fatigue*.

more apt to display unrestrained anger toward civilians and receive more citizen<sup>69</sup> complaints than their well-rested counterparts.<sup>70</sup> When exhausted, officers are unable to effectively communicate with community members and may even incite agitation among them.<sup>71</sup>

## Barriers to treatment

The nature of police work makes officers susceptible to physical and mental health risks. Despite the prevalence of these concerns, many officers are reluctant to seek help. Among officers experiencing PTSD, depression, and alcohol abuse problems, fewer than half seek mental health services.<sup>72</sup> Unsupportive agency culture and fear of negative work-related outcomes often deter officers experiencing mental distress from seeking help.<sup>73</sup> In many departments, cultural expectations dictate that officers must always appear “brave” or “tough.”<sup>74</sup> Moreover, officers take pride in the belief that others are depending on them. As a result, many officers make efforts to deny—even to themselves—that they are experiencing difficulties with personal wellness and could benefit from outside assistance.<sup>75</sup>

Officers regularly suppress negative emotions to conform to agency norms.<sup>76</sup> This behavior can exacerbate depressive symptoms.<sup>77</sup> Cultural standards among police departments often stigmatize asking for help as a sign of weakness, especially for addiction<sup>78</sup> or emotional problems.<sup>79</sup> Fear of becoming the recipient of contempt, distrust, or even ridicule from colleagues upon divulging such problems may prevent officers who acknowledge personal difficulties from seeking assistance,<sup>80</sup> further contributing to a “tradition of silence”<sup>81</sup> around psychological problems in policing.

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<sup>69</sup> This report occasionally uses the word “citizen” to refer to people in the community who are neither sworn law enforcement officers nor government officials. The term should not be understood to refer only to U.S. citizens.

<sup>70</sup> Rajaratnam et al., “Sleep Disorders.”

<sup>71</sup> Stephens and Mantel, *OSW Group Meeting Summary*.

<sup>72</sup> Fox et al., “Mental-Health Conditions.”

<sup>73</sup> IACP, *Breaking the Silence*; PERF, *Labor and Management*.

<sup>74</sup> Stoughton, “What a Police Expert Calls.”

<sup>75</sup> Stoughton, “What a Police Expert Calls.”

<sup>76</sup> Amaranto et al., “Police Stress Interventions.”

<sup>77</sup> DeSteno, Gross, and Kubzansky, “Affective Science and Health.”

<sup>78</sup> VanMeter, “Leading At-Risk Employees.”

<sup>79</sup> IACP, *Breaking the Silence*.

<sup>80</sup> Carlan and Nored, “An Examination of Officer Stress;” Rattue, “Serious Health Risks;” IACP, *Breaking the Silence*; Stoughton, “What a Police Expert Calls.”

<sup>81</sup> President’s Task Force on 21st Century Policing, *Final Report*.

Another reason why officers may be reluctant to seek help from their agencies is that many sources of stress stem directly from supervisors and coworkers.<sup>82</sup> Lack of cooperation among coworkers correlates significantly with perceived work stress in officers,<sup>83</sup> and officers rate criticism from supervisors as one of their most significant sources of stress.<sup>84</sup> Management insensitivity or indifference has been identified as a major concern by officers who have been assaulted by criminal offenders in the course of their job, leading to distrust of wellness resources provided through agency administration.<sup>85</sup> Officer concerns with management also extend to physical wellness. Officers report that lack of time and lack of access to exercise equipment are significant obstacles to achieving physical fitness goals.<sup>86</sup>

Cultural and interpersonal factors may also lead officers to fear negative employment outcomes from seeking wellness services, which is one of the most commonly cited barriers to accessing such services.<sup>87</sup> Officers who admit to suffering from heart disease may not be allowed back on the street if they are determined to be a heart attack risk, and officers receiving mental health counseling can lose access to firearms.<sup>88</sup> Fear of such outcomes drives perceptions that officers admitting to personal difficulties limit their own opportunities for career advancement.<sup>89</sup> As a result of these concerns, officers cite confidentiality as a major priority when seeking mental health services,<sup>90</sup> and service providers have highlighted the need for anonymous services available outside of departments.<sup>91</sup> Law enforcement leaders have recognized the need to ensure that officers receiving wellness services do not experience negative professional impacts.<sup>92</sup>

## Existing wellness services and promising practices

Existing wellness programs in police departments aim to address a number of physical and mental concerns. By 1999, more than half of state law enforcement agencies had wellness-related programming,<sup>93</sup> and the proportion of agencies with programming has continued to grow substantially since then. Programs most often focus on cardiovascular fitness, chronic disease prevention, nutrition, stress management, and resilience to trauma.<sup>94</sup> Many departments currently provide mental health

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<sup>82</sup> Gershon et al., “Mental, Physical, and Behavioral Outcomes;” Garner, “Police Stress.”

<sup>83</sup> Gershon et al., “Mental, Physical, and Behavioral Outcomes.”

<sup>84</sup> Garner, “Police Stress.”

<sup>85</sup> Crank, *Understanding Police Culture*.

<sup>86</sup> Kuhns et al., *Health, Safety, and Wellness Program Case Studies*.

<sup>87</sup> Fox et al., “Mental-Health Conditions.”

<sup>88</sup> Rattue, “Serious Health Risks.”

<sup>89</sup> Stoughton, “What a Police Expert Calls;” Crank, *Understanding Police Culture*.

<sup>90</sup> Fox et al., “Mental-Health Conditions.”

<sup>91</sup> Levenson, O'Hara, and Clark, “The Badge of Life.”

<sup>92</sup> President’s Task Force on 21st Century Policing, *Final Report*.

<sup>93</sup> Church and Robertson, “How State Police Agencies Are Addressing.”

<sup>94</sup> Kuehl et al., “The Safety and Health Improvement: Enhancing Law Enforcement Departments Study.”

services through employee assistance programs (EAP),<sup>95</sup> and most large agencies mandate that officers involved in a shooting or critical incident see medical professionals promptly following the incident.<sup>96</sup> While some departments employ internal mental and behavioral health professionals,<sup>97</sup> others refer officers to outside providers.<sup>98</sup>

## Physical wellness programming

Recognizing the role that shift work can play in sleep disorders and associated physical and psychological ailments,<sup>99</sup> several departments have partnered with researchers to determine effective scheduling practices as part of a holistic approach to officer wellness.<sup>100</sup> In studies of shift length, researchers have found that compared to a schedule of five eight-hour shifts per week, a schedule of four 10-hour shifts resulted in workers getting significantly more sleep,<sup>101</sup> experiencing less fatigue at the beginning of work shifts,<sup>102</sup> and reducing overtime.<sup>103</sup> In addition, a schedule of four 10-hour shifts is associated with lower fatigue and higher alertness than a schedule of three 12-hour shifts.<sup>104</sup>

In light of these demonstrated benefits, researchers have recommended scheduling officers on 10-hour shifts rather than eight- or 12-hour shifts.<sup>105</sup> Researchers also advise that using permanent schedules instead of rotating schedules can improve officers' sleep and psychological well-being while reducing absentee rates.<sup>106</sup>

There is also evidence that police department incentives and education programs promoting physical fitness can improve officer health outcomes and reduce costs for agencies.<sup>107</sup> Physical fitness is associated with fewer sick days, lower rates of disability, and fewer injuries within departments,<sup>108</sup> and researchers have noted that even marginal gains in fitness can yield substantial financial benefits because of the high costs of major incidents such as in-service heart attacks.<sup>109</sup>

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<sup>95</sup> Fox, et al., "Mental-Health Conditions."

<sup>96</sup> PERF, *Labor and Management*.

<sup>97</sup> Council of State Governments Justice Center, *Mental Health Resources for Law Enforcement*.

<sup>98</sup> Kuhns et al., *Health, Safety, and Wellness Program Case Studies*.

<sup>99</sup> Charles et al., "Shift Work and Sleep."

<sup>100</sup> Amendola et al., *The Shift Length Experiment*; Vila, *Sleep Deprivation*.

<sup>101</sup> Amendola et al., *The Shift Length Experiment*.

<sup>102</sup> Vila, *Sleep Deprivation*.

<sup>103</sup> Amendola et al., *The Shift Length Experiment*.

<sup>104</sup> Amendola et al., *The Shift Length Experiment*.

<sup>105</sup> Amendola et al., *The Shift Length Experiment*; Vila, *Sleep Deprivation*.

<sup>106</sup> Vila, *Sleep Deprivation*.

<sup>107</sup> Boni, *Exercise and Physical Fitness*; Kuehl et al., "The Safety and Health Improvement: Enhancing Law Enforcement Departments Study;" Fiedler, *Officer Safety and Wellness*.

<sup>108</sup> Fiedler, *Officer Safety and Wellness*.

<sup>109</sup> Kuhns et al., *Health, Safety, and Wellness Program Case Studies*.

In cases where departments have provided resources and incentives for physical fitness, exercise participation among officers increased.<sup>110</sup> For example, a Florida department offering on-duty time for personal physical fitness and department-provided exercise equipment observed increased officer performance on yearly fitness evaluations.<sup>111</sup> Other weight loss incentives have resulted in significant reductions in the degree of officer obesity.<sup>112</sup> Following wellness education efforts, departments have also observed improvements in nutritional intake,<sup>113</sup> which is associated with prevention of illness in officers.<sup>114</sup> In addition to the physical fitness benefits, one study showed that randomly selected officers participating in regular exercise demonstrated increased rates of job satisfaction and reductions in perceived stress compared to control groups.<sup>115</sup>

## Mental wellness training programs

Several training programs aimed at reducing stress and promoting officer resilience are associated with improved wellness outcome measures.<sup>116</sup> Officers who have received criticism management and stress inoculation training<sup>117</sup>—a training program aimed at building participants’ abilities to effectively handle criticism and, in so doing, reduce the negative impact that interpersonal conflict-related stress has on their health—report less job stress and fewer health complaints than officers in control groups.<sup>118</sup> A trauma resilience training program effectively decreased cortisol (high levels of cortisol are an indicator of stress) and self-reported stress among rookie officers. An adjusted version of the program was associated with reductions in physiological stress responses for special weapons and tactics (SWAT) team officers.<sup>119</sup> A psychophysiological intervention program, built on the trauma resilience model, improved officers’ use of force decision-making in a “shoot/don’t shoot” exercise, which researchers hypothesize is the result of enhanced physiological control and situational awareness.<sup>120</sup>

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<sup>110</sup> Boyce et al., “Police Weight-Loss Competition.”

<sup>111</sup> Kuhns et al., *Health, Safety, and Wellness Program Case Studies*.

<sup>112</sup> Boyce et al., “Police Weight-Loss Competition.”

<sup>113</sup> Kuehl et al., “The Safety and Health Improvement: Enhancing Law Enforcement Departments Study;” Kuhns et al., *Health, Safety, and Wellness Program Case Studies*.

<sup>114</sup> Martinussen, Richardsen, and Burke, “Job Demands.”

<sup>115</sup> Boni, *Exercise and Physical Fitness*.

<sup>116</sup> Arnetz et al., “Trauma Resilience Training;” Andersen et al., “Applying Resilience Promotion Training;” Garner, “Police Stress.”

<sup>117</sup> Garner, “Police Stress.”

<sup>118</sup> Garner, “Police Stress.”

<sup>119</sup> Andersen et al., “Mental Preparedness.”

<sup>120</sup> Andersen et al., “Mental Preparedness.”



Mindfulness skills are also associated with promising wellness outcomes in officers. In one study, a mindfulness-based resilience training (MBRT) program for first responders was linked to better emotional regulation, less fatigue, and reductions in perceived stress among active-duty officer participants.<sup>121</sup> Greater mindfulness skills can also reduce PTSD symptoms such as intrusive memories and hyperarousal in officers.<sup>122</sup> Practitioners and researchers have begun to develop<sup>123</sup> and evaluate<sup>124</sup> emotional intelligence training opportunities specifically tailored to law enforcement personnel. This training may improve emotional intelligence and employee perceptions of well-being and job satisfaction.<sup>125</sup>

Comprehensive mental wellness programs have also been linked to increased officer participation in mental health services. One multifaceted training program for officers in Newark, New Jersey, featuring lectures on stress management, PTSD, critical incident stress management, and substance abuse was associated with significantly increased use of a department-provided volunteer mental health hotline.<sup>126</sup> Further, the Montreal (Quebec) Police Department's "Together for Life" program, which trains officers on how to identify and intervene with suicidal officers, was associated with a 79 percent reduction in officer suicide deaths in a 12-year period, even as other departments in the area experienced an 11 percent increase during the same time.<sup>127</sup>

## Peer-led models

There are different models for providing various kinds of wellness services to police officers. Officers may place greater trust in peer-led wellness programming than in models led by department service providers.<sup>128</sup> Peer-led wellness programming can be especially effective as a form of support following critical incidents.<sup>129</sup> Researchers studying a peer-led health curriculum focusing on mental and physical wellness for officers in Oregon and Washington state found that the program was associated with improvements in officers' dietary habits, increased sleep quantity, and reduced stress in officers.<sup>130</sup>

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<sup>121</sup> Christopher et al., "A Pilot Study."

<sup>122</sup> Chopko and Schwartz, "The Relation between Mindfulness and Posttraumatic Stress Symptoms."

<sup>123</sup> Turner, "Understanding the Benefits of Emotional Intelligence."

<sup>124</sup> Risan, Binder, and Milne, "Emotional Intelligence in Police Interviews."

<sup>125</sup> Cherniss and Goleman, *The Emotionally Intelligent Workplace*; Groves, McEnrue, and Shen, "Developing and Measuring the Emotional Intelligence of Leaders."

<sup>126</sup> Amaranto et al., "Police Stress Interventions."

<sup>127</sup> Mishara and Martin, "Effects of a Comprehensive Police Suicide Prevention Program."

<sup>128</sup> Stephens and Mantel, *OSW Group Meeting Summary*; Miller, "Stress in Policing."

<sup>129</sup> Prati and Pietrantonio, "The Relation of Perceived and Received Social Support; Collins and Gibbs, "Stress in Police Officers."

<sup>130</sup> Kuehl et al., "The Safety and Health Improvement: Enhancing Law Enforcement Departments Study."

Officers participating in critical incident support groups for first responders report fewer depressive symptoms,<sup>131</sup> indicating that perceived support from peers is a critical factor for officer mental wellness following traumatic events.<sup>132</sup> To address common fears about confidentiality associated with seeking mental health support,<sup>133</sup> officers in agencies such as the New York City Police Department have formed private, volunteer peer support groups organized outside of the agency for increased assurance of confidentiality.<sup>134</sup>

## Psychological counseling

Research on the effects of psychological counseling for officers has been inconclusive. In other professions, mental health treatment intervention is associated with increased productivity.<sup>135</sup> Although some evidence suggests that officers participating in psychological counseling over an extended period score higher on overall wellness measures,<sup>136</sup> a recent meta-analysis of psychological interventions for officers found limited effects of individual counseling on physiological, psychological, and behavioral outcomes.<sup>137</sup>

Researchers have suggested that instituting mandatory counseling for all officers may improve the efficacy of counseling.<sup>138</sup> Officers often express confidentiality concerns about department-provided mental health services,<sup>139</sup> yet officers working in departments where counseling is readily available report both significantly less stress and a greater willingness to use counseling.<sup>140</sup> Periodic, mandatory counseling for officers has been proposed as a technique to reduce stress-inducing stigma associated with counseling while connecting officers to resources they may not otherwise seek out.<sup>141</sup> Researchers have also suggested that family counseling may improve perceptions of support among officers<sup>142</sup> and reduce secondary traumatic stress in families.<sup>143</sup> Despite the identified benefits, family counseling is currently used by fewer than eight percent of law enforcement families.<sup>144</sup>

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<sup>131</sup> Collins and Gibbs, "Stress in Police Officers."

<sup>132</sup> Prati and Pietrantonio, "The Relation of Perceived and Received Social Support."

<sup>133</sup> Crank, *Understanding Police Culture*; Fox et al., "Mental-Health Conditions."

<sup>134</sup> PERF, *Labor and Management*.

<sup>135</sup> Hilton et al., "The Association between Mental Disorders and Productivity;" Langlieb and Kahn, "How Much Does Quality Mental Health Care Profit Employers?"

<sup>136</sup> Tanigoshi, Kontos, and Remley, "The Effectiveness of Individual Wellness Counseling."

<sup>137</sup> Patterson, Chung, and Swan, "Stress Management Interventions."

<sup>138</sup> Carlan and Nored, "An Examination of Officer Stress."

<sup>139</sup> Fox et al., "Mental Health Conditions."

<sup>140</sup> Carlan and Nored, "An Examination of Officer Stress."

<sup>141</sup> Carlan and Nored, "An Examination of Officer Stress."

<sup>142</sup> Karaffa et al., "Perceived Impact of Police Work."

<sup>143</sup> Arredondo et al., *Law Enforcement and Corrections Family Support*.

<sup>144</sup> Karaffa et al., "Perceived Impact of Police Work."

## Conclusion

Police officers are vulnerable to many physical and mental health concerns that threaten their well-being. Law enforcement leaders should recognize the need to address these challenges and invest in the health and safety of department personnel. Wellness programs can improve officers' physical and emotional health, yielding positive outcomes for police officers, their agencies, and the communities they serve.



# The Wellness Unit: Laying the Groundwork for Successful Wellness Programming in San Diego

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I learned that if your organization thinks something is important, it needs to be on the organizational chart and have the highest-ranking person possible in charge of it. It needs to be a visible, dedicated arm of the organization. Otherwise, it'll fall away.

— *Assistant Chief (ret.) Sarah Creighton, San Diego Police Department*

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When the SDPD created the Wellness Unit in 2011, then Captain Sarah Creighton<sup>145</sup> was selected to lead it, and she recruited then Sergeant Tod Bassett<sup>146</sup> to join her. While the tragedies of July and August 2011 made clear how much the department needed the Wellness Unit, Creighton and Bassett had to determine exactly what their mission would be and the specific issues they needed to address to achieve that mission.

## The department's needs drive the Wellness Unit's priorities

To begin the process of defining their mission, Captain Creighton and Sergeant Bassett developed a survey to identify the concerns of SDPD personnel. In August 2011, they sent a needs assessment survey<sup>147</sup> to the entire department, including civilians, officers, and volunteers.<sup>148</sup>

The survey asked department members a wide variety of specific questions such as the extent to which marital issues interfered with their ability to focus on their jobs. It also asked if they were contending with issues such as chronic back pain, sleep disorders, or high blood pressure.

The results were telling. Many of the more than 700 respondents were very concerned about their financial stability, their personal relationships, and their physical health.<sup>149</sup> They were grappling with stress, anger, depression, and “work turn-off.”

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<sup>145</sup> Sarah Creighton retired from the department in 2017 as an assistant chief.

<sup>146</sup> Tod Bassett is currently a lieutenant with the SDPD.

<sup>147</sup> See appendix A for the survey.

<sup>148</sup> SDPD, *Changing Organizational Culture*.

<sup>149</sup> As of 2016, SDPD had approximately 2,500 employees (1,800 sworn officers and 700 civilians).

These survey results offered the Wellness Unit a clearer picture of the critical wellness issues facing the department, and the unit used them to craft its mission statement and define its goals.

## Mission and goals

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It is extremely important to have an open atmosphere where our department personnel can feel comfortable having truly candid conversations. I want to make sure we're a healthy department, because being healthy means we will be that much better equipped to go out into our community and provide excellent service.

— *Chief (ret.) Shelley Zimmerman, San Diego Police Department*

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The SDPD ultimately defined the mission of the Wellness Unit as “reducing or removing interferences to employee wellness, whether personally or professionally induced, by providing help resources, training and intervention.”<sup>150</sup> In order to achieve this larger mission, its specific goals are as follows:

- Identifying and enhancing existing wellness resources
- Developing and providing wellness education
- Collaborating with academic institutions on innovative [law enforcement] studies
- Developing partnerships with health and wellness providers
- Staying abreast of wellness program best-practices through research
- Serving as an advocate for employees enduring personal or professional difficulties<sup>151</sup>

The Wellness Unit also assembled a panel of experts to provide advice and input on programs and policies.<sup>152</sup> Called the Wellness Advisory Committee, it includes physicians, psychologists and mental health experts, academics, employee union representatives, and police chaplains, as well as civilian and sworn members of the SDPD.<sup>153</sup>

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<sup>150</sup> SDPD, *Wellness Unit Operations Manual*, 3.

<sup>151</sup> SDPD, *Wellness Unit Operations Manual*, 3.

<sup>152</sup> The Wellness Advisory Committee meets on an as-needed basis.

<sup>153</sup> SDPD, *Wellness Unit Operations Manual*, 5.

## Overview of services

To support the Wellness Unit’s mission to support the emotional and physical health of SDPD employees, the Unit offers a range of specific services and activities. They largely fall into three categories:

1. Providing services for individuals
2. Agency-wide activities and services
3. Interagency/interdisciplinary activities and services

These services are available directly to all department members. Employees are not required or expected to notify their supervisors or ask for permission to use wellness services. Department members’ families and loved ones may also use these services, all of which are offered free of charge.

## Services for individuals

The Wellness Unit’s first broad category of duties is to provide individualized support for members of the police department. Employees who are in crisis or are experiencing a particular personal or professional issue often approach the Wellness Unit staff directly. Other times, an employee’s colleagues or loved ones ask the Wellness Unit staff to check in on the employee. Wellness Unit members also are proactive about engagement; every day, they review major incidents from the previous day and may contact officers who might need wellness services as a result.

Sometimes, the Wellness Unit has found that the only thing an individual requires is someone to listen to him or her. If an employee wants a referral to a wellness service provider or other expert (such as a financial planner or a nutritionist), staff members are trained to connect them with the appropriate resources.

## Operational philosophy

Ideally, retired Assistant Chief Creighton said, all employees’ direct supervisors would serve as their “primary caregivers” and offer the sort of individualized support that the Wellness Unit provides. However, in practice, that is not always possible, because some supervisors lack the time or skills to give employees the assistance they need. The Wellness Unit fills that gap. “There has to be some place or some person where a supervisor who doesn’t have the right interpersonal skills—or sufficient amount of time to address the issue—can send employees who need assistance and where employees who need assistance can go if their supervisors can’t provide it,” Creighton explained.

## Supporting direct managers

The Wellness Unit also addresses this issue by engaging with managers directly. “We tell supervisors and management that they are the primary caregiver for their employees. That’s part of a leader’s role,” retired Assistant Chief Creighton said. “We’ve done training to make supervisors more comfortable in this role, which has been an ongoing educational agenda. This is about a larger culture change. Wellness is about good leadership and helping department leaders become better at providing services themselves.”

Assistant Chief Sandra Albrektsen, who took command of the Wellness Unit upon Creighton’s retirement in early 2017, counts this effort among her top priorities for the Wellness Unit. “We’re working on turning the Wellness Unit more into facilitators, coaches, and teachers,” she said. “We want to use them to develop the wellness-related and interpersonal skills of our executive staff. Our command staff and managers have responsibilities to their people as leaders, and this is part of those responsibilities.”<sup>154</sup>

## Agency-wide activities and services

The second type of services the Wellness Unit provides is geared toward the entire police department or groups within the department. Developing and delivering wellness training to department members is one example of these duties. This category also includes managing, coordinating, and deploying all of the SDPD’s help resources, including police chaplains, peer support employees, and psychological services personnel. In addition, the Wellness Unit

- provides educational seminars and workshops on wellness-related issues that are important to SDPD employees (e.g., sleep hygiene, financial planning, and nutrition);
- provides wellness-related training to department members;
- keeps a record of wellness contacts to track use and trends in wellness issue areas (no identifying information is associated with these records);
- identifies new help resources to use as referrals for department members.

## Interagency and interdisciplinary activities and services

The Wellness Unit also has a third set of duties as part of its mandate: engaging with external partners. In practice, this means developing partnerships with academics and other wellness experts to ensure that the SDPD’s wellness programming is informed by promising practices.

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<sup>154</sup> See “Training: Building a Culture of Wellness” beginning on page 47 for more details.

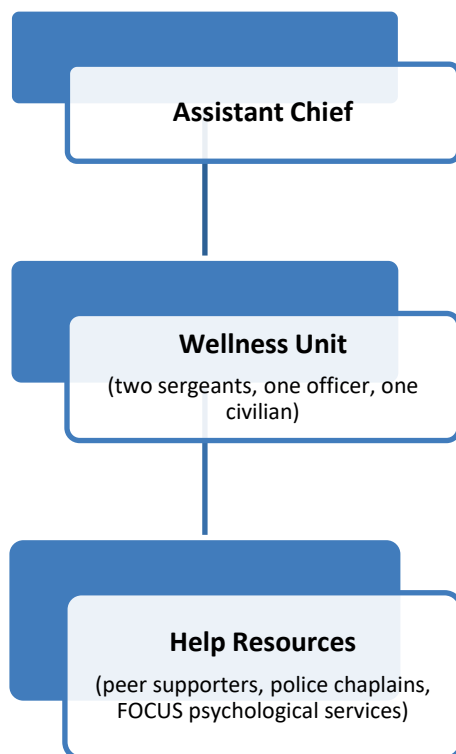


It also includes managing the County Wellness Forum. Created by the Wellness Unit, the forum meets once a quarter. Participants, who include representatives from all of the law enforcement agencies in San Diego County as well as other help resources providers, discuss promising practices, and share resources, which increases access to wellness services across agencies.<sup>155</sup> Each meeting also typically includes an educational presentation delivered by an expert on a wellness-related topic.

## Organization

The Wellness Unit has grown since 2011. Today, it is composed of two sergeants, one officer, and one dispatcher, all of whom are under the command of an assistant chief (see figure 1). The Wellness Unit also oversees and manages all of the SDPD’s help resources providers. This includes peer supporters, police chaplains, and Focus Psychological Services, which provides psychological services for employees and their dependents.<sup>156</sup>

Figure 1. SDPD Wellness Unit organizational chart



<sup>155</sup> SDPD, *Changing Organizational Culture*.

<sup>156</sup> For detailed information about these programs, see “Help Resources” beginning on page 35.

## Help resources

Many help services providers in the SDPD predate the Wellness Unit, but prior to 2011 they were under different commands and had little substantive interaction. The various providers self-deployed to critical incidents and operated largely independently of one another. Bringing them all together under the Wellness Unit ensured that their management, coordination, and training were centralized. “There was no communication among help resources prior to the Wellness Unit,” Lieutenant Bassett explained. “Now it’s automatic that we work together and coordinate deployment if there’s a critical incident or any other need. Because all of the SDPD’s help services are centralized, we are able to send the appropriate resources in the appropriate quantity.”

Organizing all of the SDPD’s help resources under the Wellness Unit also made them a more integral part of the department, said police chaplain the Reverend Chuck Price. “Once the police chaplains were brought under wellness, we got broader visibility,” he explained. “We came in with peer support and the other wellness components. It was nice to have a home and a known advocate within the organization, and it also brought us symbiosis with all of the other help services entities.”

Organizational visibility was one of retired Assistant Chief Creighton’s goals. “We had all of the resources that we needed at the SDPD—chaplains and peer supporters for example—but they were all under different umbrellas and didn’t communicate with each other,” she said.

## Civilian representation in the Wellness Unit

Another innovation of the Wellness Unit is that it includes a civilian member of the department. Currently, dispatcher Deanna Dotta, who provides wellness support to civilian and sworn employees, fills that role. She said that her inclusion in the Wellness Unit sent an important message to the department’s nonsworn staff members. “Civilians can sometimes be a second thought in law enforcement agencies, so having a civilian in the Wellness Unit makes the civilian members of the department feel like they’re a vital and valued part of the department,” she explained. “Communications and crime lab personnel experience repeated exposure to trauma. These individuals need emotional support and the opportunity to debrief just as officers do.”

## Physical location: Making the Wellness Unit visible

In addition to appearing on the SDPD’s organizational chart, the Wellness Unit is also a visible physical presence in the department. The Wellness Center, which is the Wellness Unit’s main office, is strategically located in SDPD headquarters to encourage officer engagement and reduce any stigma associated with utilizing wellness services. The Wellness Center is usually open from 7:00 a.m. to 5:00 p.m., Monday through Friday.

## Moving the Wellness Center to headquarters

The Wellness Center was moved from an off-site location to headquarters in 2012 as part of a larger effort to normalize wellness at SDPD. “We were initially off-site because of concerns that department members would be less likely to come to the Wellness Center if they thought that their colleagues might see them,” said retired Assistant Chief Creighton. “Moving the Wellness Center to headquarters really normalized Wellness as just another resource. It’s just like walking into operational support and getting a battery for your flashlight. It destigmatizes asking for help.”

The Wellness Center is also purposefully designed as a relaxed social space that encourages department members to drop in even if they are not seeking wellness services. It sits across the hall from the cafeteria, offers free coffee and snacks, and is centered on a lounge area with a couch, coffee table, and chairs.

The move to headquarters paid dividends, retired Assistant Chief Creighton said. “We saw a dramatic uptick in utilization once we moved over from our previous off-site location,” she explained. “Having the Wellness Center off-site unintentionally implied that there was something shameful about Wellness. Moving it to headquarters got rid of that.”

## Confidentiality

Studies have shown that police officers’ concerns about confidentiality are a significant barrier to seeking mental health support,<sup>157</sup> especially when the support services are provided by the police department.<sup>158</sup> The Wellness Unit worked to overcome officers’ reluctance to seek services by writing and publicizing a clear confidentiality policy and adhering to it.

The Wellness Unit’s confidentiality policy<sup>159</sup> states that the success of the Wellness Unit is predicated on maintaining the confidentiality of employees who use wellness services and requires that the “strictest confidentiality . . . be maintained, within the guidelines of the program.”<sup>160</sup> The confidentiality policy also explicitly describes the limited types of situations that are not covered and that Wellness Unit members are mandated to report, namely when any of the following conditions are met:

- The employee is a danger to him- or herself or to others
- There is suspected child abuse
- There is suspected domestic violence or a fear thereof
- There is suspected elder abuse<sup>161</sup>

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<sup>157</sup> Fox et al., “Mental-Health Conditions.”

<sup>158</sup> Fox et al., “Mental-Health Conditions.”

<sup>159</sup> See appendix B for the full policy as outlined in the Wellness Unit’s operations manual.

<sup>160</sup> SDPD, *Wellness Unit Operations Manual*, 4.

<sup>161</sup> SDPD, *Wellness Unit Operations Manual*, 13.

The following are also specifically described as issues that should be reported to the Wellness Unit commanding officer:

- Narcotics offenses (i.e., using narcotics on duty, committing a felony related to narcotics)
- Felonies
- Felonies committed while on duty
- When the person receiving wellness services requests in writing that information be shared with the Wellness Unit Commanding Officer
- “Matters that would jeopardize the safety of the public or other officers”<sup>162</sup>

“The minute that the confidentiality policy as we’ve outlined it is violated, the credibility of the Unit goes out the window,” said retired Assistant Chief Creighton. “You can ruin years of hard work and building trust by one mishandled incident.”

The Wellness Unit’s policy states that, irrespective of department rules, conversations between department employees and Wellness Unit staff—i.e., the SDPD members who are staffed to the Wellness Unit full-time—are not considered privileged because the members of the Unit are not licensed mental health professionals.<sup>163</sup> That is not true, however, of all help services providers who work with the SDPD. Focus, for instance, is an outside organization that contracts with the SDPD to provide psychological services for department members and their dependents. Though Focus psychologists work closely with the Wellness Unit, they are independent mental health care providers, so all discussions are protected by patient-provider privilege. “The biggest hurdle when it comes to getting police officers to utilize mental health services is confidentiality,” explained Dr. Jolee Brunton, the chief psychologist for Focus. “On the first day that we sit down with someone from the department, we discuss confidentiality in detail and also describe to them the circumstances in which we’re mandatory reporters: child abuse/neglect, elder abuse/neglect, and Tarasoff situations.<sup>164</sup> We are not mandated reporters of domestic violence. We’re clear and forthright,” she said, “and the officers respond well to that.”

Thus, SDPD employees who need wellness services have access to a wide range of providers who offer different degrees of confidentiality as well as different areas of expertise.

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<sup>162</sup> SDPD, *Wellness Unit Operations Manual*, 5.

<sup>163</sup> SDPD, *Wellness Unit Operations Manual*, 5.

<sup>164</sup> In the California Supreme Court’s 1976 decision in the case *Tarasoff v. Regents of the University of California*, the court found that “When a therapist determines, or pursuant to the standards of his profession should determine, that his patient presents a serious danger of violence to another, he incurs an obligation to use reasonable care to protect the intended victim against such danger.” For the full text of the decision, see *Vitaly Tarasoff et al. v. The Regents of the University of California et al.*, 17 Cal. 3d 425 (1976). [https://scholar.google.com/scholar\\_case?case=263231934673470561](https://scholar.google.com/scholar_case?case=263231934673470561).

## Recruitment and rotation in the Wellness Unit

Officers' concerns about confidentiality speak to another, practical concern that the SDPD faces when working to make the Wellness Unit successful: SDPD employees will not open up to someone they do not trust. As a result, the SDPD has focused on recruiting for interpersonal skills rather than rank when bringing new team members into the Wellness Unit.

### Picking the right people

"The success of the unit is based on picking the right people," retired Assistant Chief Creighton said. "There is no substitute for genuine caring." When discussing why she recruited Lieutenant Bassett for the Wellness Unit, Creighton explained that "he reads people really well and is all about putting others before himself. He's someone who people gravitate to, and he's also a cop's cop. He lent legitimacy to the work, and people knew that they could trust him."

"Gossip can ruin careers," Lieutenant Bassett explained. "I understand that. Before I joined the Wellness Unit, I had a good reputation for not sharing people's private information if they confided in me."

Being nonjudgmental is also critical, said Sergeant Ed Zwibel.<sup>165</sup> "We have people of all ranks calling on us for support. We're outside of their command and they know that we won't judge them," he explained. "They need to know that we're there for them and that we're there to support them as people, not criticize them for what they've done or what they're going through."

It is also important that members of the Wellness Unit "walk the walk," said Assistant Chief Albrektsen. "The credibility of the unit in general is rooted in the credibility of its members. The people in the Unit need to be well themselves."

### Recruitment and selection process

To identify new recruits to staff the Wellness Unit, Assistant Chief Albrektsen taps into the knowledge that her captains have of the officers in their divisions. "I wanted the selection process for the Wellness Unit to be transparent," she said, "so I start by asking the captains who they would recommend for the unit and go from there."

When there is a position open in the Wellness Unit, candidates are interviewed informally. "We don't ask them a list of standard questions," explained Sergeant Carmelin Rivera, who is currently in the unit. "We want them to explain why they want to work in Wellness and why they think they would be a good fit. We're also looking for people who have been here for a while and have a good understanding of the organization of the department. Understanding those nuances lends you credibility." Depending on the needs of the agency, other departments may find it useful to create structured interview questions to promote consistency and impartiality during the selection process.

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<sup>165</sup> Zwibel was previously with the Wellness Unit.

### Lessons from San Diego: Characteristics to look for when selecting members of a wellness team

- **Nonjudgmental.** Someone who knows how to make people feel cared for and who understands that the role of the wellness team is supporting others, not passing judgment on them
- **Compassionate.** Someone who is empathetic and cares for others
- **Experienced.** Someone who is familiar with the department and has a personal understanding of the stress associated with working in a law enforcement agency
- **Proven legitimacy.** Someone whom members of the department already gravitate toward when they are seeking assistance, advice, or support
- **Trustworthy.** Someone who does not gossip about others
- **Demonstrates wellness.** Someone who attends to his or her own emotional and physical health and models that for others

### Ensuring the wellness of the Wellness Unit

The serious responsibilities of the Wellness Unit can take an emotional toll on its members, which makes the risk of employee burnout high. “I mandated psychological services check-ins for myself and the other members of the Wellness Unit,” said retired Assistant Chief Creighton. “I also allowed the team to work out while they were on duty, because it was so important that they stay healthy and have effective mechanisms for managing their stress.” She added that members of the Wellness Unit also check in with one another informally on a regular basis to ensure no one is overwhelmed.

### Rotating out of the unit: The two-year limit

Assistant Chief Albrektsen formalized in policy a practice of putting a two-year limit on assignments to the Wellness Unit because of how emotionally taxing the work can be. Based on the experiences of former and current Wellness Unit members and the fact that they are essentially on-call 24/7, it was determined that the two-year limit would protect the emotional health and well-being of staff members. The limit also ensures that SDPD employees seeking services can be confident that the unit’s members are emotionally equipped to assist them.

## Training for help services providers

All members of the Wellness Unit (as well as all peer supporters) are required to attend a Commission on Police Officers Standards and Training (POST)–certified three-day peer support training.

Dr. Nancy Bohl-Penrod, head of Counseling Team International (CTI) and a POST peer support trainer, said that the training starts with a description of the characteristics of a successful peer supporter (empathetic, nonjudgmental, respects confidentiality, etc.). The training then transitions into a series of topic areas such as active listening, crisis intervention, grief, and substance abuse, each of which is followed by a role play exercise. “We also teach them about when they need to pass the baton to a professional, maintaining boundaries, and when to refer and when to not make a referral,” she said.

The SDPD’s police chaplains complete their own specialized 40-hour POST-certified chaplaincy training.

## Availability and assignments

While the Wellness Unit has a physical location with set hours, staff members also meet with employees in need at any time and in any place. SDPD employees do not need to go to the Wellness Center to receive wellness services. Members of the Wellness Unit are available 24/7.

## On-call protocol

To accommodate off-hour requests for assistance, the Wellness Unit has an on-call protocol. The Wellness Unit is included on watch commanders’ text lists, and if there is a critical incident or an employee in crisis calls the watch commander, the on-call Wellness Unit member is notified and responds. So that they are able to do so as quickly as possible, Wellness Unit members have assigned cars and take-home privileges when they are on call. If more than one member of the Wellness Unit needs to respond to an incident, whoever is not on call goes to the station to pick up his or her car before going to the scene.

In addition to this on-call protocol, SDPD employees often contact individual members of the Wellness Unit directly because they know and trust them. When that happens, “you take the call,” said Sergeant Rivera, echoing similar sentiments from other members of the Wellness Unit.

“This is a 24/7 job,” said retired Assistant Chief Creighton, “and people need to have access to us at all times.”

## Deployment

A critical lesson that the Wellness Unit learned from its first month of operation in 2011 was how to deploy help resources. Waiting for a request from command staff to send help resources to the scene of a critical incident was impractical and delayed response time. Instead, Wellness Unit staff members dispatch these service providers—and respond themselves—immediately.

This nontraditional deployment also extends to the scene itself. During the manhunt following the fatal shooting of Officer Jeremy Henwood in 2011, police chaplains and psychologists were taken to officers' posts to begin providing support to them immediately, even as the search continued.<sup>166</sup>

## Building awareness of and trust in the Wellness Unit

Ultimately, all of the operational components of the wellness program—the physical location of the unit, the availability of wellness services, the training and education sessions that the unit develops—are intended in part to build awareness of the Wellness Unit. To ensure that services are used and to build department members' trust in wellness services, the Wellness Unit has an active internal outreach program.

### Going to lineups

The unit has proactively engaged with SDPD employees since its inception. “We went to lineups,” retired Assistant Chief Creighton said, “to talk to members of the department about who we were, what the Wellness Unit was, and what we wanted to accomplish for them.”

These early efforts were critical to obtaining support, said the Reverend Dale Lowrimore, a police chaplain. “We went to every lineup at every command and gave a presentation to every single person,” he said. “We needed to explain what was changing in terms of the reorganization and what the confidentiality policy was, to overcome fears that Wellness was a ‘tattle tale’ place. We also needed command staff to understand who we were and what we were about.”

### Newsletters, brochures, and written announcements

The Wellness Unit also produces written materials to explain its services and publicize its events, including a Wellness Unit Employee Resources brochure<sup>167</sup> and a monthly newsletter, *Wellness News*.<sup>168</sup>

The Wellness brochure is a one-page, double-sided quick reference guide that lists all of the help services offered and outlines additional resources that the SDPD provides. The information in the brochure includes the following:

- The mission of the Wellness Unit
- Wellness Unit services
- The names and contact information (office number, cell number, and email) of all members of the Wellness Unit
- A list of the SDPD's peer supporters

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<sup>166</sup> SDPD, *Changing Organizational Culture*.

<sup>167</sup> See appendix C for a copy of the brochure.

<sup>168</sup> See appendix D for a copy of the monthly newsletter from August 2017.



- The mission of the police chaplain program
- A list of the SDPD's police chaplains and their contact information (phone and email)
- A description of Focus Psychological Services, who they serve, and the services that they provide as well as their contact information (email and phone)
- A description of the Alcohol and Substance Abuse Program (ASAP) and contact information (email and phone) for the SDPD's ASAP counselors
- A list of additional resources and contact information (phone) for the following:
  - Medical assistance
  - EAP
  - The San Diego Police Officers' Association (SDPOA)
  - The San Diego Metropolitan Employees Association (SDMEA)
  - AFSCME127 (a local labor union)

The Wellness Unit distributes this brochure widely, sharing it at trainings, events, and lineups. Wellness Unit members also give a copy of this brochure to new officers the day they start the academy as part of a strategy to create a culture of wellness in the department by normalizing wellness services among new hires.<sup>169</sup>

*Wellness News*, the Wellness Unit's monthly newsletter, is distributed using the SDPD listserv. It provides articles on wellness topics, information about upcoming wellness-related events, and wellness tips and resources. The information that it offers is holistic, touching on all aspects of wellness.

The August 2017 newsletter<sup>170</sup> included

- a message from Assistant Chief Albrechtsen on the benefits of blood donation;
- an informational flyer about an upcoming blood drive;
- an announcement about the negative effects of neglecting self-care, including the impact on officers' families;
- a fitness and weight loss success story, with photos, written by a department member;
- an article about wellness, mindfulness, and the Wellness Unit, written by Deanna Dotta of the Wellness Unit;
- an article titled "The Lies We Tell Ourselves—Barriers to Wellness," written by Sergeant Rivera of the Wellness Unit;
- an announcement about fitness opportunities at the department and workout resources;

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<sup>169</sup> This is part of a larger strategy to create a culture of wellness in the department.

<sup>170</sup> See appendix D.

- a list of items that officers should always have in their gear bags, including disinfecting wipes, a first aid kit, and extra gloves;
- book recommendations, including a discount coupon code for one of the suggested titles;
- an SDPD wellness resource list (including contact information for Focus, the EAP, police chaplains, and the Wellness Unit staff).

“The wellness newsletter is fantastic,” said Marie Cuvadar, a police dispatch supervisor and peer supporter, “and they reach a really wide audience.”

In addition to announcing upcoming training and educational seminars in the newsletter, the Wellness Unit sends out announcements to encourage participation. “We’ve put together workshops on retirement, healthy eating, and sleep hygiene,” explained Lieutenant Bassett, “and we always put out department-wide announcements so that people are aware that these events are coming up and these resources are available to them.”

The Wellness Unit also created posters that describe the unit and wellness services and include contact information for the unit and other help resources.<sup>171</sup> These posters are displayed around SDPD headquarters and in division stations.

## Building trust

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The key is when you get someone who has used wellness services and tells someone else that they had a good experience.

— *Assistant Chief (ret.) Sarah Creighton, San Diego Police Department*

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While these materials make department members aware of wellness resources, ensuring that employees use the resources depends on trust. “It has taken a lot of meetings and a lot of groundwork to build an understanding of what Wellness does,” said the Rev. Lowrimore. “Wellness has a great reputation because we hold confidentiality in the highest possible regard.”

Retired Assistant Chief Creighton said that building a reputation for discretion takes time. “It’s slow going convincing people that you respect confidentiality, even when you have the best people on your team,” she said.

Lieutenant Bassett underscored the importance of individual interactions in building trust, person by person, over time. “In the beginning, people would fish and ask who I was going to tell about our conversation,” he said. “I would say that the only person who could tell anyone was him or her.”

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<sup>171</sup> The poster has been modified since PERF’s research into the SDPD’s Wellness Program.

## What using wellness services looks like in practice: A scenario

Officer Adams is going through a difficult divorce. Since proceedings began, he has been increasingly irritable. He has told his friend, Officer Smith, that he is having trouble sleeping, and Smith is worried that Adams may be starting to drink more than normal after his shifts. Smith tries to talk to Adams about how he is coping with his divorce, but Adams rebuffs him.

Smith is familiar with the Wellness Unit because of the training the Wellness Unit provided in the academy and after field training. He knows that he can get the contact information for anyone in the Wellness Unit from several places, including the SDPD intranet, brochures, and posters located throughout headquarters.

Smith calls the Wellness Unit and asks one of the sergeants to check in on Adams. The Wellness Unit sergeant calls Adams at the end of his shift. She explains the services that the Wellness Unit provides and that the Wellness Unit is there as a resource for him. She says that she can connect him with anyone who might be helpful to him, including financial counselors, psychological services, and peer supporters who have had similar experiences.

The sergeant also encourages Adams to visit the Wellness Center. He agrees to stop by the next morning. While there, she gives him the contact information for two service providers and several peer supporters and says that she will call to check in on him the following day.

The sergeant underscores that Adams can reach out to her at any time if he needs to talk. Adams calls one of the peer supporters that afternoon, and they talk several times over the course of the week. Two weeks later, on advice of his peer supporter, he makes an appointment with a financial counselor recommended by the Wellness Unit sergeant as well.

## Metrics for success

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The only product we produce as an agency is our employees, and all of their work is improved if they're well.

— *Sergeant Ed Zwibel, San Diego Police Department*

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The Wellness Unit uses several mechanisms to measure its success: surveys, utilization reports, and a quarterly management report (QMR). For a unit that operates under a confidentiality policy, these metrics are especially critical in demonstrating the success and impact of their efforts. “There is all of this hidden work that we do that most people never know about unless they’re using wellness services, and that’s exactly how I hoped it would be,” explained Sergeant Ed Zwibel.

## Utilization reports: Recaps

Each month, the Wellness Unit produces a report, called a recap, on the number of wellness contacts (i.e., one-on-one contacts—in person, on the phone, via text, via email, etc.—that they have with department members) made that month. Each report contains the following information:

- Number of individuals served
- Type of service they received
- General demographic information
- General description of the issue(s) for which each individual was seeking assistance

Every member of the unit and every help services provider is required to submit a “recap sheet”<sup>172</sup> on the 10th day of the month that captures this information. The Unit then combines these submissions into a single report.

Importantly, recaps contain no identifying information about the employees who use wellness services. Their purpose is to assist the Wellness Unit in identifying themes and trends; to inform their outreach, events, and training protocols; and to keep track of how many department members are using help resources.

## Quarterly management report (QMR)

The Wellness Unit prepares a report for the chief’s executive committee every quarter. It documents the following:<sup>173</sup>

- The number of employees who provided wellness assistance and the number of hours they spent on wellness contacts
- The issue areas they addressed with department members, ranked from most to least prevalent
- The training that the Wellness Unit and help services provided
- Any new or ongoing projects and community partnerships
- Summaries of critical incidents

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<sup>172</sup> See appendix E for a recap sheet.

<sup>173</sup> SDPD, *Changing Organizational Culture*.

## 2013 survey

At the close of its first two years in operation, the Wellness Unit also conducted a survey<sup>174</sup> to assess its progress. The 240 respondents said the following:

- 78 percent felt like there was a lot more discussion about issues like suicide, substance abuse, and other ineffective coping behaviors than two years earlier.
- 70 percent felt that the stigma associated with asking for help was decreasing.
- 89 percent trusted that if they had a personal issue that was interfering with work or home, they could ask for help and receive help.
- 79 percent said that they would feel comfortable walking into the Wellness Center regardless of the reason for their visit.

## Sustainability planning

While the Wellness Unit has proven critical to the department, Assistant Chief Albrektsen said that sustaining it long-term depends on demonstrating that it saves money. “Partnering with other first responders and working with risk management in the city is what makes this work in the long term,” she said. “You have to work with other agencies and demonstrate a dollar savings for the city, showing that this is preventing all sorts of negative outcomes related to poor physical and emotional health in the department.” Indeed, poor physical and mental health among officers can lead to absenteeism, increased usage of workers’ compensation and sick days, and increases in early retirement,<sup>175</sup> which has proven to be a costly burden for agencies.

## Promising practices: Building and sustaining a wellness program

### First steps

- Conduct a department-wide survey to ask employees what they need and what their primary wellness concerns are. Use that information to guide the development of wellness programming and services.
- Have a clear, written confidentiality policy, communicate it to department members, and adhere to it. Ensure that reporting requirements and exceptions are understood, such as information indicating that an employee may be a danger to himself or herself or to others or that domestic violence or child abuse may be occurring. Some providers, such as clinicians, may be bound by more stringent confidentiality rules than police department employees. Ensure that employees understand these differences and understand the confidentiality rules that bind each category of help services providers.

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<sup>174</sup> See appendix F for full survey and results.

<sup>175</sup> Andersen et al., “Mental Preparedness;” Garner, “Police Stress.”

- Locate your wellness office or center in headquarters or another high-visibility location to reduce any stigma that employees may feel about seeking help.
- Your department's help resources providers should be in close communication with one another and should work together to deliver wellness services. This includes
  - having a common mission and messaging so that they are working together toward a shared wellness goal for the overall good of the department;
  - communicating with each other to coordinate responses to critical incidents.

## Outreach and engagement

- Make wellness services visible on your organizational chart to demonstrate their importance.
- Go to officer roll calls to explain wellness services.
- Develop materials to publicize the services and how to access them, including
  - brochures;
  - newsletters;
  - posters.

## Recruiting

- When recruiting people for wellness-related programs, look for interpersonal skills, not necessarily rank. Wellness unit staff members should be
  - compassionate;
  - nonjudgmental;
  - experienced in the organization;
  - trustworthy;
  - respected by colleagues.

## Training

- Mandate that help services providers receive formal training—for example, POST-certified peer support training—to ensure that they have the right tools to be successful in supporting their colleagues.
- Provide opportunities for help services components to train together. This improves team building and ensures that all providers share common messaging and goals.

## Operations

- Do not neglect civilian employees. Include them in wellness services as providers and as recipients.
- Wellness providers need to be available 24/7. Crises are not confined to business hours.
- In addition to serving as a resource during regular business hours, wellness services providers should be able to meet with employees seeking help at the times and locations that work best for them.
- To accommodate off-hour requests for assistance, develop an on-call protocol for the wellness services providers and advertise to department employees.
- Assignments for wellness providers should be made based on relationships and trust. Often, whether at the scene of a critical incident or when someone walks into the Wellness Center, an employee wishes to talk to a specific help services provider.
- Establish a policy that allows wellness services providers to deploy help services during or immediately after a crisis without needing to wait for a request from command staff.
- Wellness services providers should check in regularly with those who use their services and follow up on anniversary dates as well.

## Maintaining the wellness of help services providers

- It is important to ensure that employees who provide wellness services are themselves in good physical and emotional health. Be aware that assignment to a wellness unit can be stressful, and be mindful of the wellness of help service providers. Adopt policies and protocols to promote their physical and emotional health. Examples include
  - having mandatory psychological service check-ins;
  - allowing wellness workers to exercise while on duty.
- Have a protocol for rotating wellness service providers out of help services roles to prevent burnout. This might include one (or both) of the following:
  - A policy limiting the amount of time that someone can spend in a wellness-related role
  - A form that wellness service providers can fill out and submit without penalty asking to be relieved of wellness-related duties

## Metrics for success

- Develop a mechanism for tracking the use of help services, such as the monthly recap report that the SDPD's Wellness Unit compiles every month based on recap sheets (see appendix E) completed by each help services provider.
- Survey the department after wellness services have been in place for a year or more to determine their levels of visibility, employee trust, and use. Modify your approach as needed based on results.

## Sustainability planning

- Make it clear that a successful wellness program is good for the financial health of your law enforcement agency—i.e., keeping officers physically and emotionally healthy is a cost-saving measure in the long term—to secure support for wellness programming from city government.

## External partnerships

- Draw upon the expertise of people outside of your organization. This might include
  - a nearby law enforcement agency that already has wellness services;
  - academics with experience in wellness-related topics;
  - police psychologists.
- Partner with mental health providers, academics, and other outside experts to refine wellness program methods and initiatives and provide needed services to department members.



# Help Resources: Providers and Programs

The help resources that the Wellness Unit manages—police chaplains, peer supporters, and psychological services—are critical components of the SDPD’s wellness program. Many providers said that while these programs predate the Wellness Unit, their efficacy has increased now that they are working together under one command and toward a common goal.

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Pooling knowledge improves the delivery of wellness services to those in need.

— *Police Dispatch Administrator Mellissa Santagata, San Diego Police Department*

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“If we have an issue that we haven’t encountered previously, it’s likely other wellness providers often have seen it, and the Wellness Unit can give us the information and referrals we need without us having to reinvent the wheel,” Mellissa Santagata, a police dispatch administrator and peer supporter explained. The SDPD’s individual wellness initiatives are interconnected and serve as force multipliers for one another.

## Peer Support Program (PSP)

The SDPD’s Peer Support Program (PSP) encompasses the following:

- **General peer support.** Support provided by civilians and officers to department members and loved ones experiencing difficulties in their lives
- **Officer involved shooting (OIS)/in-custody death peer support.** Support provided by officers to officers involved in a shooting or in-custody death

**All members of the peer support program provide general peer support.** When there is an OIS or an in-custody death, however, sworn peer supporters who have themselves been involved in a shooting or an in-custody death respond. Peer supporters who do not have this experience are not assigned to supporting an involved officer in the wake of a shooting or in-custody death.<sup>176</sup>

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<sup>176</sup> This is generally true, though in extraordinary circumstances such as a mass casualty incident, as many peer supporters as needed would be mobilized to respond regardless of status.

Before the Wellness Unit was created, and indeed until 2016, general peer support and OIS peer support were two distinct programs. The former was called the Member Assistance Program and the latter was called Peer Support. They were combined to align the program with the IACP's recommendations on peer support as well as standard practice in California.

## Training

All peer supporters at the SDPD are required to attend POST-certified three-day peer support training.

In addition to the POST peer support training, the SDPD's peer supporters are also required to attend two refresher training sessions every year. These sessions, held quarterly, are organized by the Wellness Unit and are each dedicated to a different wellness topic such as mindfulness and sleep hygiene. The SDPD invites outside experts in to present during these trainings.

## OIS peer support

OIS peer support is a service provided to officers who are involved in a shooting or an in-custody death by other officers who have had the same experience. The goal of OIS peer support is to provide officers who have been involved in or have witnessed a shooting or in-custody death with emotional support and help them navigate the post-incident investigative process.<sup>177</sup>

## Recruitment

There are approximately 30 peer supporters who provide OIS-specific support (OIS peer supporters) in the SDPD Peer Support program. The eligibility requirements to provide this type of peer support include the following:

- Being a nonprobationary POII, POIII, or sergeant
- Having met departmental performance standards
- Having experience of a shooting or in-custody death (which must have occurred more than 12 months prior)
- Being a good listener and good with people
- Being available at all times (both on duty and off) to respond to critical incidents as needed
- Having a recommendation from his or her commanding officer<sup>178</sup>

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<sup>177</sup> SDPD, *Wellness Unit Operations Manual*, 11.

<sup>178</sup> SDPD, *Wellness Unit Operations Manual*, 9.

As Sergeant Rivera explained, “OIS peer supporters are vetted. We ask them to apply to be a peer supporter and if they happen to have a qualifying incident, we take them through an extra interview process to determine if they would be the right fit for providing peer support during OIS incidents.” These interviews, said Dr. Bohl-Penrod, are done by a licensed clinician and one or two members of the Wellness Unit.

## Operations

If they are responding to a scene as an OIS peer support officer while they are off duty, or if they work past the end of their shift because they are doing so, OIS peer supporters are paid overtime.<sup>179</sup>

## Deploying to the scene

All officers involved in a shooting or an in-custody death receive an OIS peer supporter. While they do self-deploy, Sergeant Rivera explained, it is the responsibility of the supervisor on-scene to request peer support. The first OIS peer support officer who arrives at a shooting is responsible for assessing the scene to determine if additional OIS peer supporters are needed. Ideally, said Detective Sergeant Jeff Sterling, there is a one-to-one ratio of OIS peer supporters to shooting and witness officers. If that is not possible, OIS peer supporters always maintain a one-to-one ratio with shooting officers.

If the officer involved would like a particular peer supporter, that request is honored as a matter of policy and practice. “If I get to a scene and the guy knows another OIS peer supporter already and wants to talk to him or has a good relationship with him, I’ll let the other peer supporter know and just stay there with the officer until the other peer supporter shows up,” explained Detective Sergeant Sterling. Sergeant Michael Shiraishi agreed, saying, “We ask the officer if they know anyone on peer support they’d rather talk to. There’s no ego there. If there is and they would, we make the call.”

## Activities on scene

As officers who have been in similar circumstances themselves, OIS peer supporters have a comprehensive understanding of the post-shooting investigation process, and they begin to help officers through it once they arrive on scene. “We sit and talk to them about what is going to happen next and what the process looks like, but it’s a fine line because we don’t want to take a statement,” Detective Sergeant Sterling said. “Our role is to give them information, drive them, get them in touch with their attorney, wait with them while they’re doing their walk-throughs on scene, wait while they’re doing their detailed interviews, and drive them home when they’re all done.”

## Follow-up activities

Officers involved in shootings and in-custody deaths participate in mandatory critical incident debriefings that are facilitated by a Focus psychologist. OIS peer supporters are not currently involved in those debriefings, but they do provide continued follow-up and support to officers.

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<sup>179</sup> SDPD, *Wellness Unit Operations Manual*, 9.

OIS peer supporter Detective Nestor Hernandez described his method as following up within the first 24 hours, then every two days for the first two weeks, and then letting the officer determine their level of contact once the two weeks have passed. Sergeant Shiraishi said, “After the debrief, one of the things that I ask them about is their home life. I talk to them about signs they should look out for, like if they become hypersensitive to their kids or if they have more tense interactions with their significant others. I’ve had officers reach out to me after the fact to say that they’re noticing that kind of stuff, and I drive them down to the psychologist at Focus to get them an appointment to talk to someone.”

## Peer support (non-OIS)

The SDPD’s Peer Support program also includes peer supporters who do not provide OIS-specific support. These peer supporters include sworn and civilian members of the SDPD. Their purpose is to provide support to department members and their loved ones who are grappling with challenges in their lives.

### Recruitment

There are approximately 40 sworn peer supporters and 13 civilian peer supporters at the SDPD in addition to the peer supporters who provide OIS-specific services. Eligibility criteria for becoming a peer supporter include the following:

- Having met departmental performance standards
- Having a reputation as someone whom others already seek out for informal peer support and who can keep information confidential
- Being a good listener and good with people<sup>180</sup>

### Making peer supporters accessible: The intranet directory

All peer supporters have a profile on the SDPD’s intranet that includes their photo as well as a description of the particular issues with which they have experience, such as divorce or the death of a loved one. Their profiles also include their contact information. Members of the department can review these profiles and reach out to the peer supporters who can speak directly to their issues and concerns.

### Operations

Peer supporters are volunteers, providing assistance on their own time and without compensation. As a result, the policy of the peer support program is that departmental and regular duties are a peer supporter’s first priority. It states that peer support work should not take peer supporters away from their jobs or negatively impact their performance.<sup>181</sup>

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<sup>180</sup> SDPD, *Wellness Unit Operations Manual*, 12.

<sup>181</sup> SDPD, *Wellness Unit Operations Manual*, 12.

## Police chaplain program

The SDPD's police chaplain program was created in 1969. It is a volunteer corps of faith leaders from the community who offer emotional support and spiritual guidance to police employees and their families. They do not proselytize, and the support they offer is nondenominational.<sup>182</sup>

Police chaplains, the Reverend Lowrimore said, are a critical component of wellness programming. "Wellness programs should address the mind, body, and spirit, and without chaplains they're not well-rounded in my view," he said. "Additionally, a lot of officers won't necessarily go to a psychologist, but they will speak with a chaplain."

The SDPD's police chaplain program has undergone an evolution since 2007, the Reverend Chuck Price said. "For many decades we defaulted into crisis-driven chaplaincy," he said, "and there was no training, policy, or organization" to the program. In an effort to change this, the Reverend Price and the other active members of the program researched chaplaincy programs and developed a written policy, based on established standards, for the program.

## Recruitment

SDPD currently has 11 police chaplains and space for nine more. "It's a challenge to fill 20 slots," said the Reverend Lowrimore, "because all of the agencies in this area are drawing from the same pool of resources. Many of us are already doing double and triple duty with different agencies."

The eligibility requirements for those who would like to join the chaplain program include the following:

- Chaplaincy recognized by a religious body and approximately five years' experience in ministry
- Current involvement in a ministry, congregation, or church-related organization in San Diego County
- Pass an oral interview and a background check
- Master's degree from an accredited graduate institution or a denominational equivalent
- Demonstrable experience and training in counseling and theology<sup>183</sup>

The emphasis on faith leaders with experience, said the Reverend Lowrimore, is intentional. "We look for senior people," he said. "We want people who have experience and who have been in ministry for a long time. We deal with life and death every day, so having a minister who is young and somewhat inexperienced doing this work may not be a good fit."

There are particular personality types to look for in recruiting for the program, the Reverend Price explained. "We've learned that we really need to look for humility. We have some people who come in humbly and want to learn how to do this, and those are the ones who do well."

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<sup>182</sup> SDPD, *Wellness Unit Operations Manual*, 16.

<sup>183</sup> SDPD, *Wellness Unit Operations Manual*, 16.

“The biggest lesson I’ve learned is that police chaplains have to be tenacious,” said the Reverend Lowrimore. “As chaplains, we have to keep going. We’re not always everyone’s cup of tea, and that’s fine—we just keep going.”

## Training

The SDPD’s police chaplains are required to complete a 40-hour POST-certified chaplaincy training program. In addition, they have bimonthly meetings that include an educational component. “At our meetings we tend to have a training of some sort, or at least a debriefing about major incidents,” explained the Reverend Lowrimore. “We may hit something specific like death calls, including what you should do when you get there, what you should have with you, and what your role should be. Police chaplains need to know what they’re doing.”

## Duties and assignments

Police chaplains are asked to dedicate at least 10 hours per month to providing support to the SDPD with the understanding that they are available at all times as a resource. Responsibilities include the following:

- Responding to an OIS and other critical incidents
- Participating in next-of-kin notifications as a resource for officers and family members
- Serving as a support system for officers in crisis<sup>184</sup>

Unlike any other help resources at the SDPD, police chaplains are all assigned to specific divisions. The Reverend Lowrimore, for instance, is responsible for the SDPD’s Western Division. “If something happens with someone in Western Division and I get a call, I go,” he said. While officers are encouraged to rotate among divisions every five years, police chaplains typically stay where they are assigned for long periods of time.

As a result of these assignments, chaplains often get to know personnel in their divisions on a personal level. Relationships of trust are established from hours spent in cars together during ride-alongs and the familiarity that develops from seeing someone day in and day out. Sometimes officers call police chaplains whom they know from their previous positions. “They might want to talk to their previous chaplain, and that’s fine,” the Reverend Lowrimore explained. “We want whatever is best for the officer.”

## Building trust: The role of ride-alongs

As both the Reverend Price and the Reverend Lowrimore underscored, building trust takes time. A critical component of that effort for police chaplains at the SDPD has been participating in ride-alongs with officers in their divisions. “They help build rapport, and the more time that I spend with officers,

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<sup>184</sup> SDPD, *Wellness Unit Operations Manual*, 16.

the more trust I build,” the Reverend Price explained. The Reverend Lowrimore echoed him, saying, “It’s all about building bridges, and we do it one officer at a time. When we’re on a ride-along, whatever they do, we do, and whatever call they go on, we go on. We’re out there in the blood and the guts and the vomit with them. It helps us understand them and it shows them that we’re committed to them.”

## Focus Psychological Services

Focus is an independent group with whom the SDPD contracts to provide counseling services to department members and their loved ones free of charge. Focus is “law enforcement–oriented,” chief psychologist Jolee Brunton said. “We know the population, and we remove every barrier possible to get them through the door.” Focus also provides counseling services for San Diego Fire-Rescue workers, the San Diego State University Police Department, the University of California San Diego Police Department, and other fire and law enforcement agencies in San Diego County.

## Services

Focus’s primary service is counseling, which can be related to any issues facing department members and their loved ones regardless of whether it is associated with police work. Focus also provides specialized training for department members as needed and participates in delivering wellness-related training with the Wellness Unit, including the wellness module of Advanced Officer Training and Effective Interactions training for new officers.<sup>185</sup> Focus teaches a five-hour block to new sergeants on topics of critical incident stress, suicide prevention, and recognition of stressful life and work events (for example injury, discipline, retirement, deployment). In addition, Focus provides consultation services for special teams and leads critical incident debriefings (which take the place of fitness-for-duty exams at the SDPD) for the department.

## Staffing and training

Focus currently has nine psychologists, two of whom are former law enforcement officers who were recruited specifically because of their experience as officers. All Focus psychologists have developed an understanding of policing because of Focus’s onboarding protocol. “Most people don’t have an expertise in police psychology, so when I take people on, in their first year I have them do ride-alongs, witness debriefings, meet with families, and go to lineups until they feel comfortable in the position,” Dr. Brunton said.

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<sup>185</sup> See Training section beginning on page 47 for more details about these trainings.

## Breaking down barriers for officers to take advantage of services

As clinicians, Focus psychologists are bound by legal privilege. “We are very clear about our confidentiality policy,” Dr. Brunton said, “because if cops don’t think we protect confidentiality, they won’t use our services. We’re mandated reporters for certain things as medical professionals, but we are completely transparent with officers. The first day they come in, we discuss confidentiality and when we’ll report something.” Officers, she said, respond well when psychologists are forthright.

Focus psychologists are also flexible about where and when they will meet with department members. “I have people who don’t want to come through the door to our offices, so we’ll schedule them at a time that no one is in the office, or we’ll meet them off site, or do whatever we need to do to get them services,” Dr. Brunton explained. This includes making every effort to see department members within a day or two of hearing from them, she said, to make it more likely that they will keep their appointment.

Thinking creatively about communication has also proven successful in overcoming barriers to utilization. “I make myself available via text,” Dr. Brunton said. Focus has also seen an uptick in engagement through their website. “It’s amazing,” Dr. Brunton noted, “how many people will text or email even if they won’t call.”

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Once I started giving out my cell number and telling officers that they could text me, our utilization increased dramatically. I get more texts than phone calls.

— Dr. Jolee Brunton, *Focus Psychological Services*

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Last, she said that she emphasizes that Focus is not part of the SDPD. “It’s critical to draw the boundary with officers that we’re an external entity and that command staff don’t get access to our records and who uses the service.” The only information that is communicated to the department is the monthly number of hours of use.

## Use

Use of services has increased significantly since the creation of the Wellness Unit, according to Dr. Brunton. “Since we’ve had the Wellness Day with new recruits and their family members,” she said, “the new recruits are much more likely to come in and use services.” In 2016, Focus dedicated 6,000 hours to providing services to SDPD members.

Anecdotally, associating with psychologists also seems to be less stigmatized in the department. “I’ve noticed a big increase in people actually making eye contact with me, talking to me, and talking about wellness since the unit was created,” Dr. Brunton said. “We’re working hard to normalize the experience



and say, ‘There’s nothing wrong with you, but this is a unique job with unique challenges and we’re here to help you do your job. If you’re a tennis player, why would you practice doing a bad backhand? Why not learn how to do it right?’”

### What using wellness services looks like in practice: A scenario

Officer Brooks is struggling after the sudden death of her brother. She has noticed that it is more difficult for her to concentrate, and she is increasingly short-tempered with her colleagues and community members. She feels exhausted all of the time and has lost interest in the hobbies that used to occupy most of her free time, like hiking and camping.

Though Brooks joined the SDPD before the Wellness Unit was created, she learned about it through the police chaplain at her division, Wellness Unit presentations at roll call, and the monthly Wellness newsletter. She calls an officer in the Wellness Unit one day after work and asks if he is free to meet her at a coffee shop near her apartment. He drives over and they talk for two hours about the issues she is facing in the aftermath of her brother’s death.

The Wellness Unit officer helps Brooks make an appointment with Focus Psychological Services for the next day and offers to drive her there. Brooks declines, so instead the Wellness Unit officer calls her before her scheduled appointment time to ensure that she made it to the Focus office. He reiterates that she can call him at any time if she needs to talk and that he will call to check in on her later in the week. He does, and he also reaches out a month later on the anniversary of her brother’s death. Brooks and the Wellness Unit officer continue to communicate regularly via text, phone, and in person during the following year.

### Alcohol/Substance Abuse Program (ASAP)

Among the specialized services that the SDPD offers is an Alcohol/Substance Abuse Program (ASAP). The primary goals of the ASAP are to help department members and their family members recover from substance abuse and, in so doing, to decrease the incidence of substance abuse overall at the SDPD. Deanna Dotta, a 911 dispatcher in the Wellness Unit, is also the SDPD’s ASAP counselor. Her duties include the following:

- Providing alcohol and substance abuse information, counseling, training, and direct assistance to management, employees, and family members
- Liaising with Focus, the municipal EAP, the Public Safety Fellowship (a 12-step program), other government agencies, and treatment centers and substance abuse counselors
- Assisting with the coordination of inpatient and outpatient treatment
- Providing internal presentations and articles on ASAP and substance abuse issues<sup>186</sup>

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<sup>186</sup> SDPD, *Wellness Unit Operations Manual*, 20.

“There are two [Alcoholics Anonymous] groups in the county that are for first responders only,” Dotta explained. She is also expanding the range of providers available to SDPD department members. “I’ve been building a network with treatment facilities in the greater southern California area beyond San Diego, because officers are often reluctant to go to the local treatment centers,” she said. “There is a real possibility they’ll run into people they may have arrested. Also, a lot of places don’t have the training and expertise to understand police work and the types of stressors that officers are under. I’ve also looked for facilities that provide a level of extra confidentiality, and that understand police officers’ concerns about that.”

In order to facilitate department members’ treatment for substance abuse, the SDPD allows employees to donate their leave time to others anonymously. “We have people donate their hours for catastrophic leave without knowing who they’re donating it to,” explained retired Assistant Chief Creighton. “That is important because it helps people get the treatment they need, and it shows them that the rest of the department cares.”

## Recruitment and training

The SDPD’s ASAP counselors have all completed training at the Navy Drug and Alcohol Counseling School. Dotta graduated from the program in 2006.

The SDPD makes specific provisions regarding recruiting those in recovery to serve as an ASAP counselor. Policy states that a counselor may be someone who has not had an addiction problem<sup>187</sup> or someone who is a recovering alcoholic with at least three years of continuous sobriety and who attends the Public Safety Fellowship or other 12-step program.<sup>188</sup>

## Promising practices: Help services and programs

### Peer support

- When creating a peer support program, start small if resource constraints are an issue—the important thing is to start providing the service. Having a formal system for providing peer support and ensuring that helpful services are delivered are critical for department members’ wellness.
- Designate someone to be in charge of overseeing peer support activities to ensure that peer support is helpful and is offered according to protocols.
- Wellness services supervisor(s) should interview all applicants to ensure they are suitable for the role.
- Peer supporters should be required to complete formal peer support training. This standardizes the delivery of peer support services and ensures that the services are helpful to officers.

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<sup>187</sup> SDPD, *Wellness Unit Operations Manual*, 20.

<sup>188</sup> SDPD, *Wellness Unit Operations Manual*, 20.

- Have a mechanism in place that allows peer supporters to leave the program at any time (for example, if they can no longer dedicate time to participating).
- Establish protocols for removing peer supporters if there are performance issues.
- Provide peer support services for civilian staff in addition to sworn staff. This includes inviting dispatchers to critical incident debriefings.
- Create a database that includes information about peer supporters, including the topics (such as divorce or death in the family) with which they have experience, so that department members can seek out a peer supporter with a first-hand understanding of their particular needs.

### Peer support specific to an OIS or in-custody death

- When recruiting for OIS peer support, look for maturity, credibility, and active listening skills.
- Require a qualifying incident for OIS peer support officers.
- If possible, have a combination of uniformed officers and investigators as peer supporters to provide a wide range of relatable experience.
- Have a mentoring system in place for OIS peer supporters. This includes mentoring in the field: Senior, experienced peer supporters should show up on scene to help new OIS peer support officers fulfill their duties.
- OIS peer supporters should be attentive to officers' basic needs—getting them water and food if appropriate, for example.
- Communicate to the officers involved what the investigation and debrief process will look like in practice (i.e., what their days will be like immediately following and potentially for months) so that they are prepared.
- Follow up with officers after they have slept and have had an opportunity to decompress.
- If the officers involved have existing relationships of trust with a particular OIS peer supporter who is not the first OIS peer supporter to arrive on a scene, call that peer supporter so that he or she can take over.
- OIS peer supporters should follow up with the officers involved in an incident on a regular schedule and use multiple methods (such as phone calls, text messages, and in-person meetings) to ensure adequate outreach and support is conveyed to the officers.

### Chaplains

- When recruiting for a police chaplain program, look for humility, credibility, and experience.
- Police chaplains should not proselytize.
- Police chaplains should go on ride-alongs to get to know the officers and to build an understanding of their jobs and the stresses and challenges they face.

## Psychological services

- Use multiple forms of communication—including technologies like text messaging and email or online appointment request forms—for making appointments and engaging with department members. This has the potential to dramatically increase use of services.
- Many psychologists do not have an expertise in police psychology. Build psychologists' understanding by directing them to go on police ride-alongs, witness critical incident debriefings, attend lineups, etc. as part of their initial orientation to working with police employees.
- If resources permit, try to ensure that officers seeking psychological wellness services do not have to wait for a significant period of time to get an appointment.
- Be absolutely clear about confidentiality rules.
- Be flexible in where and when you will meet with officers.

## Alcohol/Substance Abuse Program

- Designate a qualified department member to serve as the primary coordinator or liaison for substance abuse–related programming and outreach.
- Develop a network of local substance abuse treatment providers, looking specifically for providers who specialize in helping first responders.
- Develop a mechanism for members of the department to donate their leave time, if they would like, to other department members who need inpatient treatment. This system should maintain the anonymity of the person receiving treatment.

# Training: Building a Culture of Wellness

One of the core duties of the Wellness Unit has been developing and implementing a training program that can embed wellness at all levels of the police department.

## Reaching new officers

The heart of training for wellness is reaching new officers early and often to normalize wellness services. Normalizing means trying to ensure that SDPD officers and other employees see nothing unusual in asking for these services, just as they would apply for any other benefits of employment.

The SDPD Wellness Unit tries to achieve normalization by

- distributing the Wellness Unit Employee Resources Brochure to new officers the day before they start the academy;
- delivering training in the academy on Emotional Survival;
- facilitating a Wellness Day—officially titled Psychological Preparedness Training for New Officers—immediately after graduation from the academy, which includes programming for officers and their family members;
- delivering a two-day training on Effective Interactions immediately after field training.

## Engaging with senior staff members

New members of the police department are not the sole focus of wellness-related training. To reach senior officials, SDPD has

- made a wellness module part of mandatory advanced officer training;
- made awareness of wellness issues a requirement for promotion (e.g., members of the department must read and be tested on Emotional Survival for Law Enforcement to be promoted to lieutenant, sergeant, detective, or senior officer);
- made a wellness module part of command training.

The Wellness Unit also provides specialized training and coaching to supervisors on wellness-related issues so that, as the primary caregivers for the employees who report to them, they are able to effectively address wellness concerns in their own commands. This includes leadership training for civilian supervisors, developed and delivered in mid-2017, said Assistant Chief Albrektsen.

## Responding to emerging issues

One of the defining features of the SDPD's wellness training and educational program is its adaptability. Training is modified as needed—sometimes in the moment during a scenario-based exercise—in order to ensure that it is effective and provides employees with the greatest benefit. The Wellness Unit also offers free-standing educational programming, such as seminars on nutrition or financial planning, as needs are identified.

### Emotional Survival Training: (four-hour training delivered in the academy)<sup>189</sup>

The Wellness Unit created the SDPD's Emotional Survival training based on the work of Dr. Kevin Gilmartin.<sup>190</sup> The goal of Emotional Survival training is to equip new officers with tools to recognize and manage the unique stressors that are associated with a career in law enforcement. The Wellness Unit and the SDPD's help services providers deliver the training in the academy. It is offered near the end of officers' time in the academy so that they are more aware of law enforcement culture and can relate more directly to the training material.

### Topics

In the two-hour block of Emotional Survival training that PERF observed, which was the second of the two blocks into which the training was split, the curriculum emphasized the need to manage stress, cynicism, anger, and burnout. The training began with a discussion of Dr. Gilmartin's book, *Emotional Survival for Law Enforcement* and a discussion among the new officers about how they have changed since entering the academy. Recruits were asked to identify different coping strategies such as engaging in physical activity, talking with friends and family, investing in hobbies, and using the resources of the Wellness Unit. The instructor also discussed how hypervigilance and repeated exposure to critical incidents can induce symptoms of PTSD. Warning signs of stress such as social isolation, infidelity, and procrastination in off-duty decision-making were also presented.

The training also addressed the leading causes of death among police officers, including heart disease and suicide. The importance of physical fitness and regular exercise to mitigate these risks is stressed. The training concluded with the recruits dividing into small groups to discuss the symptoms and long-term effects of stress and anger, followed by suggested coping strategies.

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<sup>189</sup> During the period of PERF's observation of the SDPD's wellness program, the Emotional Survival training was four hours in total and recruits were not required to read Dr. Gilmartin's book. That has now changed: The training is six hours in total, and recruits are required to read the book and be tested on it.

<sup>190</sup> Dr. Gilmartin is the author of *Emotional Survival for Law Enforcement: A Guide for Law Enforcement Officers and Their Families*.

## Format

This two-hour block of Emotional Survival training was interactive and centered on group discussions. The instructor used a conversational tone, shared her own “war stories” from patrol, and asked questions to elicit participation from the class.

## Psychological Preparedness Training for New Officers: (one full day immediately after graduation from the academy)

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Since we’ve had the Wellness Day, new recruits are much more likely to come in and use psychological services.

— *Dr. Jolee Brunton, Focus Psychological Services*

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The Wellness Unit began offering its 10-hour Psychological Preparedness Training for New Officers, known informally as its Wellness Day, in 2014. The goal of the Wellness Day, which includes officers and their families,<sup>191</sup> is to set realistic expectations about the emotional impact that police work may have on officers<sup>192</sup> and to underscore the importance of wellness and utilizing wellness services to long-term career success. The Wellness Day gives help service providers an opportunity to reach officers’ family members, familiarize them with the wellness services the department offers, and establish direct lines of communication with officers’ loved ones.

## Topics and format

The Wellness Day is divided into two parts.<sup>193</sup> During the first half of the day, officers and their families are separated. They are brought together in one large group for the second half of the day. As Sergeant Rivera explained, the day is split like this for a few reasons. “For officers it’s a 10-hour training day and a work day, but that’s too long for family members to commit to,” he said. “Also, there are certain things that we discuss with our officers and some language that our presenters use when talking about the trauma they’ve experienced and their utilization of services in a way that we might have to tone down if

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<sup>191</sup> Specifically, family members older than 15 years are encouraged to attend.

<sup>192</sup> SDPD, *Wellness Unit Operations Manual*, 5.

<sup>193</sup> See appendix G for sample agenda.

family members were present. When we bring everyone together, we focus on that connection between officer and family, so we can accomplish everything we need to with the families in half a day.”

Focus facilitates the training, which includes presentations from help services providers (such as the Wellness Unit and police chaplains), stories from members of the department who have experienced significant trauma or personal crises<sup>194</sup> and who used help resources, and stories from the families of current department members.

### Effective Interactions training: (two full days after field training)

The longest single block of training that the Wellness Unit provides, lasting two days, is Effective Interactions training, which is mandatory for all new officers. The goal of the training is to help officers develop their emotional intelligence to make them more successful in their work and better able to manage the stressors associated with policing.

The Wellness Unit developed the initial iteration of its Effective Interactions training in partnership with Dr. Daniel Blumberg, a police psychologist who is developing strategies for agencies to prevent and respond to police misconduct. Training programs such as the SDPD’s are a critical part of prevention efforts and give officers tools to be successful.

The Wellness Unit offers Effective Interactions training immediately after officers complete their field training. This timing is intentional, explained Sergeant Rivera. “We wanted them to have some experience before doing this training,” he said, “so that they didn’t consider it an extension of the academy and so they can apply some of their experiences and stories to the training to make it more real for them.”

### Facilitators

The Wellness Unit facilitates Effective Interactions training in partnership with Focus and senior members of the department who are involved in academy training.

### Day one: Topics and format

During the Effective Interactions training that PERF observed, the first day of training was centered on a discussion of emotional intelligence and included presentations, videos, group discussions (large and small), and breakout exercises. Facilitators arranged the room in clusters rather than classroom style to encourage discussion and participation.

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<sup>194</sup> SDPD, *Changing Organizational Culture*.



## Anonymous polling: Emotional intelligence

The day began with anonymous, real-time polling of the new officers: Questions were posed on a screen at the front of the room using an online polling program, officers responded using their phones, and the results were captured and displayed. The facilitator put the following questions to the class, asking them to identify a percent range in which their skills fall:

- What is your proficiency with firearms today?
- What is your proficiency with the Emergency Vehicle Operator Course (EVOC)?
- What is your proficiency in defensive tactics?
- What is your proficiency in emotional intelligence?

While most officers rated their skill levels for the first three questions as high, they rated themselves lower in emotional intelligence. This was expected; the purpose of this exercise was to demonstrate to new officers that emotional intelligence is a skill that they need to develop in order to be successful police officers. As one facilitator said, “We don’t have a qualification phase to test your emotional intelligence. Your qualifications phase for this is when you’re on the street every day interacting with the community.”

Including a discussion of the science of emotional response, said retired Assistant Chief Sarah Creighton, helps officers to understand why it is important. It is not unusual for people to respond badly to stressful situations. “We need officers to understand that humans are wired in a certain way and how to work with it,” she explained. “The science gives us permission to not feel badly, but rather to understand the ‘why’ and how to work past it.”

The remainder of the morning on the first day of training was split among

- presentations on topics such as the core components of emotional intelligence; the science of emotional response to stressful situations; and the challenges that police face in engaging with the community;
- videos of officers engaging with community members (some positive, others negative), followed by facilitated small-group discussions of the videos and then a debriefing with the entire training class;
- group scenarios in which the class acted out positive and negative versions of the same community interactions (such as a traffic stop) and discussed the outcomes.

The latter half of the first day was dedicated to interactive breakout sessions that demonstrated the effects of stress, exhaustion, and hypervigilance on the mind and body. Then, students were presented with tools to mitigate these effects in the course of their duties. The class was divided into five groups, which rotated among stations at which facilitators discussed one of five topics:

1. Self-awareness
2. Self-management
3. Social awareness
4. Relationship management
5. Communication with peers

At the self-management station, for example, the facilitator asked the officers to do 20 burpees (a strenuous exercise routine) and then attempt to thread a needle. The purpose of this exercise was to demonstrate the effect that physical exertion and adrenaline have on fine motor skills, and how fitness and stress-management techniques like tactical breathing can improve officers' performance in the field.

## Day two: Topics and format

The second day of Effective Interactions training was dedicated entirely to five interactive scenarios, performed by community volunteers and facilitated by sworn SDPD members. Some of these SDPD members volunteer; others were recruited by the Wellness Unit. "What we look for is someone who has a history of community engagement and outreach," said Sergeant Rivera. "We also want people who have teaching experience."

### Community volunteers

The Wellness Unit recruited its community volunteers from a variety of sources, including the Civilian Complaint Review Board; clergy members; and CRISIS, a civilian crisis response team. This community involvement is critical because it gives community members an opportunity to contribute to and learn more about their police department while giving new officers a chance to engage with community members in an educational setting.

## Scenarios

The class was divided into five groups, which rotated among the following five scenarios:<sup>195</sup>

1. Responding to a large party
2. Parking in the red zone outside a 7-11 to take a break and being confronted by a community member
3. Responding to a disturbance call involving two community members
4. Stopping a jogger running late at night in an area where car break-ins have been reported
5. A traffic stop

Every officer (or pair of officers, depending on the scenario) went through each exercise, one by one. The group members who had not yet completed the scenario were kept out of sight and hearing so that they were not able to prepare for the scenario before going through it themselves. Officers were told not to talk about the scenarios with one another on their breaks.

After each officer completed the scenario, the community members shared their thoughts about the interaction, and the facilitators provided constructive feedback. Officers who had completed the scenario then remained nearby to observe the other members of their group and learn from the feedback that they received as well.

While the scenarios were in progress, the Wellness Unit sergeant rotated among them, observing and sometimes modifying the scenarios to provide the greatest learning opportunity for officers. (These modifications might include asking a community member to be more confrontational, for example, or changing the facts of a scenario to explore different responses.) Floating among scenarios also afforded the Wellness Unit sergeant the opportunity to observe the new officers and identify and address any problematic behaviors.

## Advanced Officer Training (AOT)

In addition to its training for new officers, the Wellness Unit also delivers a half-day wellness module during the department's week-long Advanced Officer Training (AOT). The wellness module covers the following topics:

- Leadership
- Police suicide statistics
- The importance of maintaining a balanced life
- Coping skills and techniques

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<sup>195</sup> See appendix H for the scenarios.

- Retirement planning
- Anger management
- Substance abuse awareness and prevention

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It can be a tough group but humor is really helpful in getting through to people. You reach people you never thought you would. We're often approached afterwards by people who ask us to check in on their friends and colleagues.

— *Sergeant Ed Zwibel, San Diego Police Department*

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Videos were integrated into the module that PERF observed, including a video about the dangers that alcohol can pose to an officer's career and how it is incumbent upon members of the department to ensure that colleagues do not put themselves and others in danger because of alcohol. The video was shot and edited by SDPD members with SDPD members acting roles in it.

Interactive exercises were also an important component of the training. For example, Dr. David Bond, a former police captain and current police psychologist with Focus, asked the class to write down what their ideal retirement looked like and who they would like to have with them in their retirement. Then he collected the responses and read them aloud, using them to launch a conversation about what the officers could do in the present to achieve their retirement goals and the role that wellness plays in securing their future.

## **Educational programming tailored to emerging issues**

The Wellness Unit responds to emerging trends at the SDPD, creating programming as needed to fill gaps and address employees' concerns.

### **Series for Growth: Training for civilian supervisors**

One such program, created in 2017, is the Series for Growth, which is intended for civilian supervisors. "I discovered that there was a lot of conflict in the ranks on our civilian side," Assistant Chief Albrektsen said. "When we examined it in detail, we believed supervisory mentorship and training could be beneficial."

To address this, Assistant Chief Albrektsen and the Wellness Unit developed a series of classes designed to improve civilian managers' communication and leadership skills. "We've put together a management academy for them, which covers everything from management theory to the practical conflicts that they're encountering," Albrektsen said. Attendance is voluntary, and the class is held in the middle of the day to make it as easy as possible for department members to attend.

According to Dotta, the benefits of the Series for Growth extend beyond skill building. “It shows civilians they’re a valued part of this organization,” she explained. “It shows that the SDPD cares about all of us.”

## Stand-alone workshops

In addition to developing new, long-term training programs, the Wellness Unit also organizes stand-alone educational opportunities. The topics of these workshops are suggested by department members or are identified by the Wellness Unit in response to emerging trends. Past workshops have discussed financial planning, retirement, healthy eating, and sleep hygiene. The Wellness Unit identifies outside experts to make presentations and publicizes the workshops through the department listserv and the Wellness newsletter.

In identifying locations for these meetings, retired Assistant Chief Creighton said, the Wellness Unit often needs to think creatively. “We don’t have a budget for renting facilities,” she said, “so if it’s a big training, we ask our community partners if they have space we can use for free. Churches are great, for example.”

## Promising practices: Training to build a culture of wellness

- Draw upon vetted external experts, such as academics and psychologists, to develop wellness-related training.
- Include an explanation of the science of emotional wellness and psychology in this training.
- Develop a plan for reaching new officers immediately with wellness-related training, which may include the following activities:
  - Providing them with information about wellness services before they begin the academy
  - Incorporating a wellness module into academy training
  - Delivering a wellness training class after the academy
- Involve officers’ loved ones in wellness training and awareness-building activities. For example, host a family wellness day after officers graduate from the academy to familiarize officers’ loved ones with available wellness services and to normalize the use of wellness services.
- Use scenarios, discussions, exercises, and other interactive techniques in delivering wellness training.
- Include a wellness module in advanced officer training.

- Tie wellness to career advancement by making awareness of wellness issues a requirement for promotion—e.g., members of the department must read and be tested on *Emotional Survival for Law Enforcement* to be promoted to any supervisory position.
- Create educational programming such as stand-alone workshops or ongoing brown-bag round tables that addresses emerging issues in the department. Examples of topics include sleep hygiene, leadership skills, or financial planning. Identify and involve outside experts to deliver presentations during these workshops as appropriate.
- Think creatively when looking for meeting spaces in which to hold training and educational programming at low or no cost. For instance, consider reaching out to partners such as faith-based and community organizations to see if they have available facilities.

# Conclusion

Unaddressed physical and mental health issues can take a toll on officers both on and off duty. As a result, law enforcement agencies should proactively promote officers' wellness through innovative programming. Because personal wellness is multifaceted, promoting wellness requires an inclusive and holistic approach. Addressing wellness is not limited to simply improving physical fitness or offering psychological counseling services. Although these are crucial components of wellness, agency leaders should consider other important topics such as promoting financial health, improving nutrition, and extending support to family members.

Implementing a wellness unit or developing wellness services is not a one-size-fits-all endeavor. Agencies must tailor their wellness initiatives to meet their specific needs. Ask department members what their wellness-related concerns and issues are and build programming around those topics. Also, engage with external partners to expand expertise and consolidate resources. Developing partnerships with academics and other wellness experts ensures that wellness programming is informed by best practices. Collaborating with help service providers and representatives from other law enforcement agencies also allows for the sharing of resources and access to wellness services across agencies.

One of the most important lessons from the case study of the SDPD's wellness initiative is that wellness programs only work when the members of the department are invested in them. "The biggest single piece of advice that I have for other agencies is that people want to feel like they're co-creating the wellness program," said retired Assistant Chief Creighton. An SDPD officer expressed a similar sentiment, saying, "This is a program for officers, and it's officers who need to sell it. I don't need my captain to sell me on it, I need my partner to."

Achieving a high level of acceptance of wellness programs requires time, patience, and persistence. "It will take a long time, even if you have great ideas, because you have to break down the stigma that's associated with seeking help," said Sergeant Rivera. Normalizing wellness within the agency will reduce the stigma associated with seeking help. Wellness providers and programs should be visible in the agency to encourage officer engagement and increase the use of wellness services. Build awareness through active internal outreach. Promote wellness initiatives by presenting at roll call, offering training and education sessions, and producing written materials (e.g., newsletters, brochures, and written announcements) to publicize services and events.

When conducting outreach to encourage use of the wellness resources, agencies must remember that confidentiality is paramount in establishing trust and legitimacy. Building a reputation of trust takes time and is done by respecting confidentiality. A clear confidentiality policy should be publicized and adhered to absolutely. In addition, internal and external wellness providers should explain confidentiality guidelines to department employees prior to offering services.

The results of an internal SDPD survey issued to department members two years after the Wellness Unit's inception demonstrate that these strategies work. Not only did a majority of respondents say they had heard about the services offered but 70 percent also felt that the stigma associated with asking for help was decreasing, and 79 percent said that they would feel comfortable walking into the Wellness Center regardless of the reason for their visit. Focus psychological services also reported a significant increase in the use of counseling services since the creation of the unit. These outcomes reflect a broader culture change facilitated by the Wellness Unit's devotion to normalizing wellness and destigmatizing seeking help.

Another important takeaway for agencies just getting started is that to effectively promote the health of department members, wellness must be embedded within the culture of an agency. An agency-wide commitment to wellness relies on the support of every employee. As such, wellness services and resources should be extended to all department personnel. Exposure to trauma is not limited to sworn employees—civilian employees, such as dispatchers and crime scene technicians, encounter unique stressors and should have access to wellness resources and support systems.

Finally, according to the Reverend Lowrimore, agencies simply need to get started. "People procrastinate, but agencies should start moving on wellness, because officers need someone to talk to and to offer them help," he said. "And there are people like us in every jurisdiction who will help. You just need to ask."



# Summary of Promising Practices

## Building and sustaining a wellness program

### *First steps*

- Conduct a department-wide survey to ask employees what they need and what their primary wellness concerns are. Use that information to guide the development of wellness programming and services.
- Have a clear, written confidentiality policy, communicate it to department members, and adhere to it. Ensure that reporting requirements and exceptions are understood, such as information indicating that an employee may be a danger to himself or herself or to others or that domestic violence or child abuse may be occurring. Some providers, such as clinicians, may be bound by more stringent confidentiality rules than police department employees. Ensure that employees understand these differences and understand the confidentiality rules that bind each category of help services providers.
- Locate your wellness office or center in headquarters or another high-visibility location to reduce any stigma that employees may feel about seeking help.
- Your department's help resources providers should be in close communication with one another and should work together to deliver wellness services. This includes
  - having a common mission and messaging so that they are working together toward a shared wellness goal for the overall good of the department;
  - communicating with each other to coordinate responses to critical incidents.

### *Outreach and engagement*

- Make wellness services visible on your organizational chart to demonstrate their importance.
- Go to officer roll calls to explain wellness services.
- Develop materials to publicize the services and how to access them, including
  - brochures;
  - newsletters;
  - posters.

### *Recruiting*

- When recruiting people for wellness related programs, look for interpersonal skills, not necessarily rank. Wellness unit staff members should be
  - compassionate;
  - nonjudgmental;
  - experienced in the organization;
  - trustworthy;
  - respected by colleagues.

### *Training*

- Mandate that help services providers receive formal training—for example, POST-certified peer support training—to ensure that they have the right tools to be successful in supporting their colleagues.
- Provide opportunities for help services components to train together. This improves team building and ensures that all providers share common messaging and goals.

### *Operations*

- Do not neglect civilian employees. Include them in wellness services as providers and as recipients.
- Wellness providers need to be available 24/7. Crises are not confined to business hours.
- In addition to serving as a resource during regular business hours, wellness services providers should be able to meet with employees seeking help at the times and locations that work best for them.
- To accommodate off-hour requests for assistance, develop an on-call protocol for the wellness services providers and advertise to department employees.
- Assignments for wellness providers should be made based on relationships and trust. Often, whether at the scene of a critical incident or when someone walks into the Wellness Center, an employee wishes to talk to a specific help services provider.
- Establish a policy that allows wellness services providers to deploy help services during or immediately after a crisis without needing to wait for a request from command staff.
- Wellness services providers should check in regularly with those who use their services and follow up on anniversary dates as well.

### *Maintaining the wellness of help services providers*

- It is important to ensure that employees who provide wellness services are themselves in good physical and emotional health. Be aware that assignment to a wellness unit can be stressful, and be mindful of the wellness of help service providers. Adopt policies and protocols to promote their physical and emotional health. Examples include
  - having mandatory psychological service check-ins;
  - allowing wellness workers to exercise while on duty.
- Have a protocol for rotating wellness service providers out of help services roles to prevent burnout. This might include one (or both) of the following:
  - A policy limiting the amount of time that someone can spend in a wellness-related role
  - A form that wellness service providers can fill out and submit without penalty asking to be relieved of wellness-related duties

### *Metrics for success*

- Develop a mechanism for tracking the use of help services, such as the monthly recap report that the SDPD's Wellness Unit compiles every month based on recap sheets (see appendix E) completed by each help services provider.
- Survey the department after wellness services have been in place for a year or more to determine their levels of visibility, employee trust, and use. Modify your approach as needed based on results.

### *Sustainability planning*

- Make it clear that a successful wellness program is good for the financial health of your law enforcement agency—i.e., keeping officers physically and emotionally healthy is a cost-saving measure in the long term—to secure support for wellness programming from city government.

### *External partnerships*

- Draw upon the expertise of people outside of your organization. This might include
  - a nearby law enforcement agency that already has wellness services;
  - academics with experience in wellness-related topics;
  - police psychologists.
- Partner with mental health providers, academics, and other outside experts to refine wellness program methods and initiatives and provide needed services to department members.

## Help services and programs

### *Peer support*

- When creating a peer support program, start small if resource constraints are an issue—the important thing is to start providing the service. Having a formal system for providing peer support and ensuring that helpful services are delivered are critical for department members' wellness.
- Designate someone to be in charge of overseeing peer support activities to ensure that peer support is helpful and is offered according to protocols.
- Wellness services supervisor(s) should interview all applicants to ensure they are suitable for the role.
- Peer supporters should be required to complete formal peer support training. This standardizes the delivery of peer support services and ensures that the services are helpful to officers.
- Have a mechanism in place that allows peer supporters to leave the program at any time (for example, if they can no longer dedicate time to participating).
- Establish protocols for removing peer supporters if there are performance issues.
- Provide peer support services for civilian staff in addition to sworn staff. This includes inviting dispatchers to critical incident debriefings.
- Create a database that includes information about peer supporters, including the topics (such as divorce or death in the family) with which they have experience, so that department members can seek out a peer supporter with a first-hand understanding of their particular needs.

### *Peer support specific to an OIS or in-custody death*

- When recruiting for OIS peer support, look for maturity, credibility, and active listening skills.
- Require a qualifying incident for OIS peer support officers.
- If possible, have a combination of uniformed officers and investigators as peer supporters to provide a wide range of relatable experience.
- Have a mentoring system in place for OIS peer supporters. This includes mentoring in the field: Senior, experienced peer supporters should show up on scene to help new OIS peer support officers fulfill their duties.
- OIS peer supporters should be attentive to officers' basic needs—getting them water and food if appropriate, for example.

- Communicate to the officer involved what the investigation and debrief process will look like in practice (i.e., what their days will be like immediately following and potentially for months) so that they are prepared.
- Follow up with officers after they have slept and have had an opportunity to decompress.
- If the officer involved has an existing relationship of trust with a particular OIS peer supporter who is not the first OIS peer supporter to arrive on a scene, call that peer supporter so that he or she can take over.
- OIS peer supporters should follow up with the officers involved in an incident on a regular schedule and use multiple methods (such as phone calls, text messages, and in-person meetings) to ensure adequate outreach and support is conveyed to the officer.

#### *Chaplains*

- When recruiting for a police chaplain program, look for humility, credibility, and experience.
- Police chaplains should not proselytize.
- Police chaplains should go on ride-alongs to get to know the officers and to build an understanding of their jobs and the stresses and challenges they face.

#### *Psychological services*

- Use multiple forms of communication—including technologies like text messaging and email or online appointment request forms—for making appointments and engaging with department members. This has the potential to dramatically increase use of services.
- Many psychologists do not have an expertise in police psychology. Build psychologists' understanding by directing them to go on police ride-alongs, witness critical incident debriefings, attend lineups, etc. as part of their initial orientation to working with police employees.
- If resources permit, try to ensure that officers seeking psychological wellness services do not have to wait for a significant period of time to get an appointment.
- Be absolutely clear about confidentiality rules.
- Be flexible in where and when you will meet with officers.

### *Alcohol/Substance Abuse Program*

- Designate a qualified department member to serve as the primary coordinator or liaison for substance abuse–related programming and outreach.
- Develop a network of local substance abuse treatment providers, looking specifically for providers who specialize in helping first responders.
- Develop a mechanism for members of the department to donate their leave time, if they would like, to other department members who need inpatient treatment. This system should maintain the anonymity of the person receiving treatment.

### **Training to build a culture of wellness**

- Draw upon vetted external experts, such as academics and psychologists, to develop wellness-related training.
- Include an explanation of the science of emotional wellness and psychology in this training.
- Develop a plan for reaching new officers immediately with wellness-related training, which may include the following activities:
  - Providing them with information about wellness services before they begin the academy
  - Incorporating a wellness module into academy training
  - Delivering a wellness training class after the academy
- Involve officers' loved ones in wellness training and awareness-building activities. For example, host a family wellness day after officers graduate from the academy to familiarize officers' loved ones with available wellness services and to normalize the use of wellness services.
- Use scenarios, discussions, exercises, and other interactive techniques in delivering wellness training.
- Include a wellness module in advanced officer training.
- Tie wellness to career advancement by making awareness of wellness issues a requirement for promotion—e.g., members of the department must read and be tested on *Emotional Survival for Law Enforcement* to be promoted to any supervisory position.
- Create educational programming such as stand-alone workshops or ongoing brown-bag round tables that addresses emerging issues in the department. Examples of topics include sleep hygiene, leadership skills, or financial planning. Identify and involve outside experts to deliver presentations during these workshops as appropriate.
- Think creatively when looking for meeting spaces in which to hold training and educational programming at low or no cost. For instance, consider reaching out to partners such as faith-based and community organizations to see if they have available facilities.

# Appendix A. 2011 Needs Assessment Survey

*NOTE: This appendix has been slightly modified to conform to COPS Office publishing standards.*

This is the survey that the SDPD's Wellness Unit sent to the entire department in 2011 to determine department members' needs and concerns. The Wellness Unit used this information to craft its mission and goals.

## Survey letter

Dear SDPD member:

As you are probably aware, the department recently formed a Wellness Unit. The unit's primary mission is to assist you, the employee. It is our belief that by removing obstacles from your work environment and providing resources to help with preoccupying personal issues, you will better serve yourself, your coworkers, and your family. We recognize that we cannot fix everything, but we are committed to providing feedback to management (City and internal) in the interest of making any changes we can and to provide resources for you for any personal issues that you may want to address. As you are aware, several effective resources have been in place for a long time. In the survey we ask that you rate any services you have used and that you answer questions about your experiences at work and at home that will help us identify services that should be made available. It is our hope to add services as indicated by your responses. We recognize that anything we build should be based on the needs and desires of our employees and volunteers for maximum effectiveness and utilization.

Your participation in this survey is completely voluntary and your individual responses will be held strictly confidential. Your responses will not be traced to you. For those of you completing the survey online, simply submit your completed survey as instructed. To ensure confidentiality for those submitting a hard copy, the Police Officers Association (POA) has provided their ballot bags and will have a volunteer pick them up and deliver the contents to us in mass so that no division or unit will be specifically identified. Demographic information captured on the survey is only intended to assist us in tailoring services to a particular population (i.e., sworn vs. civilian) and may be used to assist University of California San Diego (UCSD) Medical School as pilot data for a future study on law enforcement wellness.

The POA, Local 127, and Municipal Employees Association (MEA) fully support the wellness effort in the police department and have been consulted on the survey and other aspects of the program. A member of each organization will be represented on our advisory board.

If you have any questions about the survey, please feel free to call the Wellness Unit.

## Survey questions

- What personal issues, if any, present a challenge to your general wellness?
  - Finances
  - Controllable health
  - Marital/relationship
  - Time management
  - Care of family/parents
  - Chronic health issues
  - Children
  - Other
- Rate the level of challenge the following job related issues have on your general wellness (1=Not a challenge; 2=Rarely; 3=Occasionally; 4=Significant; 5=Overwhelming):
  - Benefit changes
  - Underappreciated
  - Stress
  - Ignored
  - Layoffs
  - Exposure
  - Wasteful practice
  - Supervisor pressure
  - Turn off work
  - Physical dangers
  - Timelines
  - Other
- Rate the level of interference the following personal issues have had on your ability to focus on your job (1=Not an interference; 2=Rarely; 3=Occasionally; 4=Significant; 5=Overwhelming):
  - Financial
  - Divorce
  - Anger
  - Depression



- Alcohol
- Domestic violence
- Drug use
- Suicide
- Other
- Rate the following personal issues that interfere/or have interfered with your immediate coworkers' ability to focus on their job (1=Not an interference; 2=Rarely; 3=Occasionally; 4=Significant; 5=Overwhelming):
  - Financial
  - Divorce
  - Anger
  - Depression
  - Alcohol
  - Domestic violence
  - Drug use
  - Suicide
  - Other
- What coping mechanisms do you regularly rely on when dealing with stress (circle all that apply)?
  - Exercise/sports
  - Family
  - Vacations
  - Hobbies
  - Friends
  - Faith
  - Shopping
  - Self-medication
  - Meditation
  - Counseling
  - Extreme sports

- Gambling
- Group programs
- Other
- Do you have any of the following?
  - Chronic back pain
  - Sleep disorder
  - High blood pressure
  - Digestive problems
  - Chronic headaches
  - Obesity
  - Frequent colds/flu
  - Diabetes
  - Ulcers
  - Heart disease
- Would you participate in any of the following programs or support groups if they were offered?
  - Incentive fitness
  - Incentive wellness
  - Retirement planning
  - Rec sports league
  - Health fairs
  - Faith-based programs
  - Spousal support
  - Support groups
  - Smoking [cessation]
  - Other

# Appendix B. Wellness Unit Confidentiality Policy

*NOTE: This appendix has been slightly modified to conform to COPS Office publishing standards.*

The acceptance and success of the San Diego Police Department's Wellness Unit will be determined, in part, by observance of confidentiality. It is imperative that the strictest confidentiality of all information learned about an individual be maintained, within the guidelines of the program.

The policy of the San Diego Police Department Wellness Unit is to maintain confidentiality. Communication between Wellness Unit personnel and a peer is considered confidential except for matters that involve the following:

The employee is a

- danger to oneself;
- danger to others;
- suspected child abuse;
- domestic violence;
- factual elder abuse.

The following issues should be reported to the Wellness Unit commanding officer:

- Narcotics offenses (e.g., sales, transportation, cultivation, or manufacturing)
- Felonies (crimes against persons)
- Felonies committed on duty
- When a peer requests, in writing, the information be divulged
- Matters that would jeopardize the safety of the public or other officers

Personnel should keep in mind that communication between Wellness Unit personnel and employees is not privileged conversation under the law, regardless of departmental policy, because peers are not licensed mental health professionals. As a result, courts may require disclosure of this information.

# Appendix C. Wellness Unit Employee Resources Brochure

*The following pages contain the Wellness Unit Employee Resources brochure.*

## OIS PEER SUPPORT

Phil Bozarth  
 Mark Brenner  
 Michael Chinn  
 Anthony Creazzo  
 Blaine Ferguson  
 Linda Griffin  
 Chappie Hunter  
 Quinton Kawahara  
 Chris Leahy  
 Brian Lenahan  
 Nicholas Nguyen  
 Franklin White

Andres Ruiz  
 Tristan Schmotlach  
 Steve Schnick  
 Michael Shiraishi  
 Jeff Sterling  
 Mark Zdumich  
 Patrick Hall  
 Nestor Hernandez  
 Chuck Marciniak  
 Kerry Mensior  
 Kelly Stewart  
 John Thompson

Todd Turner  
 Chris Velovich  
 Terrance Bryan  
 Jeff Gross  
 Robert Heims  
 Kellen Jackson  
 J.R. Pearson  
 Arthur Scott  
 John Sullivan  
 Nathan Whann  
 Travis Whipple  
 Jared Wilson

## PEER SUPPORT

### SWORN

Bernie Colon  
 Geoffrey Burr  
 Desiree Spurlock  
 Kelly Stinnette  
 Anthony Dupree  
 Richard Hinz  
 Mike Miranda  
 Maria Humes  
 Kenneth Impellizzeri  
 Edward Kaszucki  
 Robert Korbecki  
 Andrew Korenkov  
 Lawrence Cahill  
 Jonathan Lowe  
 Michael Brown  
 Chris Luth  
 Corissa Pich  
 Cory Gilmore

Andrea Myers  
 Kimberly Norcia  
 Patrick Murphy  
 Ricky Castro  
 Robert McDonald  
 Victor Rodriguez  
 Paul Salas  
 Pepper Kelly  
 Robert Stinson  
 Jared Thompson  
 Tod Bassett  
 Mariam Sadri  
 Scott Barnes  
 Steve Schnick  
 Al Ambito  
 Charles De La Cruz  
 Lisa McKean  
 Bryan Castillo  
 Nate Parga  
 Meghan Bisesto  
 Eric Portnoy  
 Mario Larrea  
 Nina Medina

### SPOUSES

Patsy Bell  
 Dena Brown

### CIVILIAN

Betty Alvarez  
 Carl Rader  
 Marie Cuvadar  
 Deanna Dotta  
 Jennifer Duffy  
 Laura Manasan  
 Mellissa Santagata  
 Rebecca Spradley  
 Roxanne Cahill  
 Dantelle Schule  
 Nancy Brown  
 Liz Cavanaugh  
 Phet Guiney

## San Diego Police Chaplains

Rev. Christopher Chadwick—Comm  
[chris.chadwick@sanjosecatholicdiocese.org](mailto:chris.chadwick@sanjosecatholicdiocese.org)  
 858-204-1565

Rev. Robert Cobb—Central  
[robcc@mvcf.com](mailto:robcc@mvcf.com)  
 619-300-5020

Deacon Guillermo Valdivia—Southern  
[Guillemovaldivia75@gmail.com](mailto:Guillemovaldivia75@gmail.com)  
 619-289-1796

Rabbi Barney Kasdan—Northern  
[bkasdan@kehilatrael.org](mailto:bkasdan@kehilatrael.org)  
 858-204-2174

Rabbi David Kornberg—Northwestern  
[rabbik@betham.com](mailto:rabbik@betham.com)  
 858-354-2533

Rev. Dale Lowrimore—Western  
[dlowrimore@cox.net](mailto:dlowrimore@cox.net)  
 619-916-9632

Rev. Mike Macintosh—Northwestern  
[mike@horizonsd.org](mailto:mike@horizonsd.org)  
 858-518-5155

Rev. Chuck Price—Eastern/Traffic/GST  
[wixim@cox.net](mailto:wixim@cox.net)  
 619-249-2229

Rev. Herb Smith—Northeastern  
[hsmithc1e@aol.com](mailto:hsmithc1e@aol.com)  
 858-442-6417

Rev. Erin Hubbard—MidCity  
[erinhubbard@cox.net](mailto:erinhubbard@cox.net)  
 619-933-7889

Past. Kendrick Neal—Northeastern  
[kneal@fbcmm.org](mailto:kneal@fbcmm.org)  
 703-508-7017

## San Diego Police Department Chaplain Program

*Mission of Chaplains: To provide a presence of spiritual and emotional care and counseling for all SDPD personnel.*

# SAN DIEGO POLICE DEPARTMENT

# WELLNESS UNIT



**FOCUS Psychological Services**

FOCUS offers confidential counseling services to all San Diego Police Department employees-sworn, civilian, retired, and their dependents are eligible. The following is a list of available counseling: Individual Counseling, Marriage/Relationship Counseling, Child/Adolescent Counseling, Family/Step Family Counseling, Post Traumatic Incident Counseling, Habit Control (Weight/smoking), Alcohol/Substance Abuse Counseling, Stress Management, Anger Management, Treatment of depression/anxiety, Grief resolution, Divorce Counseling.

(858)565-0066 [www.focuspsychservices.com](http://www.focuspsychservices.com)

**A.S.A.P. (Alcohol Substance Abuse Program)**

Trained counselors with experience in 12-step recovery programs. Available to provide alcohol/substance abuse information, counseling, training and direct assistance to all department employees and their families. Access to closed AA meetings for first responders.

Deanna Dotta (Communications)  
619-857-5005 [ddotta@pd.sandiego.gov](mailto:ddotta@pd.sandiego.gov)

Mark Zdunich (SWAT Armory)  
619-972-4589 [mzdunich@pd.sandiego.gov](mailto:mzdunich@pd.sandiego.gov)

**ADDITIONAL RESOURCES**

Medical Assistance  
(619) 531-2124

Employee Assistance Program (EAP)  
(619) 236-6373

SDPOA  
(858) 573-1199

SDMEA  
(858) 300-3888

AFSCME17  
(619) 640-4939

**Wellness Unit Services**

- **Resource Identification**-we will help link you to a resource that best fits your needs whether in answer to a personal or professional issue.
- **Check on employees**-we will call anyone you are concerned about but may not feel comfortable calling and let them know the services we have available. Your request will be kept completely confidential at your request.
- **Provide answers when we can.** We will check on the status of any personnel investigation you may be under and provide you with a status update or rough timeline of when you can expect to hear from the investigator. We will not, however, insert ourselves into the details of the investigation or make recommendations to the investigator about how to handle the investigation.
- **Provide educational seminars and workshops.** We will facilitate workshops around the issues that are important to your well-being and health.
- **Share important Law Enforcement studies and collaborate with academic institutions** willing to partner on studies important to our department.
- **Rally immediate debriefing and intervention resources** for all employees impacted by significant critical incidents, officer deaths, or other spontaneous events where employees would benefit from a variety of help resources being immediately available.
- **We will continually recruit and train prospective peer support personnel,** and provide coordination for the department's chaplain services.
- **Identifying and enhancing existing resources**
- **Developing and providing wellness education**
- **Collaborating with academic institutions on innovative LE studies**
- **Developing partnerships with health and wellness providers**
- **Staying abreast of wellness program best-practices through research**
- **Developing and administering a fitness and preventive health incentive program**
- **Serving as an advocate for employees enduring personal or professional difficulties**

**SAN DIEGO POLICE DEPARTMENT**  
**WELLNESS UNIT**

**Sgt. Ed Zwibel**  
Office (619)531-2243  
Cell (619)569-6189  
email: [zwibele@pd.sandiego.gov](mailto:zwibele@pd.sandiego.gov)

**Sgt. Carmelin Rivera**  
Office (619)531-2740  
Cell (619)743-1151  
email: [crivera@pd.sandiego.gov](mailto:crivera@pd.sandiego.gov)

**Off: Marnie Minton**  
Office (619)531-2246  
Cell (619)218-2062  
email: [fminton@pd.sandiego.gov](mailto:fminton@pd.sandiego.gov)

**Deanna Dotta**  
Office (619)531-2244  
Cell (619)857-5005  
email: [ddotta@pd.sandiego.gov](mailto:ddotta@pd.sandiego.gov)

**Wellness Unit Mission**

***“The Wellness Unit is committed to removing and reducing interferences to employee wellness.”***

## Appendix D. *Wellness News* Newsletter

This is the August 2017 edition of the *Wellness News* newsletter, which the Wellness Unit creates and distributes to SDPD on a monthly basis.



# SAN DIEGO POLICE

# WELLNESS

# NEWS

AUGUST 2017

VOLUME 44



*A Message from  
Assistant Chief  
Sandra Albrektsen*

### *The Benefits of Donating Blood*



Everyone has their own formula for what works best for them when it comes to health and wellness. One way is donating blood which can benefit you and someone else. Like any other health or wellness program always check with your primary physician to ensure you are a candidate.

For those who can donate blood (studies show fewer than 10% donate) there are huge benefits. According to an article in The Good Life, April 2017, there are some big positive outcomes:

**Strengthening your Heart**-Too much iron can stack up in your body causing people to have an elevated risk of cardiovascular disease and heart attacks.

**Free Check Up**-Before any blood is drawn your vitals are checked. After you give blood, your sample will be tested for West Nile, Hepatitis, and Zika. You will be notified if anything were to come back positive.

**Smile**-Your donation could save as many as three people's lives; everything from premature babies in need of a transfusions, cancer patients mid-treatment or car accidents.

#### **How It Works:**

As soon as you donate your red & white blood cell counts start to drop, this sends a signal to special cells in the kidneys to secrete a hormone (erythropoietin) into the bloodstream.

This hormone travels to your bone marrow where it kick-starts the production of new cells.

Your bone marrow churns out about 2 million red & 115,000 white blood cells every second (pew!), so within a few days or weeks your levels will be back to normal. Most people who are properly hydrated are back to normal within a few hours.

**The Red Cross** makes donating easy by having centers all over the county with weekend and night hours. Where I donate, in El Cajon, I pick my time online, check in, and I'm out within one hour. **Please consider giving on September 19 in Room 213, HQ.**







**American  
Red Cross  
Blood Drive**



**San Diego Police Department & The American Red Cross  
Invite You to Join Forces  
To Deliver The  
Most Successful Blood Drive to Date!**

**WHEN:**

**TUESDAY, SEPTEMBER 19TH  
10:00-4:00PM**

**WHERE:**

**SAN DIEGO POLICE HEADQUARTERS  
1401 BROADWAY, RM 213.**

**Register Online Now With the Red Cross to  
Reserve Your Preferred  
Appointment.**

**Just copy & paste the link below:**

**[https://esibelarecprod.redcrossblood.com/eevents\\_enu/start.swe?  
SWECmd=Start&SWEHo=esibelarecprod.redcrossblood.com](https://esibelarecprod.redcrossblood.com/eevents_enu/start.swe?SWECmd=Start&SWEHo=esibelarecprod.redcrossblood.com)**

# WARNING

THE  
EFFECTS OF NEGLECTING YOUR  
OWN SELF-CARE.



**HYPERVIGILANCE. UNWILLINGNESS.  
BROKEN RELATIONSHIPS.  
DENIAL. ANGER. CANCER. HEART ATTACK.  
HIGH BLOOD PRESSURE.  
PTSD. FEAR. DEPRESSION. SUICIDE.  
POLICING IS NO JOKE. THIS JOB AFFECTS NOT ONLY  
THE OFFICER, BUT THE OFFICER'S ENTIRE FAMILY  
AS WELL.**



**SELF-CARE SHOULD BE YOUR #1 PRIORITY**

## Success Stories ...

### My Story, My Secret

By Steve Willard

Two years ago I weighed 301 pounds. Now I'm 181. As one might guess one of the most asked questions I get is, "how'd you do it?" Stay tuned, you may not like the answer.

According to the National Institute of Health, more than 2-3 adults are overweight or obese. More than 1-20 adults have extreme obesity. Now for something really scary. There aren't a lot of obese senior citizens because the associated illnesses have killed them. Those who are alive are often on a slew of medicines.

Are you overweight? Men, if your waist size doubles to less than your height then you're fine. At 6 feet tall I'm healthy. Two years ago I needed to be 7 foot 3.

Now for my secret:

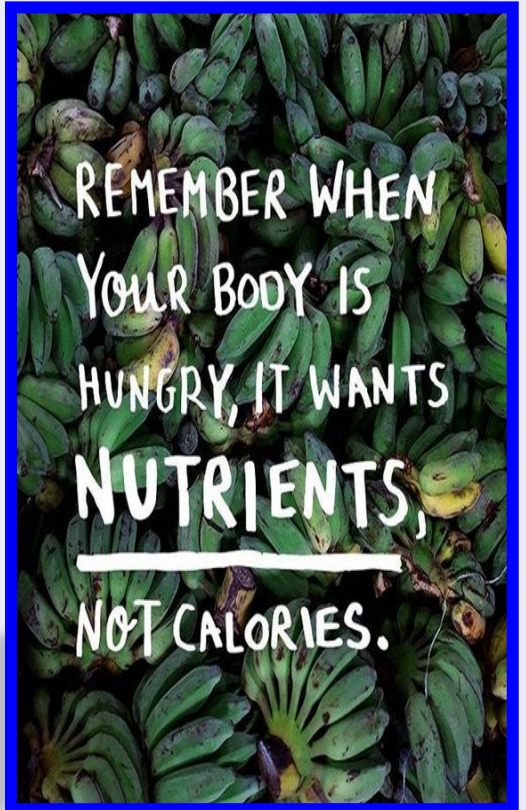
1. You're in for a long journey of hard work. Weight loss isn't easy.
2. Come to terms with why you're fat. For me that meant some counseling.
3. No more lies. Once, when I had to physically compete with some coworkers, I feigned injury so they wouldn't see I couldn't keep up. In the end I was only making an idiot out of myself.
4. No more diets. Diets are temporary plans to deliver temporary results. You need a new way of life. For me I eliminated sugar and meals after 6 pm. My portions were cut in half. When I deviate I add a half an hour to my next workout.
5. Exercise. Then, as you lose weight, dump your bigger clothes. This eliminates the scenario when you discover you pants are too snug so you grab the bigger pair.

The five rules caused my weight to drop. When my pants became too big they went to the Goodwill. I was there so often they started greeting me by name. The same at Nordstrom. I spent a fortune on clothing but the compliments came rolling in. That helped with motivation.



*CONTINUED ON NEXT PAGE*

Today, I'm completely different physically, mentally and emotionally. I feel great! I can run the P.A.T. in under 3 minutes and I can run several miles without being winded. When I first began my journey I couldn't do 3 pushups. I can now easily do 40. Sit ups are almost double my pushup count. Please don't take this as bragging. It's not. It's simply my story of sacrifice and it's what's kept me from allowing the weight to return – something that happens 85% of the time with diets. If you need to lose weight please look at my journey like this: If an average guy like me can do it, so can you. Good luck. I hope this helps. Feel free to contact me if you need more specific advice. We're all in this together.



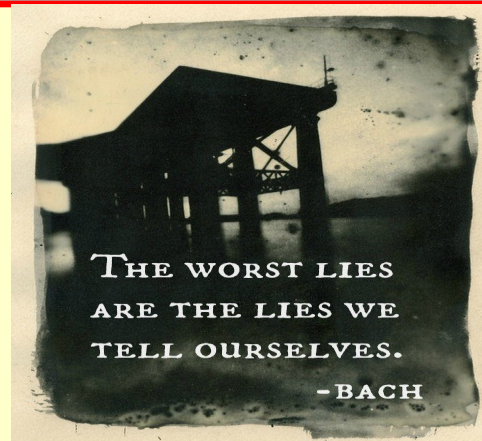




# The Lies We Tell Ourselves – Barriers to Wellness

Sgt. Carmelin Rivera, Wellness Unit

*Part one of a two-part series*



One of the most powerful things we can do is teach people that it's okay to be human. The trauma, both physical and emotional, that police officers and civilian/professional staff encounter in this profession tends to be much greater than that of the average citizen. We have made great strides as a profession to diminish the impact of all the junk and messiness that we see, feel, and encounter daily at work, compounded by what we experience in our personal lives. We are still slowly unmasking many of the underlying causes of trauma that we experience in this profession. While we are no different than any other people outside our profession, those that experience life without ever walking in our shoes only see the things that we see in their nightmares, where they have the option to wake up and horror immediately vanishes. We have tendencies to cope in negative ways at alarming rates. It is impossible to walk through years of this profession and come out unscathed. It's difficult to walk in the shoes of police officer or civilian employee from our profession.

We also need to recognize what our civilian employees encounter. Consider who are the individuals in our department who receive the emergency calls and dispatch police officers to critical incidents? Who are the employees who are dealing with angry citizens who want their impounded property back? Who are the members in this department who are racing against time to identify a DNA profile to help investigators identify a serial rapist? Who is photographing and collecting the evidence from horrific crime scenes? Who is dealing with difficult customers wanting access to their police arrest records? These questions are just a sampling of the types of questions we need to ask ourselves to help us recognize the staff that supports much of our daily activities as police officers and help serve our communities.

Now let us recognize the lies we tell ourselves that are barriers to the wellness of all employees. In this newsletter, we identify the first five lies that end up insulating us from the truths we need to achieve wellbeing in this chaotic career.

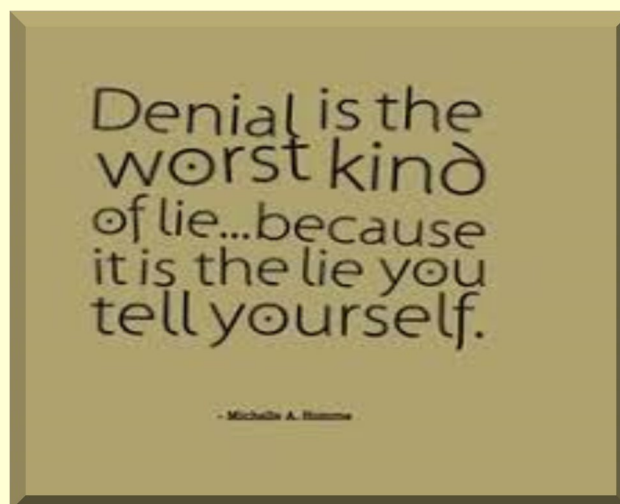
**1. I am in control.** In this profession we are trained to always be in control...of everything. When we lose control that is sign of weakness, so we tell ourselves that we can master everything. Instead, we should recognize that there are many things out of our control, and we spend too much time trying to gain control over them that we often fail at the most basic things. Focus on the things you can control and let the rest go.

**2. I can do this on my own.** We train to handle incidents as a team in the field, but often fail miserably when we try to tackle emotional survival by ourselves. No one does anything alone. No matter what accomplishments you have achieved, you didn't do it completely on your own. It takes a great team, a wonderful group of talented people to make an impact. Ask yourself who has contributed to your success? Emotional wellness is a team activity and this department has a Wellness Unit, FOCUS psychologists, chaplains, and peer supporters to help you navigate through whatever you are going through. *(continued on next page)*

**3. If I ignore it, it will go away.** Many employees ignore the root causes of many of their challenges. Some individuals ignore their injuries and force themselves to work when they should be on light duty. They excessively drink alcohol because it helps them deal with their pain or emotional trauma, ignoring the cause of the trauma to begin with. Most of the time what we ignore grows bigger and becomes even more cumbersome. Whatever is happening, seek resources to help you deal with it. You can't change what you refuse to confront.

**4. Everybody does it.** We are influential people and we often model the way for others. We know the difference between right and wrong, no matter what anybody else says or does, yet we justify our actions based on others' behaviors. If we are at a bar or someone's home with other employees and recognize that someone might have had too much to drink, the appropriate action to take is to not let that employee drive away drunk. Yet, we reflect on what we believe everyone else does in these situations (in the past it has been to not be confrontational and let the person drive away) – so we allow the person to drive away. We need to model the correct way for each other and do what we know is right.

**5. Emotion is weakness.** This is where we have made some breakthrough as a profession – identifying that being emotional is being human. Yet many of us remain in the Dark Ages of policing and we continue to lie to ourselves, proclaiming – at least publicly – that showing emotion should be banned from this profession. We lie to ourselves that emotion gets in the way of safety. Nobody in our profession will argue that when we are dealing with the public and handling critical incidents, our professional face should be on display and we should not allow our emotions to take over. However, how do we cope afterwards when those emotions creep up – while we are in bed trying to sleep; when we are asleep; in our relationships; with other co-workers? Sharing our pain, fears, and emotional discomfort and making ourselves vulnerable is not comfortable – and not safe for many of us – so we hold ourselves beyond emotion to appear strong. Getting past this lie that we tell ourselves is difficult for many. Accepting that being emotional is human is a critical step to acknowledging that we may not be in control as we think we are, we may need others to help us deal with the anguish, we have been ignoring the best practices that will actually make us address the real issues that we are dealing with, and we can now stop rationalizing our poor coping mechanisms.





**ALL** AREA STATIONS AND HEADQUARTERS HAVE FITNESS ROOMS.

HQ HAS **A LOT OF STAIRS TO WALK UP AND DOWN,** (THEY DON'T GET STUCK UNLESS YOU STOP).



A CLASS AT HQ IN ROOM 213 ON TUESDAY, WEDNESDAY AND THURSDAY FROM 1630-1730. THIS A IS CONDITIONING CLASS USING CALISTENICS & CARDIO. CONTACT BERNIE IN RECORDS FOR FURTHER INFO AT 619-531-2949.

RIGHT ACROSS THE STREET AT **INVICTUS CROSSFIT** IS A CLASS CALLED "**BURN 30**". FROM 12-1230 MONDAY, WEDNESDAY AND FRIDAY. WE ALREADY HAVE EMPLOYEES WHO ARE PARTICPATING! VIVIAN HAMMI FROM DATA SYSTEMS IS A PARTICIPANT AND LOVES IT! YOU CAN CALL HER FOR INFO AT 619-531-2650.

**\*\*\*\*\* PLEASE LET US KNOW IF YOU HAVE ANY FITNESS CLASSES OR INFO YOU WOULD LIKE TO SHARE FOR OTHER EMPLOYEES\*\*\*\*\***

**RESOURCES:**

**5 Minute Workout:**

<https://thegoddess.com/wp-content/uploads/2017/04/29-Office-Workout.jpg>

**5 Minute Workout:**

<https://www.youtube.com/watch?v=eR1AWOp6t30>



## ***ADDITIONAL FITNESS RESOURCES & EVENTS***

**24 Hour Fitness:** <https://citynet.sandiego.gov/employee-discounts/24hourfitness>

**AquaVie Fitness + Wellness Club:** <https://citynet.sandiego.gov/employee-discounts/aquavie>

**Balanced Fitness & Health:** <https://citynet.sandiego.gov/employee-discounts/balanced>

**YMCA of San Diego County:** <https://citynet.sandiego.gov/employee-discounts/ymca>

**In addition**, don't forget that our Park and Recreation Department offers 55 recreation centers, 13 pools, five skate parks and many other recreational facilities that serve all ages, abilities and income levels.



**ITEMS TO KEEP IN  
YOUR GEAR BAG:**

**1. DISINFECTING WIPES  
(FOR DIRTY STEERING  
WHEELS)**

**2. LEATHERMAN TOOL**

**3. NIGHT VISION  
MONOCULAR**

**4. VICKS TO PUT  
IN YOUR NOSE WHEN  
YOU SMELL  
SOMETHING BAD.**

**5. YOUR OWN FIRST AID  
KIT FILLED WITH WHAT  
YOU WANT.**

**6. TYLENOL**

**7. TUMS**

**8. \$10—\$20.00  
Emergency Cash**

**9. Hand Wipes**

**10.Extra Gloves**

# Good Reads

## **1. *ARMOR YOUR SELF***

*How To Survive a Career in Law Enforcement*

Written by John Marx.

The author wrote this book to offer guidance and support for officers and their families.

Author John Marx has given out a coupon code to discount the book from \$24.95 to \$20.00.

Code is: AYSF&F2017

Available at <http://www.CopsAlive.com>

This book is highly regarded by  
**Lt. Col. Dave Grossman Ph.D.**

The author of  
**On Killing**

*and*

**Kevin Gilmartin, Ph.D.**

Author of

**Emotional Survival for Law Enforcement**

## **2. *CHASING RELEVANCE***

6 STEPS TO UNDERSTAND,

ENGAGE, AND MAXIMIZE

NEXT-GENERATION LEADERS IN THE WORKPLACE

Written by Dan Negroni

## SDPD WELLNESS RESOURCE LIST



444 CAMINO DEL RIO SOUTH,  
SUITE 215

SAN DIEGO, CA 92108

• PHONE: (858) 565-0066

• FAX: (619) 291-4662

EMAIL:

[INFO@FOCUSPSYCHSERVICES.COM](mailto:INFO@FOCUSPSYCHSERVICES.COM)

**SDPOA** 858-573-11999 [sdpoa.org](http://sdpoa.org) **SWORN MEMBERS**

**SDMEA** 858-300-3888 [sdmea.org](http://sdmea.org) **CIVILIAN MEMBERS**

### SDPD CHAPLAINS

CHAPLAIN HERB SMITH (858) 442-6417  
CHAPLAIN DALE LOWRIMORE (619) 916-9632  
CHAPLAIN CHUCK PRICE (619) 249-2229

<http://sdpd/documents/chaplainpics/pdf>

**SDPD HUMAN RESOURCES:** 619-531-2126

**SDPD MEDICAL ASSISTANCE:** 619-531-2124

CITY OF SAN DIEGO  
EMPLOYEE ASSISTANCE PROGRAM  
(FOR ALL CITY EMPLOYEES)

619-533-3460

<http://citynet.sannet.gov/riskmanagement/eap>

## YOUR WELLNESS STAFF:

SGT. CARMELIN RIVERA  
(619) 531-2740

TUES-FRI 0700-1700

[CRIVERA@PD.SANDIEGO.GOV](mailto:CRIVERA@PD.SANDIEGO.GOV)

OFFICER DANI RESCH  
(619) 531-2246

TUES-FRI 0600-1600

[DJACKSON@PD.SANDIEGO.GOV](mailto:DJACKSON@PD.SANDIEGO.GOV)

911 DISPATCHER DEANNA DOTTA  
(619) 531-2244

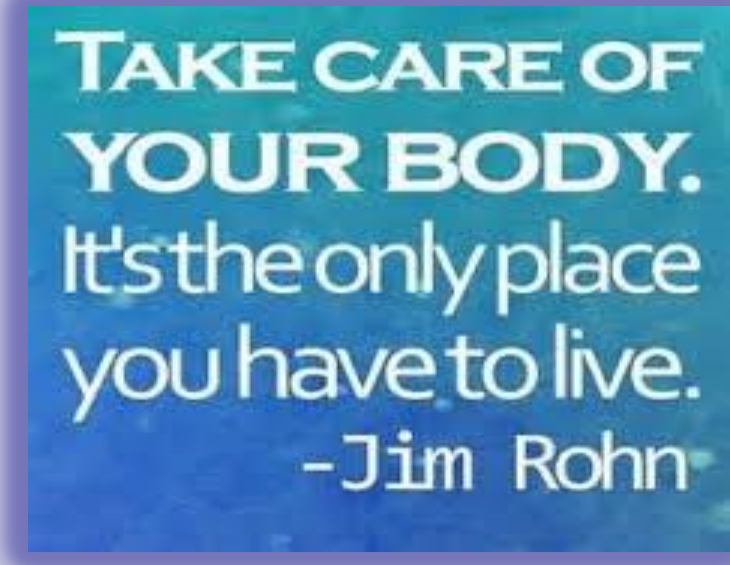
MON-THURS. 0800-1800

[DDOTTA@PD.SANDIEGO.GOV](mailto:DDOTTA@PD.SANDIEGO.GOV)

ALCOHOL & SUBSTANCE ABUSE PROGRAM  
COORDINATOR

[thewellnessunit@pd.sandiego.gov](mailto:thewellnessunit@pd.sandiego.gov)

**WE WELCOME YOUR COMMENTS AND SUGGESTIONS.**



**TAKE CARE OF  
YOUR BODY.**  
It's the only place  
you have to live.  
-Jim Rohn

# Appendix E. Sample Recap Sheet

*NOTE: This appendix has been slightly modified to conform to COPS Office publishing standards.*

This is an example of the log that SDPD help services providers use to keep track of and report their wellness contacts.

SAN DIEGO POLICE DEPARTMENT

Peer Support Program and Alcohol Substance Abuse Program

Name:

Month/Year:

“X” the box unless otherwise noted.

<b>Department Member</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
Sworn										
Civilian										
Family member										
Male										
Female										
<b>ISSUES:</b>										
Alcohol abuse										
Bereavement										
Career concerns										
Children / child care										
Coworker										
Critical incident / trauma										
Dating										
Depression										
Disability										
Disciplinary issues										
Financial concerns										
Marital										
Medical/Health problems										
Parents										
PTSD										
Retirement concerns										
Spiritual / Religious										
Stepchildren										
Stress issues										
Subordinate										
Substance abuse										
Suicide										
Supervisor										
<b>Walk-in</b>										
<b>Old case</b>										
<b>New case</b>										
<b># Personal contacts</b>										
<b># Phone/email contacts</b>										
<b># Referrals</b>										
<b>Total hours of contact</b>										

# Appendix F. 2013 Wellness Survey

*NOTE: This appendix has been slightly modified to conform to COPS Office publishing standards.*

This is the survey that the Wellness Unit created and administered in 2013 to gauge the effectiveness of their programs and their organizational visibility.

## Wellness Unit Services Survey

Since the inception of the Wellness Unit in July 2011, I have heard about the services offered via:

- |  |              |
|--|--------------|
| 1. Advanced Officer Training             | yes___ no___ |
| 2. Supervisor's update training          | yes___ no___ |
| 3. Civilian Resiliency Training          | yes___ no___ |
| 4. Unit or division meetings             | yes___ no___ |
| 5. Patrol Line-up or supervisors meeting | yes___ no___ |
| 6. Wellness Newsletter                   | yes___ no___ |
| 7. Department Intranet                   | yes___ no___ |
| 8. Word of mouth                         | yes___ no___ |

## Resources

I have personally utilized the following service(s) offered by the Wellness Unit:

- |  |              |
|--|--------------|
| 9. Focus   | yes___ no___ |
| 10. Peer Support   | yes___ no___ |
| 11. Chaplains  | yes___ no___ |
| 12. M.A.P. (Member Assistance Program)   | yes___ no___ |
| 13. Biometric Screenings (Kaiser or Sharp)   | yes___ no___ |
| 14. Health and Wellness Lectures<br>(Nutrition, meditation, financial)   | yes___ no___ |
| 15. Guest Speakers<br>(Kevin Gilmartin, David Grossman, Clarke Paris, Jack Enter, Bobby Smith, Robert Douglas) | yes___ no___ |

**Only IF YOU HAVE** utilized the listed services **within the last 2 years** please respond to the following:

## Peer Support

16. I felt my peer support officer was compassionate. yes\_\_\_ no\_\_\_
17. I felt my peer support officer was knowledgeable. yes\_\_\_ no\_\_\_
18. I felt there was value in having an assigned peer support officer. yes\_\_\_ no\_\_\_
19. I felt that the psychological debrief was useful for me. yes\_\_\_ no\_\_\_
20. I felt that the psychological debrief was useful for others involved. yes\_\_\_ no\_\_\_

## MAP (Member Assistance Program)

21. I felt my MAP person was compassionate. yes\_\_\_ no\_\_\_
22. I felt my MAP person was knowledgeable. yes\_\_\_ no\_\_\_
23. I felt my MAP person was interested in helping me with my issues rather than telling me their story. yes\_\_\_ no\_\_\_
24. I felt my MAP person was knowledgeable about resources available to me. yes\_\_\_ no\_\_\_

## Focus

25. I was easily able to get an appointment when needed. yes\_\_\_ no\_\_\_
26. I know how to get in touch with Focus on my own. yes\_\_\_ no\_\_\_
27. I felt the psychologist was compassionate. yes\_\_\_ no\_\_\_
28. I felt the psychologist understood the demands of law enforcement. yes\_\_\_ no\_\_\_

## Chaplains

29. I know and regularly see the chaplain(s) assigned to my unit or division. yes\_\_\_ no\_\_\_
30. I feel comfortable having a chaplain ride with or visit me at work. yes\_\_\_ no\_\_\_
31. It is comforting to me to see a chaplain during the aftermath of a critical incident. yes\_\_\_ no\_\_\_
32. I know how to contact any of our chaplains after hours if needed. yes\_\_\_ no\_\_\_

## Wellness Unit

33. I have contacted the Wellness Unit and asked them to reach out to someone I was concerned about. yes\_\_\_ no\_\_\_
34. I have visited the Wellness Unit on a social call. yes\_\_\_ no\_\_\_
35. I have visited the Wellness Unit to ask for resources or seek assistance. yes\_\_\_ no\_\_\_
36. The resources or assistance provided were beneficial. yes\_\_\_ no\_\_\_



**IF YOU HAVE NOT** utilized the above mentioned services, please answer the following:

- 37. Although I have not utilized a MAP person about any issues, I would if the need arose. yes\_\_\_ no\_\_\_
- 38. I have seen the M.A.P. Profile book at my division. yes\_\_\_ no\_\_\_
- 39. Although I have not utilized Focus about any issues, I would if the need arose. yes\_\_\_ no\_\_\_
- 40. Although I have not utilized a chaplain about any issues, I would if the need arose. yes\_\_\_ no\_\_\_
- 41. I know how to contact any of our chaplains after hours if needed. yes\_\_\_ no\_\_\_
- 42. Although I have not utilized the Wellness Unit about any issues, I would if the need arose. yes\_\_\_ no\_\_\_
- 43. I know of people who have utilized the services of the Wellness Unit. yes\_\_\_ no\_\_\_
- 44. I do/would feel comfortable walking into the Wellness Unit regardless of the reason for my visit yes\_\_\_ no\_\_\_
- 45. I am aware of ASAP. yes\_\_\_ no\_\_\_

### Stigma and Attitude Change

- 46. I feel like the stigma associated with asking for help is reducing. yes\_\_\_ no\_\_\_
- 47. I feel like there is a greater awareness of employee wellness and resiliency building in the department. yes\_\_\_ no\_\_\_
- 48. I feel like there is a lot more discussion about issues like suicide, substance abuse, and other ineffective coping behaviors than two years ago. yes\_\_\_ no\_\_\_
- 49. I trust that if I had a personal issue that was interfering with work or at home I could ask for assistance and receive help. yes\_\_\_ no\_\_\_
- 50. I am: sworn\_\_\_\_ civilian\_\_\_\_
- 51. I am: male\_\_\_\_ female\_\_\_\_

### Optional:

**Division/ Unit** \_\_\_\_\_

**Additional comments or suggestions:**

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# Appendix G. “Wellness Day” Agenda

This is the agenda from the Psychological Preparedness Training for New Officers (known as “Wellness Day”) held on November 4, 2017 for new officers and their loved ones.

# WELLNESS DAY

SATURDAY NOVEMBER 4, 2017

0700-1700

WATER DEPT TRAINING & DEVELOPMENT AUDITORIUM

5510 KIOWA DR., LA MESA 91942

0700-1130: OFFICERS ONLY W/FOCUS AND WELLNESS STAFF:

1. 0730-0900 FOCUS INTRO, BACKGROUNDS, DISCUSSION

0900-0910 BREAK BREAK BREAK BREAK BREAK BREAK BREAK BREAK BREAK

2. 0915-1045 GUEST OFFICER'S SHARING CRITICAL INCIDENT EXPERIENCE

0915-1000

1000-1045

1045-1055 BREAK BREAK BREAK BREAK BREAK BREAK BREAK BREAK BREAK

3. 1100-1130 WELLNESS STAFF/FOCUS

1130-1230 LUNCH BREAK LUNCH BREAK LUNCH BREAK LUNCH

4. 1230-1330-FOCUS W/OFCRS ON PATIO

5. 1230-1330: FAMILY INSIDE WITH WELLNESS STAFF & CHAPLAINS.

1330-1340 BREAK BREAK BREAK BREAK BREAK BREAK BREAK BREAK BREAK

1. 1340-1400 CHIEF

2. 1400-1415 ASAP

3. 1415-1500 GROUP & OUTSIDE INTERACTION (ROCKS & HYPERVIGILANCE)

4.

1500-1510 BREAK BREAK BREAK BREAK BREAK BREAK BREAK BREAK BREAK

5. 1515-1600: MARRIED COUPLE TESTIMONY

6. 1600-1615 FAMILY RESOURCE TEAM

1615-1700: WELLNESS STAFF

# Appendix H. Effective Interactions Scenarios

These are descriptions of the scenarios used during day two of Effective Interactions training for new officers.

## Scenario 1. Large party

Officers respond to a large party in the back yard. The party goers are celebrating a quinceañera and it is now 3:00 a.m. The officers need to make contact with the owners of the residence and use effective interactions skills to diffuse the situation and help shut down the party. This upsets the 15-year-old birthday girl.

## Scenario 2. 7-11 parking

An officer goes to a 7-11 convenience store to take a break from patrol. The officer parks on the red curb outside the store. An adult customer and his/her fifteen-year old son/daughter drive into the 7-11 parking lot and see where the officer parks. The son/daughter is confused because the adult recently received a parking citation for parking in a red zone. The angry adult confronts the officer as he/she is leaving the store, and questions the officer on the double-standard that seems to permit police officers to park in a red zone when there is no emergency while community members are cited for the same offense.

## Scenario 3. Disturbance and authority

Officers respond to a disturbance call involving neighbors who are arguing over a civil dispute. Also present is a clergy member or teacher. The clergy member/teacher tells the officer that he/she knows the individuals well and has intervened in their prior disputes, resulting in peaceful resolutions. The officer should recognize the authority that clergy member or teacher holds in the community and should ask them for guidance in resolving this dispute.

### Scenario 4. Jogger matches the description

A community member contacts an officer to describe a suspicious jogger at a park late at night. The community member is vague, but alludes to the fact that the jogger might be casing cars to break into them. Moments later, a jogger who matches the description goes by and the officer makes contact. The jogger is angry because he/she feels the officer is “just harassing” and “profiling” him/her, as this is the third time he/she has been stopped in a month and always seems to “match the description” of an alleged criminal offender in the area.

### Scenario 5. Traffic stop

An officer stops a car for a stop sign violation. The stop is made in front of the adult driver’s residence. The driver’s father/mother comes out of the house with a cell phone camera, wanting to record the officers “harassing” his/her 18-year old son/daughter. The parent yells at the officer. The officer now has two individuals to deal with and must interact with both effectively.



# Bibliography

- Amaranto, Ernesto, Jakob Steinberg, Cherie Castellano, and Roger Mitchell. "Police Stress Interventions." *Brief Treatment and Crisis Intervention* 3, no. 1 (2003), 47–53.  
<http://triggered.stanford.clockss.org/ServeContent?url=http%3A%2F%2Fbtci.stanford.clockss.org%2Fcgi%2Freprint%2F3%2F1%2F47>.
- Amendola Karen L., David Weisburd, Edwin E. Hamilton, Greg Jones, and Meghan Slipka. *The Shift Length Experiment: What We Know about 8-, 10-, and 12-Hour Shifts in Policing*. Washington, DC: Police Foundation, 2011. <http://www.policefoundation.org/content/the-shift-length-experiment>.
- Andersen, Judith P., Konstantinos Papazoglou, Bengt B. Arnetz, and Peter I. Collins. "Mental Preparedness as a Pathway to Police Resilience and Optimal Functioning in the Line of Duty." *International Journal of Emergency Mental Health and Human Resilience* 17, no. 3 (2015), 624–627.  
<https://www.omicsonline.org/open-access/mental-preparedness-as-a-pathway-to-police-resilience-and-optimal-functioning-in-the-line-of-duty-1522-4821-1000243.pdf>.
- Andersen, Judith P., Konstantinos Papazoglou, Mari Koskelainen, Markku Nyman, Harri Gustafsberg, and Bengt B. Arnetz. "Applying Resilience Promotion Training among Special Forces Police Officers." *Journal of Police Emergency Response* 5, no. 2 (2015).  
<http://journals.sagepub.com/doi/full/10.1177/2158244015590446>.
- Arnetz, Bengt B., Dana C. Nevedal, Mark A. Lumley, Lena Backman, and Ake Lublin. "Trauma Resilience Training for Police: Psychophysiological and Performance Effects." *Journal of Police and Criminal Psychology* 24, no. 1 (2009), 1–9. <https://link.springer.com/article/10.1007/s11896-008-9030-y>.
- Arredondo, Rudy, Sterling T. Shumway, Thomas G. Kimball, Charette A. Dersch, C. Nichole Morelock, and Laura Bryan. *Law Enforcement and Corrections Family Support: Development and Evaluation of a Stress Management Program for Officers and Their Spouses*. Washington, DC: U.S. Department of Justice, 2002. <https://www.ncjrs.gov/pdffiles1/nij/grants/197900.pdf>.
- Boni, Nadia. *Exercise and Physical Fitness: The Impact on Work Outcomes, Cognition, and Psychological Well-Being for Police*. Current Commentary no. 10. Marden, South Australia: Australasian Centre for Policing Research, 2004. <http://d.scribd.com/docs/1u7w5067v7kem3185d6h.pdf>.
- Boyce, Robert W., Elizabeth A. Dyer, Tyler K. Willett, Jorge L. Figueroa, and Glenn R. Jones. "Police Weight-Loss Competition in the United States with Gender, Age, and Job Comparisons with Health Promotion Recommendations." *International Journal of Health Promotion and Education* 53, no. 4 (2015), 204–215. <https://www.tandfonline.com/toc/rhpe20/53/4?nav=toclist>.

- Brunetto, Yvonne, Sephen T.T. Teo, Kate Shacklock, and Rod Farr-Wharton. "Emotional Intelligence, Job Satisfaction, Well-being, and Engagement: Explaining Organisational Commitment and Turnover Intentions in Policing." *Human Resource Management Journal* 22, no. 4 (2012), 428–441. <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1748-8583.2012.00198.x>.
- Carlan, Philip E., and Lisa S. Nored. "An Examination of Officer Stress: Should Police Departments Implement Mandatory Counseling?" *Journal of Police and Criminal Psychology* 23, no. 1 (2008), 8–15. <https://link.springer.com/article/10.1007/s11896-008-9015-x>.
- Carlier, Ingrid V.E., Regina D. Lamberts, and Berthold P.R. Gersons. "Risk Factors for Posttraumatic Stress Symptomatology in Police Officers: A Prospective Analysis." *Journal of Nervous and Mental Disease* 185, no. 8 (1997), 498–506. [https://journals.lww.com/jonmd/Abstract/1997/08000/Risk\\_Factors\\_for\\_Posttraumatic\\_Stress.4.aspx](https://journals.lww.com/jonmd/Abstract/1997/08000/Risk_Factors_for_Posttraumatic_Stress.4.aspx).
- Charles, Luenda E., Cecil M. Burchfiel, Desta Fekedulegn, Bryan Vila, Tara A. Hartley, James Slaven, Anna Mnatsakanova, and John M. Violanti. "Shift Work and Sleep: The Buffalo Police Health Study." *Policing: An International Journal of Police Strategies and Management* 30, no. 2 (2007), 215–227. <https://www.emeraldinsight.com/doi/full/10.1108/13639510710753225>.
- Cherniss, Cary, and Daniel Goleman, eds. *The Emotionally Intelligent Workplace: How to Select for, Measure, and Improve Emotional Intelligence in Individuals, Groups, and Organizations*. San Francisco, CA: Jossey-Bass, 2001.
- Chopko, Brian A., and Robert C. Schwartz "The Relation between Mindfulness and Posttraumatic Stress Symptoms Among Police Officers." *Journal of Loss and Trauma* 18, no. 1 (2013), 1–9. <https://www.tandfonline.com/doi/full/10.1080/15325024.2012.674442>.
- Christopher, Michael S., Richard J. Goerling, Brant S. Rogers, Matthew Hunsinger, Greg Baron, Aaron L. Bergman, and David T. Zava. "A Pilot Study Evaluating the Effectiveness of a Mindfulness-Based Intervention on Cortisol Awakening Response and Health Outcomes among Law Enforcement Officers." *Journal of Police and Criminal Psychology* 31, no. 1 (2016), 15–28. <https://link.springer.com/article/10.1007/s11896-015-9161-x>.
- Church, Rosanna L., and Naomi Robertson. "How State Police Agencies Are Addressing the Issue of Wellness." *Policing: An International Journal of Police Strategies and Management* 22, no. 3 (1999), 304–312. <https://www.emeraldinsight.com/doi/full/10.1108/13639519910285062>.
- Collins, P.A., and A.C.C. Gibbs. "Stress in Police Officers: A Study of the Origins, Prevalence, and Severity of Stress-Related Symptoms within a County Police Force." *Occupational Medicine* 53, no. 4 (2003), 256–264. <https://academic.oup.com/occmed/article/53/4/256/1442925>.
- COPS Office (Office of Community Oriented Policing Services). "National Officer Safety and Wellness Group." Office of Community Oriented Policing Services. Accessed May 3, 2018. <https://cops.usdoj.gov/Default.asp?Item=2603>.



- Council of State Governments Justice Center. *Mental Health Resources for Law Enforcement*. Washington, DC: Bureau of Justice Assistance, n.d.  
<https://www.valorforblue.org/Documents/Publications/Public/MentalHealthResourcesforLawEnforcement5232016.pdf>.
- Covey, Thomas J., Janet L. Shucard, John M. Violanti, Jeff Lee, and David W. Shucard. "The Effects of Exposure to Traumatic Stressors on Inhibitory Control in Police Officers: A Dense Electrode Array Study Using a Go/NoGo Continuous Performance Task." *International Journal of Psychophysiology* 87, no. 3 (2013), 363–375.  
<https://www.sciencedirect.com/science/article/abs/pii/S0167876013000597>.
- Crank, John P. *Understanding Police Culture*. New York: Routledge, 2004.
- DeSteno, David, James J. Gross, and Laura Kubzansky. "Affective Science and Health: The Importance of Emotion and Emotion Regulation." *Health Psychology* 32, no. 5 (2013), 474–486.  
<http://psycnet.apa.org/doiLanding?doi=10.1037%2Fa0030259>.
- Destination Zero. "2016 Officer Wellness Winner: San Diego (CA) Police Department." National Law Enforcement Officers Memorial Fund. Accessed May 3, 2018.  
<http://www.nleomf.org/programs/destination-zero/award-winner-submissions/officer-wellness/officer-wellness-winner-2016.html>.
- Fiedler, Mora L. *Officer Safety and Wellness: An Overview of the Issues*. Washington, DC: Office of Community Oriented Policing Services, 2011. <https://cops.usdoj.gov/pdf/OSWG/e091120401-OSWGReport.pdf>.
- Fox, Justin P., Mayur M. Desai, Karissa Britten, Georgina Lucas, Renee Luneau, and Marjorie S. Rosenthal. "Mental-Health Conditions, Barriers to Care, and Productivity Loss Among Officers in An Urban Police Department." *Connecticut Medicine* 76, no. 9 (October 2012), 525–531,  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4089972/>.
- Garner, Randy. "Police Stress: Effects of Criticism Management Training on Health." *Applied Psychology in Criminal Justice* 4, no. 2 (2008), 243–259.  
[http://dev.cjcenter.org/\\_files/apcj/4\\_2\\_5%20Garner.pdf](http://dev.cjcenter.org/_files/apcj/4_2_5%20Garner.pdf).
- Gershon, Robyn R.M., Briana Barocas, Allison N. Canton, Xianbin Li, and David Vlahov. "Mental, Physical, and Behavioral Outcomes Associated with Perceived Work Stress in Police Officers." *Criminal Justice and Behavior* 36, no. 3 (2009), 275–289.  
<http://journals.sagepub.com/doi/pdf/10.1177/0093854808330015>.
- Gilmartin, Kevin M. *Emotional Survival for Law Enforcement: A Guide for Officers and Their Families*. Tucson, AZ: E-S Press, 2002.

- Groves, Kevin S., Mary Pat McEnrue, and Winny Shen. "Developing and Measuring the Emotional Intelligence of Leaders." *Journal of Management Development* 27, no. 2 (2008), 225–250. <https://www.emeraldinsight.com/doi/full/10.1108/02621710810849353>.
- Hartley, Tara A., Cecil M. Burchfiel, Desta Fekedulegn, Michael E. Andrew, and John M. Violanti. "Health Disparities in Police Officers: Comparisons to the U.S. General Population." *International Journal of Emergency Mental Health* 13, no. 4 (2011), 211–220. <https://www.omicsonline.org/open-access/health-disparities-in-police-officers-comparisons-to-the-us-general-populations.pdf>.
- Hilton, Michael F., Paul A. Scuffham, Judith Sheridan, Catherine M. Cleary, Nerina Vecchio, and Harvey A. Whiteford. "The Association between Mental Disorders and Productivity in Treated and Entreated Employees." *Journal of Occupational and Environmental Medicine* 51, no. 9 (2009), 996–1003. [https://journals.lww.com/joem/Abstract/2009/09000/The\\_Association\\_Between\\_Mental\\_Disorders\\_and.5.aspx](https://journals.lww.com/joem/Abstract/2009/09000/The_Association_Between_Mental_Disorders_and.5.aspx).
- IACP (International Association of Chiefs of Police). *Breaking the Silence on Law Enforcement Suicides: IACP National Symposium on Law Enforcement Officer Suicide and Mental Health*. Washington, DC: Office of Community Oriented Policing Services, 2017. <https://ric-zai-inc.com/ric.php?page=detail&id=COPS-P281>.
- Karaffa, Kerry, Linda Openshaw, Julie Koch, Hugh Clark, Cynthia Harr, and Chris Stewart. "Perceived Impact of Police Work on Marital Relationships." *The Family Journal: Counseling and Therapy for Couples and Families* 23, no. 2 (2015), 120–131. <http://journals.sagepub.com/doi/full/10.1177/1066480714564381>.
- Kimble, Matthew O., Kevin Fleming, and Kelly A. Bennion. "Contributors to Hypervigilance in a Military and Civilian Sample." *Journal of Interpersonal Violence* 28, no. 8 (2013), 1672–1692. <http://journals.sagepub.com/doi/full/10.1177/0886260512468319>.
- Kuehl, Kerry S., Diane L. Elliot, Linn Goldberg, David P. MacKinnon, Bryan j. Vila, Jennifer Smith, Milica Miočević, Holly P. O'Rourke, Matthew J. Valente, Carol DeFrancesco, et al. "The Safety and Health Improvement: Enhancing Law Enforcement Departments Study: Feasibility and Findings." *Frontiers in Public Health* 2:38 (2014). <https://www.frontiersin.org/articles/10.3389/fpubh.2014.00038/full>.
- Kuhns, Joseph B., Edward R. Maguire, and Nancy R. Leach. *Health, Safety, and Wellness Program Case Studies in Law Enforcement*. Washington, DC: Office of Community Oriented Policing Services, 2015. <https://ric-zai-inc.com/ric.php?page=detail&id=COPS-P332>.
- Langlieb, Alan M., and Jeffrey P. Kahn. "How Much Does Quality Mental Health Care Profit Employers?" *Journal of Occupational and Environmental Medicine* 47, no. 11 (2005), 1099–1109. [https://journals.lww.com/joem/Abstract/2005/11000/How\\_Much\\_Does\\_Quality\\_Mental\\_Health\\_Care\\_Profit.2.aspx](https://journals.lww.com/joem/Abstract/2005/11000/How_Much_Does_Quality_Mental_Health_Care_Profit.2.aspx).

- Levenson, Richard L., Andrew F. O'Hara, and Ron Clark, Sr. "The Badge of Life Psychological Survival for Police Officers Program." *International Journal of Emergency Mental Health and Human Resilience* 12, no. 2 (2010), 95–101. <https://www.omicsonline.org/open-access/critical-incident-stress-management-in-a-school-setting-following-police-shooting-of-an-adolescent.pdf>.
- Martinussen, M., A.M. Richardsen, and R.J. Burke. "Job Demands, Job Resources, and Burnout among Police Officers." *Journal of Criminal Justice* 35, no. 3 (2007), 239–249. <https://www.sciencedirect.com/science/article/pii/S0047235207000335>.
- McCaslin, Shannon E., Cynthia E. Rogers, Thomas J. Metzler, Suzanne R. Best, Daniel S. Weiss, Jeffrey A. Fagan, Akiva Liberman, and Charles R. Marmar. "The Impact of Personal Threat on Police Officers' Responses to Critical Incident Stressors." *Journal of Nervous and Mental Disease* 194, no. 8 (2006), 591–597. [https://journals.lww.com/ionmd/Abstract/2006/08000/The\\_Impact\\_of\\_Personal\\_Threat\\_on\\_Police\\_Officers\\_.6.aspx](https://journals.lww.com/ionmd/Abstract/2006/08000/The_Impact_of_Personal_Threat_on_Police_Officers_.6.aspx).
- McCormick, Amanda V., Irwin M. Cohen, and Darryl Plecas. *Nutrition and General Duty Police Work: The Case of Surrey RCMP Officers*. Abbotsford, BC: University of the Fraser Valley Centre for Public Safety and Criminal Justice Research, 2011. [https://www.ufv.ca/media/assets/ccjr/reports-and-publications/Surrey\\_-\\_Nutrition\\_Report.pdf](https://www.ufv.ca/media/assets/ccjr/reports-and-publications/Surrey_-_Nutrition_Report.pdf).
- Miller, Laurence. "Stress in Policing: Syndromes and Strategies." Testimony before the President's Task Force on 21st Century Policing, Washington, DC, February 13, 2015.
- Mishara, Brian L, and Norman Martin. "Effects of a Comprehensive Police Suicide Prevention Program." *Crisis* 33, no. 3 (2012), 162–168. <https://econtent.hogrefe.com/doi/abs/10.1027/0227-5910/a000125>.
- Nikolaou, Ioannis, and Ioannis Tsaousis. "Emotional Intelligence in the Workplace: Exploring Its Effects on Occupational Stress and Organizational Commitment." *International Journal of Organizational Analysis* 10, no. 4 (2002), 327–342. <https://www.emeraldinsight.com/doi/abs/10.1108/eb028956?journalCode=tijoa>.
- Patterson, George T., Irene W. Chung, and Philip W. Swan. "Stress Management Interventions for Police Officers and Recruits: A Meta-Analysis." *Journal of Experimental Criminology* 10, no. 4 (2014), 487–513. <https://link.springer.com/article/10.1007/s11292-014-9214-7>.
- Pearsall, Beth. "Sleep Disorders, Work Shifts, and Officer Wellness." *NIJ Journal* 270 (June 2012). <https://www.ncjrs.gov/pdffiles1/nij/238487.pdf>.
- PERF (Police Executive Research Forum). *Labor and Management Roundtable Discussions: Collaborating to Address Key Challenges in Policing*. Washington, DC: Office of Community Oriented Policing Services, 2015. <https://ric-zai-inc.com/ric.php?page=detail&id=COPS-P325>.

- . *ICAT: Integrating Communications, Assessment, and Tactics. Training Guide for Defusing Critical Incidents*. Washington, DC: Police Executive Research Forum, 2016. <http://www.policeforum.org/assets/icattrainingguide.pdf>.
- . *Police Accountability: Findings and National Implications of an Assessment of the San Diego Police Department*. Critical Response Technical Assessment Review. Washington, DC: Office of Community Oriented Policing Services, 2015. <https://ric-zai-inc.com/ric.php?page=detail&id=COPS-W0756>.
- Piazza, Jennifer R., Susan T. Charles, Martin J. Sliwinski, Jacqueline Mogle, and David M. Almeida. "Affective Reactivity to Daily Stressors and Long-Term Risk of Reporting a Chronic Physical Health Condition." *Annals of Behavioral Medicine* 45, no. 1 (2013), 110–120. <https://link.springer.com/article/10.1007/s12160-012-9423-0>.
- Prati, Gabriele, and Luca Pietrantonio. "The Relation of Perceived and Received Social Support to Mental Health among First Responders: A Meta-Analytic Review." *Journal of Community Psychology* 38, no. 3 (2010), 403–417. <https://onlinelibrary.wiley.com/doi/abs/10.1002/jcop.20371>.
- President's Task Force on 21st Century Policing. *Final Report of the President's Task Force on 21st Century Policing*. Washington, DC: Office of Community Oriented Policing Services, 2015. <https://ric-zai-inc.com/ric.php?page=detail&id=COPS-P311>.
- Rajaratnam, Shantha M.W., Laura K. Barger, Stephen W. Lockley, Steven A. Shea, Wei Wang, Christopher P. Landrigan, Conor S. O'Brien, Salim Qadri, Jason P. Sullivan, Brian E. Cade, et al. "Sleep Disorders, Health, and Safety in Police Officers." *Journal of the American Medical Association* 306, no. 23 (2011), 2567–2578. <https://jamanetwork.com/journals/jama/fullarticle/1104746>.
- Rattue, Petra. "Serious Health Risks Among Police Officers Due To Stress." *Medical News Today*, July 12, 2012. <http://www.medicalnewstoday.com/articles/247781.php>.
- Risan, Patrick, Per-Einar Binder, and Rebecca J. Milne. "Emotional Intelligence in Police Interviews—Approach, Training and the Usefulness of the Concept." *Journal of Forensic Psychology Practice* 16, no. 5 (2016), 410–424. <https://www.tandfonline.com/doi/full/10.1080/15228932.2016.1234143>.
- SDPD (San Diego Police Department). *Wellness Unit Operations Manual*. San Diego, CA: San Diego Police Department, 2016.
- . *Changing Organizational Culture: A Commitment to Wellness*. San Diego, CA: San Diego Police Department, n.d. <https://s3.amazonaws.com/destination-zero/2016/San-Diego-Wellness-Unit-Narrative.pdf>.
- Spence, Deborah, ed. *Improving Law Enforcement Resilience: Lessons and Recommendations*. Officer Safety and Wellness Group Meeting Summary. Washington, DC: Office of Community Oriented Policing Services, 2017. <https://ric-zai-inc.com/ric.php?page=detail&id=COPS-P362>.

- Stephens, Darrel W., and Lisa Mantel. *OSW Group Meeting Summary: Psychological Health, February 4, 2013*. Washington, DC: Office of Community Oriented Policing Services. [https://cops.usdoj.gov/pdf/OSWG/OSW\\_Psychological\\_Health\\_v6.pdf](https://cops.usdoj.gov/pdf/OSWG/OSW_Psychological_Health_v6.pdf).
- Stinchcomb, Jeanne B. "Searching for Stress in All the Wrong Places: Combating Chronic Organizational Stressors in Policing." *Police Practice and Research: An International Journal* 5, no. 3 (2004), 259–277. <https://www.tandfonline.com/doi/full/10.1080/156142604200227594>.
- Stoughton, Seth. "What a Police Expert Calls the Most Ignored Cause of Cop Violence." Talking Points Memo, June 15, 2015. <http://talkingpointsmemo.com/cafe/stress-ignored-cause-of-police-violence>.
- Tanigoshi, Holly, Anthony P. Kontos, and Theodore P. Remley, Jr. "The Effectiveness of Individual Wellness Counseling on the Wellness of Law Enforcement Officers." *Journal of Counseling and Development* 86, no. 1 (2008), 64–74. <https://onlinelibrary.wiley.com/doi/abs/10.1002/j.1556-6678.2008.tb00627.x>.
- Taylor, Bruce, Heath Grant, Bruce Kubu, Jack Roberts, Megan Collins, and Daniel J. Woods. *A Practitioner's Guide to the 2011 National Body Armor Survey of Law Enforcement Officers*. Washington, DC: National Institute of Justice, 2012. <https://www.ncjrs.gov/pdffiles1/nij/grants/240225.pdf>.
- Toch, Hans. *Stress in Policing*. Washington, DC: American Psychological Association, 2002.
- Turner, Timothy W. "Understanding the Benefits of Emotional Intelligence for Officer Growth and Agency Budgets." *The Police Chief* 76, no. 8 (2009). <http://www.policechiefmagazine.org/understanding-the-benefits-of-emotional-intelligence-for-officer-growth-and-agency-budgets/>.
- VanMeter, Michael. "Leading At-Risk Employees: Law Enforcement and the Addiction Crisis." Leadership Spotlight. FBI Law Enforcement Bulletin, January 6, 2016. [https://leb.fbi.gov/2016/january/leadership-spotlight-leading-at-risk-employees-law-enforcement-and-the-addiction-crisis?utm\\_campaign=email-Daily&utm\\_content=502975](https://leb.fbi.gov/2016/january/leadership-spotlight-leading-at-risk-employees-law-enforcement-and-the-addiction-crisis?utm_campaign=email-Daily&utm_content=502975).
- Vila, Bryan. "Sleep Deprivation: What Does It Mean for Public Safety Officers?" *NIJ Journal* 262 (n.d.). <https://www.ncjrs.gov/pdffiles1/nij/225762.pdf>.
- . *Tired Cops: The Importance of Managing Police Fatigue*. Washington, DC. Police Executive Research Forum, 2000.
- Vila, Bryan, Gregory B. Morrison, and Dennis J. Kenney. "Improving Shift Schedule and Work-Hour Policies and Practices to Increase Police Officer Performance, Health, and Safety." *Police Quarterly* 5, no. 1 (2002), 4–24. <http://journals.sagepub.com/doi/pdf/10.1177/109861102129197995>.

Violanti, John M. *Shifts, Extended Work Hours, and Fatigue: An Assessment of Health and Personal Risks for Police Officers*. Washington, DC: U.S. Department of Justice, 2012.  
<https://www.ncjrs.gov/pdffiles1/nij/grants/237964.pdf>.

Violanti, John M., Cecil M. Burchfiel, Desta Fekedulegn, Michael E. Andrew, Joan Dorn, Tara A. Hartley, Luenda E. Charles, and Diane B. Miller. "Cortisol Patterns and Brachial Artery Reactivity in a High Stress Environment." *Psychiatry Research* 169, no. 1 (2009), 75–81.  
<https://www.sciencedirect.com/science/article/pii/S0165178108001790?via%3Dihub>.

Violanti, John M., Luenda E. Charles L.E., Tara A. Hartley, Anna Mnatsakanova, Michael E. Andrew, Desta Fekedulegn, Bryan Vila, and Cecil M. Burchfiel. "Shift-Work and Suicide Ideation among Police Officers." *American Journal of Industrial Medicine* 51, no. 10 (2008), 758–768.  
<https://onlinelibrary.wiley.com/doi/abs/10.1002/ajim.20629>.

Violanti, John M., Tara A. Hartley, Ja K. Gu, Desta Fekedulegn, Michael E. Andrew, and Cecil M. Burchfiel. "Life Expectancy in Police Officers: A Comparison with the U.S. General Population." *International Journal of Emergency Mental Health* 15, no. 4 (2013), 217–228.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4734369/>.

von Kuenssberg Jehle, Dietrich, David G. Wagner, James Mayrose, and Usman Hashmi. "Seat Belt Use by Police: Should They Click It?" *Journal of Trauma and Acute Care Surgery* 58, no. 1 (2005), 119–120.  
[https://journals.lww.com/jtrauma/Abstract/2005/01000/Seat\\_Belt\\_Use\\_By\\_Police\\_Should\\_They\\_Click\\_It\\_.20.aspx](https://journals.lww.com/jtrauma/Abstract/2005/01000/Seat_Belt_Use_By_Police_Should_They_Click_It_.20.aspx).

Zimmerman, Franklin H. "Cardiovascular Disease and Risk Factors in Law Enforcement Personnel: A Comprehensive Review." *Cardiology in Review* 20, no. 4 (2012), 159–166.  
[https://journals.lww.com/cardiologyinreview/Abstract/2012/07000/Cardiovascular\\_Disease\\_and\\_Risk\\_Factors\\_in\\_Law.1.aspx](https://journals.lww.com/cardiologyinreview/Abstract/2012/07000/Cardiovascular_Disease_and_Risk_Factors_in_Law.1.aspx).

# About PERF

The **Police Executive Research Forum (PERF)** is an independent research organization that focuses on critical issues in policing. Since its founding in 1976, PERF has identified best practices on fundamental issues such as police use of force; developing community policing and problem-oriented policing; using technologies to deliver police services to the community; and evaluating crime reduction strategies.

PERF strives to advance professionalism in policing and to improve the delivery of police services through the exercise of strong national leadership, public debate of police and criminal justice issues, and research and policy development.

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- *The Police Response to Mass Demonstrations: Promising Practices and Lessons Learned (2018)*
- *The Changing Nature of Crime and Criminal Investigations (2018)*
- *The Revolution in Emergency Communications (2017)*
- *The Unprecedented Opioid Epidemic (2017)*
- *The "Crime Gun Intelligence Center" Model: Case Studies of the Denver, Milwaukee, and Chicago Approaches to Investigating Gun Crime (2017)*
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- *Gun Violence: Regional Problems, Partnerships, and Solutions (2015)*

- *Implementing a Comprehensive Performance Management Approach in Community Policing Organizations: An Executive Guidebook (2015)*
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# About the COPS Office

The **Office of Community Oriented Policing Services (COPS Office)** is the component of the U.S. Department of Justice responsible for advancing the practice of community policing by the nation's state, local, territorial, and tribal law enforcement agencies through information and grant resources.

Community policing begins with a commitment to building trust and mutual respect between police and communities. It supports public safety by encouraging all stakeholders to work together to address our nation's crime challenges. When police and communities collaborate, they more effectively address underlying issues, change negative behavioral patterns, and allocate resources.

Rather than simply responding to crime, community policing focuses on preventing it through strategic problem-solving approaches based on collaboration. The COPS Office awards grants to hire community policing officers and support the development and testing of innovative policing strategies. COPS Office funding also provides training and technical assistance to community members and local government leaders, as well as all levels of law enforcement.

Since 1994, the COPS Office has invested more than \$14 billion to add community policing officers to the nation's streets, enhance crime fighting technology, support crime prevention initiatives, and provide training and technical assistance to help advance community policing. Other achievements include the following:

- To date, the COPS Office has funded the hiring of approximately 130,000 additional officers by more than 13,000 of the nation's 18,000 law enforcement agencies in both small and large jurisdictions.
- Nearly 700,000 law enforcement personnel, community members, and government leaders have been trained through COPS Office-funded training organizations.
- To date, the COPS Office has distributed more than eight million topic-specific publications, training curricula, white papers, and resource CDs and flash drives.
- The COPS Office also sponsors conferences, round tables, and other forums focused on issues critical to law enforcement.

COPS Office information resources, covering a wide range of community policing topics such as school and campus safety, violent crime, and officer safety and wellness, can be downloaded via the COPS Office's home page, [www.cops.usdoj.gov](http://www.cops.usdoj.gov). This website is also the grant application portal, providing access to online application forms.

Law enforcement agencies around the country are recognizing the importance of monitoring and tending to employees' physical and mental health and wellness. This publication discusses the establishment and operation of a dedicated unit at the San Diego Police Department with the goal of promoting a department-wide culture of wellness. Working toward this goal will also help the department better serve its community. The Police Executive Research Forum, working with the SDPD under a cooperative agreement from the COPS Office, identified lessons learned and recommendations that will help guide other local agencies that may be interested in setting up similar programs.



U.S. Department of Justice  
Office of Community Oriented Policing Services  
145 N Street NE  
Washington, DC 20530

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## Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009)

Robert D Daniels, Travis L Kubale, James H Yiin, et al.

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## ORIGINAL ARTICLE

# Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009)

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## ABSTRACT

**Objectives** To examine mortality patterns and cancer incidence in a pooled cohort of 29 993 US career firefighters employed since 1950 and followed through 2009.

**Methods** Mortality and cancer incidence were evaluated by life table methods with the US population referent. Standardised mortality (SMR) and incidence (SIR) ratios were determined for 92 causes of death and 41 cancer incidence groupings. Analyses focused on 15 outcomes of a priori interest. Sensitivity analyses were conducted to examine the potential for significant bias.

**Results** Person-years at risk totalled 858 938 and 403 152 for mortality and incidence analyses, respectively. All-cause mortality was at expectation (SMR=0.99, 95% CI 0.97 to 1.01, n=12 028). There was excess cancer mortality (SMR=1.14, 95% CI 1.10 to 1.18, n=3285) and incidence (SIR=1.09, 95% CI 1.06 to 1.12, n=4461) comprised mainly of digestive (SMR=1.26, 95% CI 1.18 to 1.34, n=928; SIR=1.17, 95% CI 1.10 to 1.25, n=930) and respiratory (SMR=1.10, 95% CI 1.04 to 1.17, n=1096; SIR=1.16, 95% CI 1.08 to 1.24, n=813) cancers. Consistent with previous reports, modest elevations were observed in several solid cancers; however, evidence of excess lymphatic or haematopoietic cancers was lacking. This study is the first to report excess malignant mesothelioma (SMR=2.00, 95% CI 1.03 to 3.49, n=12; SIR=2.29, 95% CI 1.60 to 3.19, n=35) among US firefighters. Results appeared robust under differing assumptions and analytic techniques.

**Conclusions** Our results provide evidence of a relation between firefighting and cancer. The new finding of excess malignant mesothelioma is noteworthy, given that asbestos exposure is a known hazard of firefighting.

## INTRODUCTION

There are approximately 1.1 million volunteer and career firefighters in the US.<sup>1</sup> During firefighting activities, these workers may be exposed to many known carcinogens (eg, polycyclic aromatic hydrocarbons (PAHs), formaldehyde, benzene, 1,3-butadiene, asbestos and arsenic) in volatilised combustion and pyrolysis products or debris.<sup>2</sup> These exposures have raised concerns of increased cancer among firefighters and have prompted a number of exposure assessment and epidemiologic investigations. Some studies have found excess

## What this paper adds

- From previous studies, there is limited epidemiological evidence of increased risk of cancer from firefighting.
- We examined cancer in 30 000 career firefighters by pooling information from urban fire departments in three large US cities. The large sample size and long follow-up period improved risk estimates compared with previous studies.
- We report that firefighting may be associated with increased risk of solid cancers. Furthermore, we report a new finding of excess malignant mesothelioma among firefighters, suggesting the presence of an occupational disease from asbestos hazards in the workplace.

cancers of the brain,<sup>3–8</sup> digestive tract,<sup>4 5 7–10</sup> genitourinary tract<sup>5 7 11 12</sup> and lymphohematopoietic organs.<sup>6 8 13</sup> In a recent meta-analysis of 32 studies, significant excess risk was reported for brain, stomach, colon, rectum, prostate, testes, multiple myeloma and non-Hodgkin lymphoma (NHL).<sup>14</sup> Similarly, the International Agency for Research on Cancer (IARC) reviewed 42 studies and reported significant summary risks for prostatic and testicular cancers and NHL.<sup>2</sup> Given limited evidence, however, IARC concluded that firefighter exposures were only possibly carcinogenic to humans (Group 2B).

Most studies have examined mortality, but not cancer incidence, among relatively few firefighters recruited from one fire department. The current study examines mortality and cancer incidence in a pooled cohort of firefighters employed in three major US cities. Malignancies of the brain, stomach, oesophagus, intestines, rectum, kidney, bladder, prostate, testes, leukaemia, multiple myeloma and NHL were of a priori interest in the current study, based on possible sites identified in previous reviews.<sup>2 14</sup> Lung cancer and chronic obstructive pulmonary disease (COPD) were also of interest because inhalation is a major pathway for firefighter exposures, and there is evidence of



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chronic and acute inflammatory respiratory effects in firefighters, which may be linked to cancer.<sup>2</sup> Breast cancer was included as a result of interests shared in researcher discussions with firefighters.

## METHODS

### Data collection methods

This research was approved by the Institutional Review Boards of the National Institute for Occupational Safety and Health (NIOSH) and the National Cancer Institute (NCI). Personnel records and previous study data were used to assemble the study roster, which comprised male and female career firefighters of all races employed for at least 1 day in fire departments serving San Francisco, Chicago, or Philadelphia, from 1 January 1950, through 31 December 2009. Fire departments were selected based on size, location, work experience, records availability and the willingness of labour and city management to participate. 'Career firefighter' status was determined from job titles categorised by researchers and vetted by each fire department. Selected job titles included general classifications of firefighters, firefighter paramedics, and fire department arson investigators. Persons of known race were mostly Caucasian (81%) and those missing race (2.5%) were hired in earlier periods of lower minority hiring (median year at hire=1955). Therefore, persons missing race were assumed Caucasian and retained in main analyses to maximise study size. Analyses were also conducted excluding persons of unknown race.

Vital status was ascertained from the National Death Index-Plus (NDI-Plus), the Social Security Administration Death Master File (SSA-DMF), personnel and pension board records, and records from the previous studies.<sup>9 10</sup> Firefighters not found to be deceased were confirmed alive by matches to employment records, Internal Revenue Service (IRS) records, and data accessible through LexisNexis (a private vendor of residential information).

Causes of death were obtained from previous studies,<sup>9 10</sup> NDI-Plus, and death certificates collected from state vital records and retirement boards. Deaths of Philadelphia firefighters through 1986 were previously determined by Baris *et al.*,<sup>9</sup> who retrieved and coded death certificates to the ninth revision of the International Classification of Diseases (ICD-9). San Francisco firefighter deaths were determined through 1982 by Beaumont *et al.*<sup>10</sup> In that and the current study, causes of death were coded to the ICD revision in effect at the time of death. The underlying cause of death determined by a trained nosologist was used for all mortality analyses.

Incident cases were defined as all primary invasive cancers, and in situ bladder cancers among firefighters matched to state cancer registries on name, gender, race, date of birth and Social Security number. The last known residence and the state of death were used to narrow inclusion of registries for case ascertainment to 11 states (ie, Arizona, California, Florida, Illinois, Indiana, Michigan, Nevada, New Jersey, Oregon, Pennsylvania and Washington) where nearly 95% of all deaths in known states occurred (see online supplementary table S1). The site and histology of each tumour were used to classify cancers in one of 41 diagnostic groups using the International Classification of Diseases for Oncology, 3rd Edition (ICD-O-3).<sup>15</sup> The conversion from ICD-O-3 to ICD-10 used the Surveillance, Epidemiology and End Results Program (SEER) recodes (dated 27 January 2003) following slight modification to align with mortality groupings and to account for recent classification changes. Diagnosis dates were assigned as of 1 July of the year of diagnosis if only the diagnosis year was

known, and on the 15th of the month of diagnosis if only the diagnosis month and year were known. The death date was used when death preceded the estimated date.

### Statistical methods

The NIOSH Life Table Analysis System (LTAS.NET) was used to examine mortality and cancer incidence.<sup>16</sup> Main analyses used the US population as referent. In all analyses, person-years at risk (PYAR) were stratified by gender, race (Caucasian, other races), age (age 15–85+ years in 5-year categories), and calendar year (in 5-year categories). Confidence limits for risk measures were estimated based on a Poisson distribution for the observed outcome, with exact limits for outcomes with 10 or fewer occurrences.

For mortality analyses, PYAR began on the latest of 1 January 1950 or the date of cohort inclusion, and ended the earliest of the date of death (DOD), the date last observed (DLO), or 31 December 2009. US mortality rates (1950–2009) were used to estimate the expected numbers of deaths for all causes, all cancers and 92 categories of underlying cause of death.<sup>17</sup> Additional mortality rates were developed to separately report on cancers of the small intestine, large intestine and testes to coincide with incidence rates; however, these rates were limited to time periods after 1959. In both cases, the subsites of interest (ie, colon and testes) account for the largest proportion of the deaths in the respective aggregate site (ie, intestine or male genital organs excluding prostate); therefore, the aggregate site reasonably approximates the subsite. The standardised mortality ratio (SMR) was calculated as the ratio of the observed to the total number of expected deaths.

Two approaches were used to examine cancer incidence. The main analyses included first and later primary cancers (ie, multiple-cancer approach) occurring within the risk period. PYAR accrued from the date of statewide ascertainment by the respective fire department's state cancer registry (eg, 1 January 1988 for San Francisco firefighters (see online supplementary table S1)) or cohort inclusion, whichever was latest, and ended at the earliest of the DOD, DLO, or 31 December 2009. Secondary analyses were restricted to the first occurrence of invasive cancer (ie, first-cancer approach). In these analyses, PYAR for cases ended on the date of first diagnosis. In both approaches, the standardised incidence ratio (SIR) was calculated as the ratio of observed malignancies to the expected number of cases estimated using US incidence rates (1985–2009) calculated from SEER data.<sup>18</sup> Additional steps required for first-cancer analyses were: selecting the most common cancer when diagnoses included multiple primary tumours on the same day (n=21), excluding firefighters known to have a cancer diagnosis prior to the start of the risk date (n=55), and adjusting US rates for cancer prevalence using methods described by Merrill *et al.*<sup>19</sup>

Heterogeneity in fire department-specific SMRs and SIRs was examined using Poisson regression modelling. To control for gender, age, calendar year and race, an offset term was set to the expected number of deaths or cases in each stratum of the classification table. To address differences between fire departments, a mixed model was used that specified a random intercept term. Thus, the model intercept is the log of the pooled SMR, adjusted for heterogeneity among the fire departments. The significance of heterogeneity was assessed by likelihood ratio test (significance level of 0.05).

Several sensitivity analyses were conducted. First, we examined the effects of including prevalent hires (workers employed before 1950) and short-term workers (those employed <1 year)

in mortality analyses. Prevalent hires must be employed long enough to be recruited into the study; thus, these workers may have a survival advantage compared with persons hired during the follow-up period (ie, incident hires).<sup>20</sup> Short-term workers include temporary hires and probationary firefighters whose health and lifestyle patterns may differ from those employed one or more years. Short-term workers may also have had substantial occupational histories other than as firefighters, possibly in jobs with hazardous exposures. Second, we examined age effects on risk estimates in two age-at-risk categories (17–64, 65+ years). Testing of an effect across all 5-year age groups was accomplished using mixed models adjusted for age-at-risk groups. Third, we conducted SMR analyses restricting observation to age 84 years or less. Including PYAR for ages 85+ years could bias results from: rates used in analyses that are open-ended, more uncertainty in underlying cause of death at later ages, and subjects who are incorrectly traced as alive having a disproportionate effect in the open-ended age group.<sup>21</sup> Fourth, we calculated SMRs using California, Illinois and Pennsylvania State populations as referent for firefighters from San Francisco, Chicago and Philadelphia, respectively. Last, SMRs and standardised rate ratios (SRRs) were calculated for categories of employment duration (<10, 10–<20, 20–<30, 30+ years). Trend slopes with Wald-based two-sided p values (significance level of 0.05) were calculated for the change in SRRs with increasing duration.

## RESULTS

There were 29 993 firefighters available for study, contributing 858 938 PYAR (table 1). The cohort was largely male (97%), with mean age at first employment and total years employed of 29 and 21 years, respectively. Fewer than 5% of firefighters

were short-term workers and approximately 30% were first employed prior to 1950. A higher percentage of women (9.4%) were short-term workers compared with men (4.3%) (see online supplementary table S2). Prevalent hires, on average, tended to be employed longer (+7.9 years, t test  $p < 0.001$ ) and had a greater attained age (+17.0 years, t test  $p < 0.001$ ) than incident hires. Persons eligible for incidence analyses using the multiple-cancer approach ( $n = 24\,453$ ) contributed 403 152 PYAR. The first-cancer approach included 24 398 persons contributing 383 577 PYAR. There were 4461 malignant tumours distributed among 3903 firefighters with cancer. Among these, 488 reported cancers at multiple primary sites. Mortality and cancer incidence results are summarised in table 2 and in online supplementary tables S3–S5. To aid in comparisons with previous studies, table 2 also shows summary risk estimates (SREs) reported by LeMasters *et al*<sup>14</sup>, whose meta-analysis included studies published through 2003.

## Mortality

With the US population referent, all-cause mortality was at expectation (SMR=0.99, 95% CI 0.97 to 1.01,  $n = 12\,028$ ). Ischaemic heart disease was the leading cause of death (SMR=1.01, 95% CI 0.98 to 1.04,  $n = 3619$ ). There was significantly decreased mortality in other outcomes that may be related to healthy worker selection and survivor effects (HWE), such as non-malignant respiratory diseases (SMR=0.80, 95% CI 0.74 to 0.86,  $n = 796$ ), cerebrovascular disease (SMR=0.91, 95% CI 0.84 to 0.98,  $n = 636$ ), diabetes mellitus (SMR=0.72, 95% CI 0.62 to 0.83,  $n = 175$ ), nervous system disorders (SMR=0.80, 95% CI 0.69 to 0.93,  $n = 187$ ), and alcoholism (SMR=0.61, 95% CI, 0.41 to 0.86,  $n = 31$ ). In particular, there was a strong decrease in COPD mortality (SMR=0.72, 95% CI

**Table 1** Demographic characteristics of the cohort by fire department and combined (1950–2009)

Description	All fire departments	San Francisco	Chicago	Philadelphia
Study cohort:				
Eligible for mortality analysis	29 993	5313	15 185	9495
PYAR	858 938	154 317	419 414	285 207
Years of follow-up; avg. (SD)	29 (16)	29 (16)	28 (16)	30 (16)
Race (%):				
White	24 244 (80.8)	4254 (80.1)	11 736 (77.3)	8254 (86.9)
Other	5008 (16.7)	986 (18.6)	2808 (18.5)	1214 (12.8)
Unknown	741 (2.5)	73 (1.4)	641 (4.2)	27 (<1.0)
Gender (%):				
Male	29 002 (96.7)	5009 (94.3)	14 694 (96.8)	9299 (97.9)
Female	991 (3.3)	304 (5.7)	491 (3.2)	196 (2.1)
Vital status:				
Alive (%)	17 965 (59.9)	3239 (61.0)	9241 (60.9)	5485 (57.8)
Deceased (%)	12 028 (40.1)	2074 (39.0)	5944 (39.1)	4010 (42.2)
Unknown cause of death	144	9	91	44
Attained age*; avg. (SD)	60 (16)	62 (16)	59 (16)	61 (16)
LTFU	175	1	32	142
PYAR potentially LTFU (%)	8809 (1.0)	59 (<1.0)	1483 (<1.0)	7267 (2.5)
Employment:				
Avg. hire year	1968	1967	1970	1965
Age at hire; avg. (SD)	29 (5)	29 (5)	29 (5)	27 (5)
Employment years; avg. (SD)	21 (11)	22 (11)	21 (11)	21 (11)
Hired before 1950 (%)	8085 (27)	1682 (32)	3294 (22)	3109 (33)
Employed <1 year (%)	1328 (4.4)	194 (3.7)	891 (5.9)	243 (2.6)

\*Age attained at earliest of the date of death, date LTFU or 31 December 2009.  
Avg., average; LTFU, lost to follow-up; PYAR, person-years at risk.



**Table 2** Standardised mortality and incidence ratios in firefighters for select outcomes compared to results from a recent meta-analysis

Underlying cause (ICD-10 codes)	Current study results (US population referent)					Meta-analysis of LeMasters <i>et al</i> <sup>14*</sup>		
	Mortality (1950–2009)†		Cancer incidence (1985–2009)			Studies	SRE (95% CI), Likelihood rating	
	Obs	SMR (95% CI)	All cancers	First cancer	Obs			SIR (95% CI)
All cancers (C00–C97)	3285	1.14 (1.10 to 1.18)	4461	1.09 (1.06 to 1.12)	3890	1.09 (1.06 to 1.12)	25	1.05 (1.00 to 1.09), 3
MN oesophagus (C15)	113	1.39 (1.14 to 1.67)	90	1.62 (1.31 to 2.00)	80	1.71 (1.36 to 2.13)	8	1.16 (0.86 to 1.57), 3
MN stomach (C16)	110	1.10 (0.91 to 1.33)	93	1.15 (0.93 to 1.40)	72	1.02 (0.80 to 1.28)	13	1.22 (1.04 to 1.44), 2
MN intestine (C17–C18)	326	1.30 (1.16 to 1.44)	398	1.21 (1.09 to 1.33)	351	1.29 (1.16 to 1.43)	NA	NA
MN large intestine (C18)	264	1.31 (1.16 to 1.48)	381	1.21 (1.09 to 1.34)	335	1.28 (1.15 to 1.43)	25	1.21 (1.03 to 1.54), 2
MN small intestine (C17)	8	1.66 (0.72 to 3.27)	17	1.15 (0.67 to 1.85)	16	1.43 (0.82 to 2.33)	NA	NA
MN rectum (C19–C21)	89	1.45 (1.16 to 1.78)	166	1.11 (0.95 to 1.30)	140	1.09 (0.91 to 1.28)	13	1.29 (1.10 to 1.51), 2
MN lung (C33–C34)	1046	1.10 (1.04 to 1.17)	716	1.12 (1.04 to 1.21)	602	1.13 (1.04 to 1.22)	19	1.03 (0.97 to 1.08), 3
MN breast (C50)	8	1.39 (0.60 to 2.73)	26	1.26 (0.82 to 1.85)	24	1.32 (0.84 to 1.96)	NA	NA
MN prostate (C61)	282	1.09 (0.96 to 1.22)	1261	1.03 (0.98 to 1.09)	1176	1.03 (0.97 to 1.09)	13	1.28 (1.15 to 1.43), 1
MN other male genital (C60, C62–C63)	<5	0.47 (0.13 to 1.20)	17	0.62 (0.36 to 0.99)	17	0.67 (0.39 to 1.07)	NA	NA
MN testes (C62)	<5	0.73 (0.15 to 2.14)	15	0.75 (0.42 to 1.24)	15	0.79 (0.44 to 1.30)	4	2.02 (1.30 to 3.13), 2
MN kidney (C64–C66)	94	1.29 (1.05 to 1.58)	166	1.27 (1.09 to 1.48)	129	1.24 (1.04 to 1.48)	12	1.07 (0.78 to 1.46), 3
MN bladder (C67–C68)‡	84	0.99 (0.79 to 1.22)	316	1.12 (1.00 to 1.25)	272	1.18 (1.05 to 1.33)	11	1.20 (0.97 to 1.48), 3
MN brain (C47, C70–C72)	73	1.01 (0.79 to 1.27)	51	1.02 (0.76 to 1.34)	48	1.06 (0.78 to 1.41)	19	1.32 (1.12 to 1.54), 2
NHL (C46.3, C82–C85, C88.0, C88.3, C91.4, C96)§	123	1.17 (0.97 to 1.40)	170	0.99 (0.85 to 1.15)	145	0.99 (0.83 to 1.16)	8	1.51 (1.31 to 1.73), 1
Leukaemia (C91.0–C91.3, C91.5–C91.9, C92–C95)	122	1.10 (0.91 to 1.31)	100	0.94 (0.77 to 1.15)	85	0.93 (0.74 to 1.15)	8	1.14 (0.98 to 1.31), 2
Multiple myeloma (C88.7, C88.9, C90)	42	0.89 (0.64 to 1.20)	36	0.72 (0.50 to 0.99)	33	0.75 (0.52 to 1.06)	10	1.53 (1.21 to 1.94), 1
Other cancers:¶								
Mesothelioma (C45)	12	2.00 (1.03 to 3.49)	35	2.29 (1.60 to 3.19)	26	2.00 (1.31 to 2.93)	NA	NA
MN buccal and pharynx (C00–C14)	94	1.40 (1.13 to 1.72)	174	1.39 (1.19 to 1.62)	148	1.41 (1.20 to 1.66)	9	1.23 (0.96 to 1.55), 2

\*Results from Table 5 of LeMasters *et al*<sup>14</sup>; likelihood of cancer risk by meta-analysis criteria: 1=probable, 2=possible, 3=unlikely.

†SMRs restricted to 1960–2009 for MN large intestine, MN small intestine, and MN testes and 2000–2009 for mesothelioma.

‡Urinary bladder incidence included in situ (D09.0) and invasive cases as per SEER protocol.

§NHL incidence data exclude Kaposi sarcoma (C46.3).

¶Sites not listed among cancers of a priori interest but reporting statistically significant excess mortality and cancer incidence.

ICD-10, International Classification of Diseases, 10th Revision; MN, malignancy; NA, not applicable; NHL, non-Hodgkin lymphoma; Obs, observed; SEER, Surveillance, Epidemiology and End Results; SIR, standardised incidence ratio; SMR, standardised mortality ratio; SRE, summary risk estimate.



0.65 to 0.80,  $n=367$ ). Few non-malignant outcomes were elevated, although statistically significant excess mortality was observed for cirrhosis and other chronic liver disease (SMR=1.26, 95% CI 1.12 to 1.41,  $n=299$ ) and acute glomerulonephritis with renal failure (SMR=1.56, 95% CI 1.07 to 2.20,  $n=32$ ). Deaths from falls (SMR=1.31, 95% CI 1.08 to 1.58,  $n=113$ ) and other accidents (SMR=1.17, 95% CI 1.01 to 1.34,  $n=197$ ) were also elevated.

By contrast with non-malignant outcomes, we observed excess overall cancer mortality (SMR=1.14, 95% CI 1.10 to 1.18,  $n=3285$ ) (table 2). The elevation was largely attributable to excess cancers of the lung (SMR=1.10, 95% CI 1.04 to 1.17,  $n=1046$ ), oesophagus (SMR=1.39, 95% CI 1.14 to 1.67,  $n=113$ ), intestine (SMR=1.30, 95% CI 1.16 to 1.44,  $n=326$ ), rectum (SMR=1.45, 95% CI 1.16 to 1.78,  $n=89$ ) and kidney (SMR=1.29, 95% CI 1.05 to 1.58,  $n=94$ ). There was little evidence of excess mortality from the remaining cancers of a priori interest; however, statistically significant SMRs were apparent for buccal and pharynx cancers (SMR=1.40, 95% CI 1.13 to 1.72,  $n=94$ ), malignancies of the liver, gall bladder and biliary tract (SMR=1.30, 95% CI 1.06 to 1.57,  $n=107$ ), and malignant mesothelioma (SMR=2.00, 95% CI 1.03 to 3.49,  $n=12$ ).

#### Women and non-Caucasians

All-cause mortality among women was near expectation (SMR=0.91, 95% CI 0.59 to 1.33,  $n=26$ ). Accidental death was the leading cause (SMR=2.79, 95% CI 1.21 to 5.50,  $n=8$ ) resulting in 31% of the total deaths among women. While there was little evidence of excess overall cancer mortality among women (SMR=0.74, 95% CI 0.27 to 1.61,  $n=6$ ), most cancer deaths were from breast cancer (SMR=1.46, 95% CI 0.30 to 4.26,  $n<5$ ). Bladder cancer mortality was statistically significant (SMR=33.51, 95% CI 4.06 to 121.05,  $n<5$ ) based on few cases. Non-Caucasian males were characterised by decreased all-cause mortality (SMR=0.68, 95% CI 0.62 to 0.74,  $n=453$ ) and all-cancers (SMR=0.80, 95% CI 0.65 to 0.97,  $n=104$ ). They had few observed deaths in any a priori outcome, and lung cancer mortality was below expectation (SMR=0.67, 95% CI 0.44 to 0.97,  $n=27$ ). Only prostate cancer mortality showed an excess approaching statistical significance (SMR=1.64, 95% CI 0.95 to 2.63,  $n=17$ ) among non-Caucasian males (table 3).

#### Cancer incidence

There was little difference in SIRs when comparing analysis approaches; therefore, reporting focused on results from the multiple-cancer approach (table 2). All-cancer incidence was slightly above expectation (SIR=1.09, 95% CI 1.06 to 1.12,  $n=4461$ ). Observed elevations in cancers of a priori interest were generally consistent with mortality data as evidenced by significant excess cancers of the oesophagus (SIR=1.62, 95% CI 1.31 to 2.00,  $n=90$ ); large intestine (SIR=1.21, 95% CI 1.09 to 1.34,  $n=381$ ); kidney (SIR=1.27, 95% CI 1.09 to 1.48,  $n=166$ ) and lung (SIR=1.12, 95% CI 1.04 to 1.21,  $n=716$ ). As in mortality analyses, there were excess buccal and pharynx cancers (SIR=1.39, 95% CI 1.19 to 1.62,  $n=174$ ) and malignant mesothelioma (SIR=2.29, 95% CI 1.60 to 3.19,  $n=35$ ). Of those diagnosed with mesothelioma, 31 (88.6%) were pleural. Excess laryngeal cancer incidence was also observed (SIR=1.50, 95% CI 1.19 to 1.85,  $n=84$ ). The incidence of most remaining cancer sites was near expectation; however, multiple myeloma was significantly decreased (SIR=0.72, 95% CI 0.50 to 0.99,  $n=36$ ).

#### Women and non-Caucasians

Overall cancer incidence among women was elevated, but not significantly (SIR=1.24, 95% CI 0.89 to 1.69,  $n=40$ ). Consistent with mortality, female bladder cancer incidence was statistically significant but based on few cases (SIR=12.53, 95% CI 3.41 to 32.08,  $n<5$ ). Nearly half of all cases were breast cancer (SIR=1.45, 95% CI 0.86 to 2.29,  $n=18$ ). Nearly all breast cancers were diagnosed prior to the attained age of 55 years, with the highest SIR between the ages of 50 and 54 years (SIR=2.66, 95% CI 0.86 to 6.21,  $n=5$ ). Left-sided disease appeared more frequent (61%,  $n=11$ ). Overall cancer incidence among non-Caucasian male firefighters was near expectation (SIR=0.92, 95% CI 0.81 to 1.05,  $n=240$ ). There was excess prostate cancer (SIR=1.26, 95% CI 1.02 to 1.54,  $n=94$ ) but decreased lung cancer (SIR=0.67, 95% CI 0.43 to 1.00,  $n=24$ ) (tables 3 and 4).

#### Sensitivity analyses

Except for COPD and cancers of the lung, prostate and brain, there was little evidence of heterogeneity in SMRs (see online supplementary table S6) or SIRs (see online supplementary table S7) across fire departments for outcomes of a priori interest. For mortality, the between-department variance was largely attributable to outlying decreased lung cancer (SMR=0.76, 95% CI 0.64 to 0.89,  $n=142$ ) and COPD (SMR=0.53, 95% CI 0.40 to 0.69,  $n=57$ ) in San Francisco firefighters, and excess cancers of the prostate (SMR=1.28, 95% CI 1.08 to 1.50,  $n=152$ ) and lung (SMR=1.23, 95% CI 1.13 to 1.34,  $n=566$ ) in Chicago firefighters. The between-department variance in mortality persisted when using state populations as referent (see online supplementary table S8). Similarly, heterogeneous lung cancer incidence stemmed from decreased cases among San Francisco firefighters (SIR=0.70, 95% CI 0.56 to 0.87,  $n=81$ ); however, there was outlying excess prostate cancer incidence among San Francisco firefighters (SIR=1.22, 95% CI 1.08 to 1.37,  $n=276$ ). Brain cancer SIRs varied widely across fire departments; excess cancer was observed in San Francisco firefighters (SIR=1.95, 95% CI 1.14 to 3.12,  $n=17$ ), while decreased cancer was reported for Chicago (SIR=0.53, 95% CI 0.28 to 0.91,  $n=13$ ).

Restricting analyses to firefighters with one or more years of employment had negligible effects (see online supplementary table S9). Slight increases in SMRs were observed for most a priori outcomes when restricting the cohort to incident hires, although these differences were not statistically significant. Age-at-risk differences in mortality also lacked statistical significance, but SMRs generally appeared greater at older ages. SMRs for cancers of the breast (SMR=1.42, 95% CI 0.46 to 3.32,  $n=5$ ), oesophagus (SMR=1.41, 95% CI 1.05 to 1.86,  $n=51$ ), and kidney (SMR=1.47, 95% CI 1.09 to 1.95,  $n=48$ ) were highest among workers less than 65 years of age (see online supplementary table S10). Significant age-at-risk differences in SIRs were evident for prostate ( $p<0.001$ ) and bladder ( $p=0.002$ ) cancers (see online supplementary table S11). The heterogeneity was largely attributable to significant increases in prostate (SIR=1.21, 95% CI 1.10 to 1.33,  $n=426$ ) and bladder (SIR=1.33, 95% CI 1.08 to 1.62,  $n=97$ ) cancer risks among firefighter aged 64 years or less. Excess prostate cancer was limited to ages 45–59 years (SIR=1.45, 95% CI 1.28 to 1.64,  $n=249$ ), while the age pattern of excess bladder cancer incidence was unclear. The effects of restricting PYAR to age-at-risk  $<85$  were inconsequential (see online supplementary table S12). Excluding firefighters without race information also had little

**Table 3** Standardised mortality and incidence ratios among men compared with the US population for causes of a priori interest

Underlying cause (ICD-10 codes)	Mortality (1950–2009)				Cancer incidence (1985–2009)*			
	Caucasian		Other		Caucasian		Other	
	Obs	SMR (95% CI)	Obs	SMR (95% CI)	Obs	SIR (95% CI)	Obs	SIR (95% CI)
All causes	11 549	1.01 (0.99 to 1.03)	453	0.68 (0.62 to 0.74)	NA	NA	NA	NA
All cancers (C00-C97)	3175	1.16 (1.12 to 1.20)	104	0.80 (0.65 to 0.97)	4181	1.10 (1.07 to 1.13)	240	0.92 (0.81 to 1.05)
MN oesophagus (C15)	110	1.46 (1.20 to 1.75)	<5	0.51 (0.11 to 1.49)	87	1.70 (1.36 to 2.09)	<5	0.73 (0.15 to 2.15)
MN stomach (C16)	105	1.12 (0.92 to 1.36)	5	0.81 (0.26 to 1.89)	87	1.19 (0.96 to 1.47)	6	0.76 (0.28 to 1.66)
MN intestine (C17-C18)	319	1.32 (1.18 to 1.48)	7	0.68 (0.27 to 1.40)	379	1.23 (1.11 to 1.36)	18	0.90 (0.53 to 1.42)
MN rectum (C19-C21)	86	1.46 (1.17 to 1.81)	<5	1.21 (0.25 to 3.53)	159	1.16 (0.99 to 1.36)	7	0.62 (0.25 to 1.28)
MN lung (C33-C34)	1019	1.12 (1.05 to 1.19)	27	0.67 (0.44 to 0.97)	689	1.15 (1.07 to 1.24)	24	0.67 (0.43 to 1.00)
MN breast (C50)	5	1.43 (0.46 to 3.34)	0	NC	6	0.79 (0.29 to 1.72)	<5	3.32 (0.40 to 12.00)
MN prostate (C61)	265	1.06 (0.94 to 1.20)	17	1.64 (0.95 to 2.63)	1167	1.02 (0.96 to 1.08)	94	1.26 (1.02 to 1.54)
MN other male genital (C60, C62-C63)	<5	0.49 (0.13 to 1.26)	0	NC	16	0.64 (0.37 to 1.04)	<5	0.38 (0.01 to 2.13)
MN kidney (C64-C66)	91	1.31 (1.05 to 1.60)	<5	1.05 (0.22 to 3.07)	151	1.26 (1.06 to 1.47)	14	1.46 (0.80 to 2.45)
MN bladder (C67-C68)†	80	0.96 (0.76 to 1.19)	<5	1.19 (0.14 to 4.30)	305	1.11 (0.99 to 1.24)	7	0.92 (0.37 to 1.91)
MN brain (C47, C70-C72)	72	1.03 (0.81 to 1.30)	<5	0.44 (0.01 to 2.47)	49	1.05 (0.78 to 1.39)	<5	0.67 (0.08 to 2.42)
NHL (C46.3, C82-C85, C88.0, C88.3, C91.4, C96)‡	119	1.18 (0.98 to 1.41)	<5	1.01 (0.28 to 2.60)	161	1.02 (0.87 to 1.19)	7	0.56 (0.23 to 1.16)
Leukaemia (C91.0-C91.3, C91.5-C91.9, C92-C95)	117	1.10 (0.91 to 1.32)	5	1.28 (0.41 to 2.98)	88	0.88 (0.71 to 1.09)	11	1.90 (0.95 to 3.40)
Multiple myeloma (C88.7, C88.9, C90)	41	0.92 (0.66 to 1.25)	<5	0.35 (0.01 to 1.97)	35	0.76 (0.53 to 1.06)	<5	0.24 (0.01 to 1.32)
COPD (J40-J44)	362	0.73 (0.65 to 0.81)	5	0.50 (0.16 to 1.16)	NA	NA	NA	NA

\*Incidence results based on analysis of all invasive primary cancers (ie, multiple-cancer approach).

†Urinary bladder incidence included in situ (D09.0) and invasive cases as per SEER protocol.

‡NHL incidence data exclude Kaposi sarcoma (C46.3).

COPD, chronic obstructive pulmonary disease; ICD-10, International Classification of Diseases, 10th Revision; MN, malignancy; NA, not applicable; NC, not calculated; NHL, non-Hodgkin lymphoma; Obs, observed; SIR, standardised incidence ratio; SEER, Surveillance, Epidemiology, and End Results; SMR, standardised mortality ratio.

**Table 4** Standardised mortality ratios (US population referent) and rate ratios for select outcomes\* by employment duration (lagged 10 years)

Underlying cause (ICD-10 codes)	Employment duration (years)								Trend slope†, p Value
	0-<10		10-<20		20-<30		30+		
	Obs	SMR (95% CI) SRR (95% CI)	Obs	SMR (95% CI) SRR (95% CI)	Obs	SMR (95% CI) SRR (95% CI)	Obs	SMR (95% CI) SRR (95% CI)	
MN oesophagus (C15)	13	1.17 (0.62 to 2.00) (Reference)	28	1.72 (1.14 to 2.48) 2.43 (1.07 to 5.50)	53	1.40 (1.05 to 1.83) 1.17 (0.56 to 2.41)	19	1.18 (0.71 to 1.84) 0.60 (0.27 to 1.35)	-2.14×10 <sup>-6</sup> , 0.141
MN stomach (C16)	12	0.80 (0.41 to 1.40) (Reference)	18	0.92 (0.54 to 1.45) 0.33 (0.08 to 1.43)	47	1.07 (0.79 to 1.43) 0.39 (0.10 to 1.55)	33	1.53 (1.06 to 2.15) 0.40 (0.10 to 1.58)	3.06×10 <sup>-7</sup> , 0.822
MN intestine (C17-C18)	27	0.86 (0.57 to 1.26) (Reference)	52	1.27 (0.95 to 1.67) 1.16 (0.38 to 3.54)	171	1.42 (1.22 to 1.65) 0.62 (0.27 to 1.44)	76	1.28 (1.01 to 1.60) 0.40 (0.17 to 0.94)	-7.54×10 <sup>-6</sup> , <0.001
MN rectum (C19-C21)	13	1.48 (0.79 to 2.54) (Reference)	19	1.58 (0.95 to 2.46) 0.99 (0.33 to 2.97)	37	1.35 (0.95 to 1.86) 0.61 (0.24 to 1.52)	20	1.52 (0.93 to 2.34) 0.43 (0.16 to 1.14)	-1.61×10 <sup>-6</sup> , 0.001
MN lung (C33-C34)	123	1.02 (0.85 to 1.22) (Reference)	184	1.03 (0.88 to 1.19) 1.32 (0.97 to 1.80)	523	1.14 (1.05 to 1.24) 1.24 (0.91 to 1.68)	216	1.12 (0.98 to 1.28) 0.80 (0.59 to 1.08)	-8.83×10 <sup>-6</sup> , 0.216
MN prostate (C61)	24	1.39 (0.89 to 2.07) (Reference)	23	1.08 (0.68 to 1.62) 0.66 (0.31 to 1.41)	148	1.10 (0.93 to 1.29) 0.84 (0.47 to 1.50)	87	1.01 (0.81 to 1.25) 0.69 (0.39 to 1.22)	-2.03×10 <sup>-6</sup> , 0.192
MN kidney (C64-C66)	12	1.10 (0.57 to 1.92) (Reference)	18	1.24 (0.73 to 1.95) 0.61 (0.26 to 1.48)	47	1.43 (1.05 to 1.90) 1.25 (0.58 to 2.69)	17	1.19 (0.69 to 1.91) 0.70 (0.29 to 1.67)	-1.05×10 <sup>-7</sup> , 0.924
MN bladder and other urinary (C67-C68)	8	1.05 (0.45 to 2.08) (Reference)	7	0.65 (0.26 to 1.34) 0.25 (0.08 to 0.79)	46	1.08 (0.79 to 1.45) 1.15 (0.49 to 2.70)	23	0.94 (0.60 to 1.41) 1.03 (0.38 to 2.83)	2.58×10 <sup>-6</sup> , 0.258
MN brain and other nervous (C47, C70-C72)	12	0.65 (0.34 to 1.13) (Reference)	15	0.88 (0.49 to 1.46) 0.80 (0.30 to 2.19)	32	1.17 (0.80 to 1.65) 1.48 (0.60 to 3.68)	14	1.47 (0.80 to 2.46) 1.52 (0.53 to 4.34)	1.01×10 <sup>-6</sup> , 0.118
NHL (C46.3, C82-C85, C88.0, C88.3, C91.4, C96)	18	0.98 (0.58 to 1.55) (Reference)	9	0.51 (0.23 to 0.96) 1.18 (0.41 to 3.45)	63	1.35 (1.04 to 1.73) 1.15 (0.60 to 2.22)	33	1.47 (1.01 to 2.06) 1.04 (0.51 to 2.15)	-7.39×10 <sup>-8</sup> , 0.849
Leukaemia (C91.0-C91.3, C91.5-C91.9, C92-C95)	18	0.91 (0.54 to 1.44) (Reference)	23	1.36 (0.86 to 2.05) 2.24 (0.92 to 5.50)	54	1.11 (0.83 to 1.45) 1.36 (0.65 to 2.87)	27	1.06 (0.70 to 1.54) 1.13 (0.48 to 2.67)	-5.10×10 <sup>-9</sup> , 0.997
Multiple myeloma (C88.7, C88.9, C90)	5	0.84 (0.27 to 1.96) (Reference)	<5	0.52 (0.14 to 1.34) 0.56 (0.11 to 2.82)	22	0.97 (0.61 to 1.47) 1.59 (0.47 to 5.41)	11	0.99 (0.49 to 1.77) 1.25 (0.33 to 4.75)	5.27×10 <sup>-7</sup> , 0.407
COPD (J40-J44)	33	0.78 (0.54 to 1.10) (Reference)	38	0.69 (0.49 to 0.94) 1.07 (0.60 to 1.91)	185	0.70 (0.60 to 0.81) 1.03 (0.67 to 1.60)	111	0.75 (0.62 to 0.91) 0.83 (0.53 to 1.31)	-2.80×10 <sup>-6</sup> , 0.005

\*Excluding a priori causes with total observations &lt;20.

†Cause-specific deaths per year of employment-person-year.

COPD, chronic obstructive pulmonary disease; ICD-10, International Classification of Diseases, 10th Revision; MN, malignancy; NHL, non-Hodgkin lymphoma; Obs, observed; SMR, standardised mortality ratio; SRR, standardised rate ratio.

effect on a priori outcomes (results not shown). Finally, there was no apparent trend in increasing risk with employment duration; however, negative trends in COPD and colorectal cancer SRRs were evident (table 4). Subsequent sensitivity analyses revealed that SRRs were largely dependent on selection of cut-points and lag periods (results not shown).

## DISCUSSION

This study is among the largest examining cancer risk in career firefighters. The pooled approach and long follow-up period improved risk estimates relative to previous studies. With few exceptions, there was little evidence of significant cancer risk heterogeneity across fire departments or age groups. Furthermore, sensitivity analyses did not suggest the potential for significant bias from including short-term workers, prevalent hires, or person-time in the open-ended age-group (85+ years). Despite notable differences in the analytical approaches, we observed remarkable similarities between mortality and incidence analyses. Additionally, the results of incidence analyses were not significantly affected by the choice of including multiple primaries or only the first cancer diagnosis. The lack of significant differences in results between fire departments, end-points, and analytic techniques suggest that the pooled study findings are robust and generalisable to similar firefighter populations.

We observed decreases in many non-malignant diseases that suggest improved health in these firefighters compared with the general population. This finding is not surprising given health requirements for entering and remaining in the fire service. Nevertheless, there was a modest excess in overall cancer mortality and incidence brought about by excess solid cancers at several sites of a priori interest. With few exceptions, our results are consistent with those previously reported and similar to SREs presented in the meta-analysis by LeMasters *et al.*<sup>14</sup> Nevertheless, we found little evidence of excess cancers of the testes, brain and lymphohematopoietic systems, which is contrary to the synthesis by LeMasters *et al.*<sup>14</sup> and subsequently published studies.<sup>8 11</sup>

We observed about a twofold increase in malignant mesothelioma mortality and incidence compared with the US population. Malignant mesothelioma is largely attributable to asbestos exposure, with sparse evidence of other causes.<sup>22</sup> Excess malignant mesothelioma in US firefighters was not previously described; however, excess incidence was recently observed in Nordic firefighters aged 70+ years,<sup>23</sup> and increased risk of asbestos-induced pulmonary and pleural fibrosis was reported in a study of New York City firefighters.<sup>24</sup> Although firefighter exposures to asbestos are known, the absence of previous reports of malignant mesothelioma is not surprising given the rarity and extremely long latency (20–40 years) of the disease. The average time between the date first employed and the date of diagnosis in the current study was 45 years; therefore, firefighting exposure-induced disease may be discernible only after lengthy follow-up. Also, previous studies have been hindered by the lack of specific codes for mesothelioma deaths before ICD-10.

We observed excess digestive cancers, mainly of oesophageal and colorectal sites. Information on occupational causes is sparse, although there is limited evidence suggesting asbestos and diesel exhaust exposures may be weakly associated with gastrointestinal cancers.<sup>25 26</sup> Still, the relation between these hazardous exposures and digestive cancers appears small compared to the effects of other factors such as diet, obesity, physical activity, tobacco use and alcohol consumption.<sup>22 27</sup> We also

found increased risk of oral, pharyngeal and laryngeal cancers, compared with the US population. Similar to digestive cancers, important risk factors for these sites are tobacco and alcohol consumption, with lesser evidence that exposures to wood dusts, smoke, asbestos, PAHs and acid mists may also increase risk.<sup>22 28 29</sup>

Some insight into the degree of a potential bias from the lack of controlling for lifestyle factors can be gained from previous surveillance of firefighter behaviours. For example, the prevalence of smoking among current firefighters appears less than the general population, and is decreasing,<sup>30–33</sup> a trend that is consistent with observed decreases in non-malignant smoking-related diseases (eg, COPD, stroke) but contradictory to excess digestive, oral and respiratory cancers. As another example, previous studies suggest there is increased obesity among firefighters compared with the general population.<sup>34–36</sup> Obesity, or a dietary intake that is high in meat, fat, or overall caloric intake could contribute increased gastric or colorectal cancer risk, although concomitant elevations in health outcomes that are more strongly related to these factors (eg, ischaemic heart disease, diabetes mellitus, hypertension and stroke) were not found. Last, information on alcohol consumption within the fire service is sparse and inconsistent.<sup>37–40</sup> Some studies suggest that firefighter behaviours may differ from the general population, although it is not clear that any perceived behavioural difference is sufficient to explain disparities in alcohol-related health outcomes. In the current study, the information on non-malignant and potentially alcohol-related mortality was at conflict; there was excess mortality from cirrhosis and other chronic liver disease, but fewer than expected alcoholism deaths. Alternate explanations for increased cirrhosis mortality may be exposures to chemical toxins or infectious disease,<sup>41–43</sup> which may also account for excess acute renal dysfunction, a disease that is more common among those with chronic liver disease.

Fewer than 4% of firefighters in our study were women. There was evidence of excess female bladder and breast cancers; however, only bladder cancer mortality and incidence reached statistical significance. Modest excess bladder cancer has been observed in some occupations involving known or suspected bladder carcinogens (eg, PAHs, and diesel exhaust), yet contrary to our findings, risk patterns by occupation tend not to differ by gender.<sup>22</sup> There is little evidence linking female breast cancer to workplace exposures; however, prolonged shift work may be a risk factor (and to a lesser extent a risk factor for prostate, colon and endometrial cancers).<sup>2</sup> Moreover, similar findings had not been reported previously, although increased risk of Hodgkin lymphoma and cancers of the cervix and thyroid among women firefighters (n=2017) was recently described.<sup>11</sup> Given the small sample and the lack of confirmatory results, our findings on female outcomes merit cautious interpretation.

Excess bladder and prostate cancer incidence was found among firefighters less than 65 years of age. Interestingly, the prostate cancer excess was limited to ages between 45 years and 59 years, which was consistent with recent observations in Nordic firefighters.<sup>23</sup> Similar mortality patterns were not observed. These cancers have relatively high survival; therefore, the underlying cause of death may be an inferior risk measure compared to cancer diagnoses. The early onset of these cancers suggests an association with firefighting. Prostate and bladder cancer diagnoses can occur following routine screening.<sup>44 45</sup> As an alternative explanation, differences in medical screening (eg, prostate-specific antigen tests) among firefighters compared to the general population could have contributed to the observed excess. Data on cancer screening practices are lacking; however,

it is plausible that screening may be more frequent among firefighters with improved healthcare availability and heightened cancer awareness.

There was little evidence of increasing cancer risk with increasing employment; however, there were notable analytical shortcomings that merit discussion. First, rather than specifying cut-points and an exposure lag period specific to each outcome, we applied cut-points (10, 20 and 30 years) used in earlier studies<sup>5 9 46</sup> and a common exposure lag period (10 years) to all outcomes; these choices were found to be influential in subsequent sensitivity analyses. Second, our methods have limited capability to account for HWE or other sources of bias that may have masked a dose response. Last, employment duration may poorly represent exposure potential given that some jobs are prone to lower exposures compared with others. For these reasons, a detailed exposure assessment is underway to support multivariable regression modelling for improved dose-response analyses.

Death certificates and registry data used in the current study are imperfect measures of cancer risk. In the absence of a national cancer registry, coverage is limited geographically; therefore, cases occurring outside catchment areas would be missed. Cases occurring before the registries attained comprehensive coverage have also been missed. Mortality analyses have the advantage of broader temporal and spatial coverage, but may poorly characterise cancers with relatively high survival (eg, cancers of the breast, bladder, testes and larynx). Finally, there may have been errors in tracing which can also bias study results. Although errors in ascertainment cannot be ruled out, our use of multiple information sources and end points, and the low numbers of participants lost to follow-up or moving out of catchment areas, act to minimise these errors.

## CONCLUSION

In this first phase of examining health effects in career firefighters, we report on mortality and cancer incidence among nearly 30 000 career firefighters followed from 1950 through 2009. Compared with the US population, we found small to moderate increases in risk for several cancer sites and for all cancers combined, stemming mostly from excess malignancies of the respiratory, digestive and urinary systems in otherwise healthy individuals. Our findings are consistent with previous studies and strengthen evidence of a relation between firefighters' occupational exposure and cancer. We found a previously unreported twofold excess of malignant mesothelioma among firefighters. Given that asbestos is the only known causal agent for malignant mesothelioma, and firefighter exposures are probable, the excess is likely to be a causal association.

This report provides the foundation for subsequent analyses of firefighter risks, some of which are ongoing. In upcoming research, detailed employment histories (eg, number and types of fire runs) and institutional knowledge (eg, use of respiratory protection and source capture ventilation of diesel exhaust) will be used to derive exposure metrics to more accurately examine dose response. Future regression modelling will also enable examination of temporal effects that are poorly suited to life-table analyses, such as time since first exposure. Expansion and continued follow-up of this cohort would enhance future analyses, particularly among women and non-Caucasian firefighters.

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**Contributors** RDD participated in design, data collection, analysis and manuscript development. TLK conceived the study and participated in design and data collection. JHY participated in design, data collection and analysis. MMD, TRH, DB, SHZ, JJB and KMW participated in design and data collection. LEP participated in design and critical appraisal. All authors participated in the interpretation and presentation of results and have read and approved the final manuscript.

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## REFERENCES

- 1 Karter MJ, Stein GP. *U.S. Fire Department Profile Through 2011* NFPA Fire Analysis and Research Division, Quincy, MA: National Fire Protection Association, 2012:1–36.
- 2 International Agency for Research on Cancer. IARC working group on the evaluation of carcinogenic risks to humans. Painting, firefighting, and shiftwork. *IARC Monogr Eval Carcinog Risks Hum* 2010;98:9–764.
- 3 Aronson KJ, Tomlinson GA, Smith L. Mortality among fire fighters in metropolitan Toronto. *Am J Ind Med* 1994;26:89–101.
- 4 Tomlinson G, Gustavsson P, Hogstedt C. Mortality and cancer incidence in Stockholm fire fighters. *Am J Ind Med* 1994;25:219–28.
- 5 Vena JE, Fiedler RC. Mortality of a municipal-worker cohort: IV. Fire fighters. *Am J Ind Med* 1987;11:671–84.
- 6 Demers PA, Heyer NJ, Rosenstock L. Mortality among firefighters from three northwestern United States cities. *Br J Ind Med* 1992;49:664–70.
- 7 Bates MN. Registry-based case-control study of cancer in California firefighters. *Am J Ind Med* 2007;50:339–44.
- 8 Kang D, Davis LK, Hunt P, et al. Cancer incidence among male Massachusetts firefighters, 1987–2003. *Am J Ind Med* 2008;51:329–35.
- 9 Baris D, Garrity TJ, Telles JL, et al. Cohort mortality study of Philadelphia firefighters. *Am J Ind Med* 2001;39:463–76.
- 10 Beaumont JJ, Chu GS, Jones JR, et al. An epidemiologic study of cancer and other causes of mortality in San Francisco firefighters. *Am J Ind Med* 1991;19:357–72.



- 11 Ma F, Fleming LE, Lee DJ, *et al.* Cancer incidence in Florida professional firefighters, 1981 to 1999. *J Occup Environ Med* 2006;48:883–8.
- 12 Ma F, Fleming LE, Lee DJ, *et al.* Mortality in Florida professional firefighters, 1972 to 1999. *Am J Ind Med* 2005;47:509–17.
- 13 Heyer N, Weiss NS, Demers P, *et al.* Cohort mortality study of Seattle fire fighters: 1945–1983. *Am J Ind Med* 1990;17:493–504.
- 14 LeMasters GK, Genaidy AM, Succop P, *et al.* Cancer risk among firefighters: A review and meta-analysis of 32 studies. *J Occup Environ Med* 2006;48:1189–202.
- 15 Fritz A, Percy C, Jack A, *et al.* eds. *International classification of diseases for oncology*. 3rd edn. (ICD-O-3). Geneva: World Health Organization, 2000.
- 16 Schubauer-Berigan MK, Hein MJ, Raudabaugh WM, *et al.* Update of the NIOSH life table analysis system: a person-years analysis program for the windows computing environment. *Am J Ind Med* 2011;54:915–24.
- 17 Robinson CF, Schnorr TM, Cassinelli RT II, *et al.* Tenth revision U.S. mortality rates for use with the NIOSH Life Table Analysis System. *J Occup Environ Med* 2006;48:662–7.
- 18 Surveillance, Epidemiology, and End Results (SEER) Program ([www.seer.cancer.gov](http://www.seer.cancer.gov)) SEER\*Stat Database: Incidence—all available registries (1985 to 2009), National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2012, based on the November 2011 submission.
- 19 Merrill RM, Sloan A, Novilla LB. Understanding population-based site-specific cancer incidence rates in the USA. *J Cancer Educ* 2012;27:263–8.
- 20 Applebaum KM, Malloy EJ, Eisen EA. Reducing healthy worker survivor bias by restricting date of hire in a cohort study of Vermont granite workers. *Occup Environ Med* 2007;64:681–7.
- 21 Sorahan T. Bladder cancer risks in workers manufacturing chemicals for the rubber industry. *Occup Med (Lond)* 2008;58:496–501.
- 22 Schottenfeld D, Fraumeni JF. eds. *Cancer epidemiology and prevention*. 3rd edn. Oxford; New York, NY: Oxford University Press, 2006.
- 23 Demers PA, Martinsen JI, Kjaerheim K, *et al.* Cancer incidence among Nordic firefighters [abstract]. *Am J Epidemiol* 2011;173:S191.
- 24 Markowitz SB, Garibaldi K, Lillis R, *et al.* Asbestos and fire fighting. *Ann N Y Acad Sci* 1991;643:573–81.
- 25 Benbrahim-Tallaa L, Baan RA, Grosse Y, *et al.* Carcinogenicity of diesel-engine and gasoline-engine exhausts and some nitroarenes. *Lancet Oncol* 2012;13:663–4.
- 26 International Agency for Research on Cancer. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Arsenic, metals, fibres, and dusts. Volume 100C. A review of human carcinogens. *IARC Monogr Eval Carcinog Risks Hum* 2012;100:11–465.
- 27 International Agency for Research on Cancer. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Personal habits and indoor combustions. Volume 100 E. A review of human carcinogens. *IARC Monogr Eval Carcinog Risks Hum* 2012;100:1–538.
- 28 Paget-Bailly S, Cyr D, Luce D. Occupational exposures to asbestos, polycyclic aromatic hydrocarbons and solvents, and cancers of the oral cavity and pharynx: a quantitative literature review. *Int Arch Occup Environ Health* 2012;85:341–51.
- 29 Paget-Bailly S, Cyr D, Luce D. Occupational exposures and cancer of the larynx—systematic review and meta-analysis. *J Occup Environ Med* 2012; 54:71–84.
- 30 Haddock CK, Jitnarin N, Poston WS, *et al.* Tobacco use among firefighters in the central United States. *Am J Ind Med* 2011;54:697–706.
- 31 Lee DJ, LeBlanc W, Fleming LE, *et al.* Trends in US smoking rates in occupational groups: the National Health Interview Survey 1987–1994. *J Occup Environ Med* 2004;46:538–48.
- 32 Poston WS, Haddock CK, Jitnarin N, *et al.* A national qualitative study of tobacco use among career firefighters and department health personnel. *Nicotine Tob Res* 2012;14:734–41.
- 33 Lee DJ, Fleming LE, Arheart KL, *et al.* Smoking rate trends in U.S. occupational groups: the 1987 to 2004 National Health Interview Survey. *J Occup Environ Med* 2007;49:75–81.
- 34 Munir F, Clemes S, Houdmont J, *et al.* Overweight and obesity in UK firefighters. *Occup Med (Lond)* 2012;62:362–5.
- 35 Poston WS, Jitnarin N, Haddock CK, *et al.* Obesity and injury-related absenteeism in a population-based firefighter cohort. *Obesity (Silver Spring)* 2011; 19:2076–81.
- 36 Tsimenakis AJ, Christophi CA, Burrell JW, *et al.* The obesity epidemic and future emergency responders. *Obesity (Silver Spring)* 2009;17:1648–50.
- 37 Haddock CK, Jahnke SA, Poston WS, *et al.* Alcohol use among firefighters in the Central United States. *Occup Med (Lond)* 2012;62:661–4.
- 38 Carey MG, Al-Zaiti SS, Dean GE, *et al.* Sleep problems, depression, substance use, social bonding, and quality of life in professional firefighters. *J Occup Environ Med* 2011;53:928–33.
- 39 Parker DA, Harford TC. The epidemiology of alcohol consumption and dependence across occupations in the United States. *Alcohol Health Res World* 1992;16:97–105.
- 40 Boxer PA, Wild D. Psychological distress and alcohol use among fire fighters. *Scand J Work Environ Health* 1993;19:121–5.
- 41 Leiss JK, Ratcliffe JM, Lyden JT, *et al.* Blood exposure among paramedics: incidence rates from the national study to prevent blood exposure in paramedics. *Ann Epidemiol* 2006;16:720–5.
- 42 Rischitelli G, Harris J, McCauley L, *et al.* The risk of acquiring hepatitis B or C among public safety workers: a systematic review. *Am J Prev Med* 2001;20:299–306.
- 43 Boal WL, Hales T, Ross CS. Blood-borne pathogens among firefighters and emergency medical technicians. *Prehosp Emerg Care* 2005;9:236–47.
- 44 Potosky AL, Miller BA, Albertsen PC, *et al.* The role of increasing detection in the rising incidence of prostate-cancer. *JAMA* 1995;273:548–52.
- 45 Moyer VA. Screening for bladder cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med* 2011;155:246–51.
- 46 Demers PA, Checkoway H, Vaughan TL, *et al.* Cancer incidence among firefighters in Seattle and Tacoma, Washington (United States). *Cancer Causes Control* 1994;5:129–35.

2017

# Law Enforcement Fitness Policies in Relation to Job Injuries and Absenteeism

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# Walden University

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This is to certify that the doctoral dissertation by

Marlana Hancock

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2017



Abstract

Law Enforcement Fitness Policies in Relation to Job Injuries and Absenteeism

by

Marlana L. Hancock

MA, Sam Houston State University, 1997

BA, University of Northern Iowa, 1994

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Policy and Administration

Walden University

August 2017

## Abstract

After employment, job-related fitness requirements vary for law enforcement agencies within North Carolina. Police academies mandate specific job-related fitness requirements for recruits as a condition of graduation. Once employed, little is known about why some law enforcement agencies in North Carolina have physical fitness policies and others do not, particularly when injury rates and healthcare costs continue to rise. To better understand this inconsistency, the current study used a mixed methods approach to examine 6 midsized law enforcement agencies in North Carolina with varying fitness policies. The policy of each agency, along with OSHA work-related injuries and absenteeism reports, were examined quantitatively to determine if a relationship existed between policy and injuries and absenteeism. Analysis of variance (ANOVA) and post-hoc tests found a greater statistical significance between policy levels and injury rates than between policy level and absenteeism rates. An interview with agency personnel qualitatively identified common themed responses to determine whether the utility function of rational choice theory explained fitness policy implementation. It was difficult to determine whether the utilitarian component was the reason behind policy decisions, but data-driven results seemed to serve as an agent of fitness policy decision making. The results contributed to the limited academic literature on this topic although further research recommendations were made. The findings advocate for better officer health and fitness standards to reduce the risk of on-the-job injuries and absenteeism, and reduce health care costs to all involved.

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## Dedication

This study is dedicated to the men and women in blue who put their lives on the line every time they put on the uniform. My prayer is that you stay healthy and steadfast to serve your community with integrity and honor. And to my beloved Ken, I will love you always...

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## Chapter 1: Introduction to the Study

A police officer is faced with daily unknowns on the job, which can be both physically and psychologically demanding (Guffey, Larson, & Lasley, 2014). It seems fitting that a law enforcement agency would require officers to maintain a certain standard of fitness or wellness to secure their safety and well-being as well as to benefit the agency, as a healthier lifestyle encourages fewer missed days of work and lower health care costs. However, this does not seem to be common practice among law enforcement agencies in North Carolina. Though fitness requirements for police academy cadets are mandated by state training and standard boards, not all agencies mandate fitness as a condition of continued employment. This creates a misunderstanding as to why consistency does not exist beyond academy training and what factors contribute to specific fitness policy decision-making at the agency level. This research examines (a) why state-mandated physical fitness standards for police academy cadets are used at some law enforcement agencies but not others as a condition of employment and (b) whether more stringent fitness policies contribute to reduced job-related injuries and absenteeism rates. If there is a significant relationship between certain fitness policies and work-related injury rates and absenteeism, then future research might address this issue and support efforts to improve officer health and lower agency costs due to officer injuries and absenteeism.

### **Background of the Study**

There is little debate that the job demands of first responders (including law enforcement) place stress on and affect a body's efficiency. Physical and psychological stress go hand in hand and the effects can include lower back pain and heart disease

(Armstrong, Clare, & Plecas, 2014; Heneweer, Picavet, Staes, Kiers, & Vanhees, 2012). These job demands stress the importance of officers maintaining optimal cardiovascular endurance in order to reduce the risk of injury on the job. Given that officers must physically deal with individuals and equipment while on the job, it is not shocking that they maintain a higher heart rate compared to the general public (Armstrong et al., 2014). Over a career, exposure to these demands along with shiftwork can affect an officer's fitness for duty, especially for officers who have 20 or more years of experience (Wirtz & Nachreiner, 2012). Thus, although physical activity is known to benefit general health and promote prevention of injuries, many law enforcement agencies do not require certain fitness standards as a condition of employment. This is the case even though the North Carolina training and standards board continues to research and update task analysis standards for its police academies.

In 2015, the North Carolina Department of Justice concluded a study to update its Police Officer Physical Abilities Test (POPAT) from years past. The completion of the POPAT within a certain time limit is required of all North Carolina police academy cadets. The test is made up of various physical tasks that are designed to mirror real situations that patrol officers might encounter on the job. Its purpose is to differentiate between those who can and cannot perform the physical functions of a police officer's job at an adequate level of proficiency (North Carolina Justice Academy [NCJA], n.d.). Ensuring that people are physically fit for work by matching capabilities with physical job requirements is an important step toward reducing injury and absence rates (Rayson, 2000). A cadet's successful completion of POPAT means passing the basic law enforcement training academy. Unsuccessful completion means failing the entire

academy. Nevertheless, the question is this: If the state deems certain physical tasks necessary to perform the job in the police academy setting, why are many law enforcement agencies not requiring similar standards for officers working in the field?

Plat, Frings-Dresen, and Sluiter (2011) recommended using early intervention to promote a healthy lifestyle, which can reduce the risk of future injuries. In their study, emergency medical services (EMS), fire, and military personnel were examined; however, similar effects would be expected among police officers. Even though prevention would seem beneficial no matter the occupation, this needs to be explored further.

Guffey et al. (2014) did not find a direct correlation between officer fitness and injuries specifically but did find a correlation between officer weight and injuries after efforts were made by several departments to improve officer wellness. This cannot be discounted because weight can be a contributing factor to overall wellness and fitness. Perhaps weight needs to be considered in hypothesizing that more stringent fitness policies lower work-related injury and absenteeism rates.

One way to promote work injury prevention is to educate personnel and use resources already in place. For example, North Carolina legislation provides for a full public health mandate, which includes injury prevention. This responsibility lies within the North Carolina Health and Human Services Department. To promote health and fitness, funding could be available for injury prevention programs (Stier, Thombley, Kohn, & Jesada, 2012) within a number of occupations. This is an important issue that should be addressed within law enforcement management to determine, first, if agencies are aware of these resources, and second, if there is interest in using these state resources

to assist with fitness policy implementation. If supported by decision makers, available funding might justify routine health screening as a prevention tool. Making agencies aware of these available resources could enhance a positive management system that strengthens an agency's commitment (Dick, 2011) to fitness. In this study, management support of fitness policies (or lack thereof) was examined to determine commitment to officer fitness. Theoretical application determined whether agency incentives for fitness improvement came from leadership, and if so, whether this influence was present in policy. Leadership management is an important component to consider when examining the policies of an agency (Schulhofer, Tyler, & Huq, 2011).

### **Problem Statement**

Law enforcement personnel have an increased risk for cardiovascular disease and other health issues due to the common shiftwork involved and the unknown demands of the job (Armstrong et al., 2014; Wright, Barbosa-Leiker, & Hoekstra, 2011). This type of work environment can lead to an increased risk of injuries if officers are not appropriately prepared to the best of their abilities. Injuries can be reduced through such prevention approaches as improved physical activity (Heneweer et al., 2012). The importance of a healthy lifestyle has been emphasized in a plethora of research (Means, Lowry, & Hoffman, 2011b). It is also known that officers are at a higher risk for injury than the average person simply because of their profession. These factors justify the action of an agency to require officers to maintain an optimal health level, especially given that medical expenses and lost productivity in the workplace total more than \$400 billion in the United States each year (Stier et al., 2012). Law enforcement is one of the industries included in those figures.



Law enforcement agencies in North Carolina define and determine their own standard operating procedures (SOPs), including fitness requirements. An agency can elect to set standards as a condition of employment as long as each standard is justified by the job requirements (Department of Labor, n.d.). Unfortunately, little is known about why some law enforcement agencies in North Carolina do and some do not have fitness standards, given the support that fitness has in research. It is not known whether having a physical fitness policy in place directly relates to job injuries and absenteeism rates. Using a sample of law enforcement agencies, the current research examined which factors contributed to implemented agency policy and determined whether the use of a fitness policy directly related to injury and absenteeism rates within an agency. Additionally, I sought to determine the following: If there was a relationship, did lost productivity, in part or whole, contribute to unfit officers getting injured?

### **Purpose of the Study**

This mixed methods study was conducted for the purpose of testing the utility function component of rational choice theory to determine if it explained fitness policy implementation and determined whether policy affected reported work-related injuries and absenteeism among North Carolina law enforcement agencies. The quantitative portion of the study examined the independent variable *policy* (defined as the presence or absence of an agency's fitness policy) over a 5-year period. The dependent variables *injuries* and *absences* consisted of the total number of work-related injuries and absences reported each year at an agency. The control variable, *progressive policy*, was defined according to an agency's increased fitness requirements over a 5-year period.

## Research Questions and Hypotheses

Three questions guided this research:

**RQ1.** What relationship, if any, exists between a North Carolina law enforcement agency's fitness policy and work-related injuries and absenteeism?

**H<sub>0</sub>:** No significant relationship exists between the stringency of fitness policy and job-related injuries and absenteeism.

**H<sub>1</sub>:** The more stringent a fitness policy is, the lower the job-related injuries and absenteeism.

**RQ2.** When research emphasizes the benefits of maintaining a certain fitness level, particularly for first responders, does the utility function within rational choice theory explain why some North Carolina law enforcement agencies mandate physical fitness requirements for officers and others do not?

**H<sub>0</sub>:** Based on the utility function, rational choice theory does not explain why an agency has the current fitness policy in place.

**H<sub>1</sub>:** Rational choice theory presumes that policy decision-making is representative of a utility function and does explain why agencies have any or more stringent fitness policies in place.

**RQ3.** Are data-driven results of injury or absenteeism an agent or constraint as they pertain to the present fitness policy?

**H<sub>0</sub>:** Injuries and/or absenteeism rates are neither an agent nor a constraint of the current fitness policy.

**H<sub>1</sub>:** Injuries and/or absenteeism rates are either an agent or a constraint of the current fitness policy.

### **Theoretical Framework**

As applied to public policy, rational choice theory contends that individuals interact through a social process and these interactions ultimately achieve organizational decision-making. Therefore, individual actions can affect the outcomes of policymaking (Green, 2002; Jones, Boushey, & Workman, 2006). As rational choice theory is specifically applied to this study, it would be expected that fitness policy implementation is influenced by the decision-making process. To test this, managers and administrators from the sample of law enforcement agencies were questioned about their fitness policies over the last 5 years and were asked about the rationale for the policy, such as whether any incentives or consequences were tied to policies. The issue of what affects agency fitness policy was explored, including circumstances such as politics, budget, data-driven results, and personal decisions. Rational choice theory is explored further in Chapter 2. The results found will be shared with all involved organizations and may influence or impact agency policy concerning officer fitness standards, either presently or in the future (Lunenburg, 2011; Royle & Hall, 2012).

### **Definitions of Terms**

For this study, the following terms are used or referenced:

*Basic Law Enforcement Training (BLET):* A North Carolina state-mandated 616-hour (minimum) training course composed of 36 separate blocks of instruction and practical exercises, concluding with a comprehensive written exam and skills testing. It prepares individuals with entry-level skills needed to become certified law enforcement

officers in the state (North Carolina Department of Justice, 2015). It is also referred to as the “police academy.”

*Law enforcement:* Individuals and agencies responsible for enforcing state and local laws in the course of maintaining public order and safety (Bureau of Justice Statistics, 2016).

*Physical fitness:* “The ability to meet life’s daily demands, without undue fatigue, while maintaining sufficient energy or leisure time pursuits and to overcome emergency situations that may arise personally and professionally” (Commission on Accreditation for Law Enforcement Agencies [CALEA], 2010).

*Police administration:* Police officers whose role is to manage and supervise police agencies.

*Police officer:* Uniformed, sworn officers assigned to the patrol function of policing.

*Police Officer Physical Abilities Test (POPAT):* Scientifically-tested series of tasks designed to assess important physical abilities necessary for effective job performance as a police officer, developed to mirror real-life situations that officers might encounter on the job (North Carolina Department of Justice, 2015).

### **Nature of Study**

A purposive sample consisting of six North Carolina midsized law enforcement agencies in the Piedmont Triad region (see Appendices A and B) was chosen to participate in the study. Two agencies from each of the following categories were sought: (a) those with no mandated/voluntary fitness policy over the last 5 years, (b) those with a progressive or changed fitness policy over the last 5 years, and (c) those with

a continued mandated fitness policy over the last 5 years. The search for agencies that fit these criteria began by using U.S. Census Bureau data to identify midsized populations in the North Carolina Piedmont Triad region. Using a quasi-experimental design, the sample of six was placed into nonrandomly assigned groups (independent, nominal variables). The number of work days missed in each of the years 2011-2015 due to work-related injuries served as the dependent, ratio-level variable.

Upon written agency permission and a guarantee of anonymity, agency administrators were asked to participate in a brief interview to answer a short, open-ended questionnaire inquiring about fitness policy implementation as it pertained to decision-making within the agency. The intent was to help determine what influences and affects these policy decisions within the agency. Descriptive statistics were used for each variable, and ANOVA and post-hoc tests were used to identify any significant relationships between the independent and dependent variables. *Progressive policy* was used as a control variable in an attempt to lessen the cause and effect order. An advisory committee was used to both construct questionnaire content and review the research process and purpose.

Permission was also secured to examine each agency's fitness policy and Occupational Safety and Health Administration (OSHA) 300A summary reports of work-related injuries and absences from the years 2011-2015. It was assumed that both fitness policies and injury reports were internally valid and therefore measured what they were supposed to. To ensure external validity prior to analysis, a collaborative effort between the researcher and agency administrator was used to review these documents to verify

that what was reported represented an accurate portrayal of information. This included a review of fitness policies, OSHA documents, and completed questionnaires.

### **Assumptions, Limitations, Delimitations**

It was assumed for this study that the participating agencies would answer interview questions honestly and provide current, accurate policy and OSHA data. In order to support this premise, questionnaires were provided in advance and question responses as well as OSHA forms were reviewed with each agency for accuracy. Any research presents potential validity and reliability issues; this study was not an exception. The stringency level of an agency's fitness policy served as a control variable; the stringency level was used to determine whether the absence or the presence of a mandate was a reliable measure of work absenteeism. It is important in research that any instrument used measures what is intended; therefore, instruments in this study were analyzed for validity to determine if the content being measured was accurate (Frankfort-Nachmias & Nachmias, 2008).

To maintain internal validity, all distributed questionnaires consisted of the same questions pertaining to fitness policy standards and absenteeism rates over the same 5-year period. For consistency purposes, an average standardized absentee rate was calculated per agency to allow cross comparisons. To establish questionnaire tool validity and reliability, a criminal justice advisory board (made up of local agency representatives) was presented with preliminary questions and solicited for feedback prior to questionnaire distribution.

Research integrity was promoted and any misconduct was avoided, as such actions reflect an organization or institution (Creswell, 2013). Data collection and

participant anonymity, privacy, and confidentiality all needed to be protected, as this helped to ensure my trustworthiness as a researcher. Data analyses and discussion were presented in neutral language and at the appropriate level for audience understanding (Creswell, 2013). The Academy of Criminal Justice Sciences (ACJS) code of ethics guided the conduct of this research. Although the steps I took did not eliminate researcher bias, they helped to reduce it. Applying reflexivity within qualitative research implies that a researcher is upfront regarding his or her background, and that any interpretation and gains that might come from the study will be fully acknowledged (Creswell, 2013). To help eliminate additional bias, a written transcription of all responses was provided to each interviewee for review of accuracy. This step was pertinent because researchers have an obligation to monitor and report as fully and truthfully as possible all procedures that were used in a study (Patton, 2002).

Also important to researchers is awareness of potential ecological and individual fallacies in a study (Frankfort-Nachmias & Nachmias, 2008). It should be emphasized that an agency's lack of enforcement of a fitness standard does not imply that officers cannot or do not take individual responsibility for their own duty fitness. It also cannot be inferred that the presence of high absentee or injury rates reflects poor officer or agency performance.

A final limitation of this study was that a sample of six agencies was used. Using such a small sample limited the detection of large differences and did not allow for the generalization of results found, either within or outside the state. However, findings help to address the research questions presented and contribute to what little is known about the relationship between fitness policies and work-related injuries and absenteeism within

law enforcement in North Carolina. The results add to the knowledge of how policies are derived.

### **Significance of Study**

A thorough search of the literature on officer fitness and injuries found very limited studies specifically comparing physical fitness policies to job injuries nationwide or in North Carolina. Every industry is required by OSHA to document and report work-related injuries. Therefore, the results of this study add to the literature by addressing whether mandated fitness requirements are related to agency-documented OSHA injury rates within the law enforcement profession. This study also contributes to the gap in field research because, although fitness is encouraged, little is being done to improve officer health as work-related-injury costs continue to rise. More specifically, research at the state level is lacking on whether fitness policies even influence the number of injuries reported among North Carolina law enforcement agencies, and what the rationale is for current policies. By addressing these issues, the study contributes to law enforcement field knowledge and any significance between fitness policies and work-related injuries and absenteeism. The significance between policy and injury rates found within the study demonstrates the need for widespread participation in wellness initiatives. This could not only improve individual officer health, but also better equip officers to perform their duties with a reduced likelihood of getting hurt. Simply put, being more fit could increase the chance of officers going home injury free at the end of each shift.

Ensuring that officers are safely and physically able to fulfill their required duties should be not only a personal officer responsibility but also a concern for each agency. Current policies may be sufficient, and there may be no relationship between work



injuries or absences, but this is understudied in North Carolina. However, because one may affect the other, and wellness, along with increased job performance and cost savings prevails, everyone involved wins. Rejecting the null hypothesis of the current statistical analyses can provide a base for positive fitness policy changes within law enforcement, thereby sustaining the importance of fitness for officers beyond academy training. Results provide an opportunity for agencies to promote fitness and wellness as a means to improve officer health and reduce injuries and absenteeism. This could benefit officers, lower agency health costs, and lower overall health insurance provider costs.

### **Social Change**

A police officer's job is not routine; it is never the same from day to day. It is difficult to predict what officers will need to do to protect themselves and the public. Therefore, officers should train and be prepared to respond to the unpredictable. This can be done through the use of combined physical and psychological exercises as provided in police academy training. Training includes intense encounters, development of survival instincts, and exercises to build strength and power endurance. These tactics should be included in regularly scheduled in-service events (Zagaria, 2007) because many officers do not continue fitness training beyond the academy, and physical training often trails off if an agency does not either promote or mandate fitness-level standards. Examining agencies that both do and do not institute fitness policies in North Carolina, I sought to bring attention to policy discrepancies at a state level. This study represented an opportunity to raise awareness of possible fitness–injury correlations and informs agencies of available resources they might not be aware of, such as health and injury prevention programs and potential funding for these programs.

Ultimately, a significant relationship between policy and injury and absenteeism rates provides a springboard to advocate for better health and fitness among officers in the state. Sharing results could also increase awareness of officer health and safety benefits as they pertain to the law enforcement job, meaning providing the necessary tools to promote officer wellness (Office of Community Oriented Policing Services, 2015) and decrease injury risks. In turn, better wellness increases both officer health/wellness and public service efficiency.

### **Summary**

This research was conducted to examine fitness policies and OSHA injury reports among six North Carolina law enforcement agencies over a 5-year period. Using a quantitative analysis, I sought to determine whether a significant relationship existed between these variables. Analyses rejected the null hypothesis, and a certain category of policies related to fewer injuries and absences; thus, findings supported the promotion of physical fitness policies for police officers beyond the police academy.

Additional analysis through qualitative examination of questionnaire responses from police administrators determined whether rational choice theory supports policy decision-making, focusing on the utility function. Responses helped in determining which factors contributed to policy decision-making and whether decisions were based on personal preferences, political influence, or other circumstances, or whether decisions were based on a representation of larger objectives. Chapter 2 explores the variety of studies I found that were related to this topic.

## Chapter 2: Literature Review

### Introduction

A generally sedentary population is at a greater risk of coronary disease than those who are more active. The same stands true for those who have more physically demanding jobs; their risk for heart attack and absenteeism is lower (Donoghue, 1977). Police work can be physically demanding as well as stressful and dangerous (Zimmerman, 2012). As patrol officers answer calls for service, they never know what will happen next, or what abilities or skills might be required of them at any given time. Therefore, suffering injury or worse is always a possibility. Law enforcement has one of the highest rates of injuries and illnesses among occupations (Bureau of Labor Statistics [BLS], 2014) and has greater mortality and morbidity rates than the general public (FitForce, Inc., 2010; Quigley, 2008; Smith & Tooker, 2011; Wright et al., 2011). Research has shown that improved endurance performance makes the body less susceptible to fatigue and a person less likely to commit errors (Donoghue, 1977). Various factors work into this equation, but one specifically, officer fitness, is the focus of this discussion. Though the police academy helps cadets prepare for entry into the law enforcement workplace, the rest of the preparation and experience depends on the officer and the hiring agency. The agency sets the tone for what is deemed acceptable and important. Sometimes certain health and fitness levels are required, or at least encouraged throughout an officer's career, but among North Carolina law enforcement agencies, this general policy seems to be more the exception than the rule, which in part was what this research set out to discover.

Health and fitness among those in law enforcement is declining. *Health* is considered “a state of complete physical, mental, and emotional well-being” (Smith & Tooker, 2011, p. 3). The consequences of not being healthy include vulnerability to on-duty illness and injury, and increased exposure to liability (FitForce, Inc., 2010; Pronk, 2015). However, does being in better health or better shape necessarily contribute to fewer work-related injuries for police officers? Interventions offered to improve physical job performance have shown diverse results (Plat et al., 2011). Therefore, the literature was explored further to address whether better officer fitness is related to fewer job injuries or less absenteeism.

Having physically fit police officers has benefits. Fit officers tend to use less time off because of injury or illness and tend to be less stressed (Bissett, Bissett, & Snell, 2012; Quigley, 2008). *Physical fitness*, as defined by the Commission on Accreditation for Law Enforcement Agencies (CALEA, 2010), is “the ability to meet life’s daily demands, without undue fatigue, while maintaining sufficient energy or leisure time pursuits and to overcome emergency situations that may arise personally and professionally” (Smith & Tooker, 2011, p. 2). Yet who decides which fitness standards to implement and why is unclear. Whether the decision is personal, administrative, or political is known only by the agency. Other factors such as personnel, resources, and funding might contribute to policy decision-making. As funding for public safety decreases (Bueermann, 2012), it is important that agencies be able to do more with less. Doing more includes informing decision makers about using the best strategies with the most desirable outcomes.

Police academies instill physical fitness training and testing as a condition of graduation. Adequately preparing cadets at the police academy adds value to their future performance (Caro, 2011), as both strength training and cardiovascular exercise have rewards and can improve individuals' quality of life in many ways (Williams, 2002). However, most departmental policies do not require that officers maintain that fitness and then leaders wonder why officers have high stress levels and suffer from various health conditions at a higher rate than the general public (Williams, 2002). Physical activity is an integral part of healthy living (Pronk, 2009), as it helps to prevent heart disease and assists with weight control, thus protecting the body from injury (Quigley, 2008). Physical tasks required of police officers are similar worldwide. Some studies have found that certain physical agility tests are not strongly related to actual job requirements (Bissett et al., 2012; Bonneau & Brown, 1995). It seems evident that policing requires strength and endurance, in that officers are engaged in physical challenges regularly (Guffey et al., 2014). Because policing is a profession whose members experience a high level of job-related stress (Hartley, Burchfiel, Fekedulegn, Andrew, & Violanti, 2011), it seems that police officers who maintain their fitness are better able to cope with job stress and are better prepared for critical incidents than their peers who do not (Ebling, 2002). Thus, given all the benefits a fit lifestyle can bring, one might wonder why many officers are still unfit for the job (Williams, 2002).

### **Searching the Literature**

A comprehensive review of the literature was conducted using several databases and search engines. Sources were obtained from Walden University's library using ProQuest Criminal Justice, EBSCO, and other databases. Google Scholar was also used

to search and obtain peer-reviewed and topic-pertinent information. Key words were used in three main categorical searches for peer-reviewed articles. First, *police*, *law enforcement*, and *cops* were used interchangeably as ‘OR’ Boolean factors. Then *fitness*, *wellness*, and *health* were used as ‘OR’ Boolean factors. Finally, *policies*, *injuries*, and *absenteeism* were included. *Rational choice theory* was also searched in the various databases. These key words resulted in multiple returns, which were then examined for relevancy according to the topic at hand. The main focus was on recent literature within the last 5 years; however, other later sources were also used if it was determined that the content had relevance to this study. Electronic sources such as the BLS, OSHA, U.S. Department of Health and Human Services, and U.S. Equal Employment Opportunity Commission were used to find the most up-to-date information on health and work-related injuries.

From the literature obtained and reviewed, the following themes for discussion emerged: (a) the physical demands of law enforcement, (b) work-related injuries, (c) physical fitness policies in law enforcement, (d) the legalities of fitness standards, (e) physical fitness testing, (f) the POPAT, (g) the impact of *fitness* for duty, (h) fitness resources for the workplace, (i) leadership in law enforcement, and (j) rational choice theory.

### **Physical Demands of Law Enforcement**

Emergency service professionals are exposed to hazards that are inherent in the job (Plat et al., 2011). The physical demands placed on law enforcement officers specifically have been documented to include such activities as apprehending suspects, foot pursuit, and even firing a weapon (Anderson, Plecas, & Segger, 2001; Brown,

Tandy, Wulf, & Young, 2013; Zimmerman, 2012). These demands include being able to apprehend and restrain individuals. In over 75% of police apprehensions, suspect resistance is moderate to strong, and the average amount of time to subdue a subject varies between 30 seconds and 2 minutes (Quigley, 2008). Such tasks require effort, which can be physically challenging (Anderson et al., 2001).

When police officers encounter high-risk situations, certain physiological patterns can be predicted and measured. Armstrong et al. (2014) documented that an officer's average heart rate throughout a shift was 22 beats a minute above an average resting heart rate. As officers encountered simulated use of force, their heart rates increased an average of 40 beats per minute. This demonstrates extra stress placed on the heart, which affects an officer both psychologically and physically (McCraty & Atkinson, 2012).

Even though police officer work patterns are characterized mainly by relatively long periods of low-level activity, occasionally, short periods of high-intensity activity are needed. To safely and effectively perform police functions, it is necessary to maintain a certain amount of physical fitness throughout one's career. Though much of the job can be executed independent of physical fitness, some tasks will require certain levels of physical fitness. However, how fit officers need to be and what factors can be used to predict successful performance are debatable (Collingwood, Hoffman, & Smith, 2004; Dillern, Jenssen, Lagestad, Nygard, & Ingebrigtsen, 2014). Ensuring that those in public safety are physically ready for their jobs can aid officers in performing their duties more safely. This effort can be enhanced by stressing positive lifestyle habits, as these habits help decrease health risks, improve quality of life, and assist agencies in reducing their liability by controlling risks and associated costs (FitForce, Inc., 2010).

A police department should ensure safe working practices, especially given that their officers face potentially violent situations (Bissett et al., 2012; Bonneau & Brown, 1995; Brown et al., 2013; “Fitness Tests Will Help Police,” 2012). For example, arrests are commonplace among police officers, and research suggests that higher fitness levels affect arrest encounters positively. Because the physical task most frequently demanded of officers is arrest, upholding some level of fitness is important (Dillern et al., 2014). Anderson et al. (2001) collected data observations that justify certain occupational requirements for police work. These observations included officers having to physically control suspects. Testing of physical abilities include tasks wherein officers have to get to a problem, control the problem, and remove the problem through appropriate simulated measures. Such observations, along with self-report surveys, can be accurately measured and tested (Anderson et al., 2001).

The last several decades have demonstrated much change in police work, such as the encouragement of alternative methods of dispute resolution and new computer and technology skills. Therefore, some have questioned whether physical abilities are still important for police officers (Bonneau & Brown, 1995). The fact remains, however, that there is nothing routine about police work, and it often requires short, intense encounters. Therefore, officers should train to condition their bodies to adapt and perform under various unpredictable conditions (Zagaria, 2007).

Police are subjected to both physical and psychological stress as they relate to the workplace (Phadke, Khan, Iqbal, & Ramakrishnan, 2014). Thus, another important component of officer fitness is psychological fitness for duty. Fitness-for-duty evaluations (FFDEs) can be and are used when situations exist wherein officers must be



psychologically ready for duty. The key object of this type of evaluation is to reduce an agency's liability (Fischler et al., 2011). Physical skills can be quite crucial when they are needed; they also have an important function from a psychological perspective for officers. Officers report that good physical skills can provide them with confidence as well as security when interacting with the public (Lagestad, 2012), therefore tying physical and psychological well-being to one another. However, it could be argued that the police job itself does not cause poor officer fitness and health; rather, a lack of agency fitness standards and programs is likely to blame (FitForce, Inc., 2010). This idea is explored later.

### **Work-Related Injuries**

The Occupational Safety and Health (OSH) Act of 1970 requires certain employers to maintain work-related injury and illness records (Form 300) and note the extent and severity of each case. An injury or illness is considered work-related if an event or exposure in the work environment caused or contributed to the condition or significantly aggravated a preexisting condition (OSHA, n.d.). Trends show that recently, law enforcement has experienced a reduction in health and fitness in the United States, making officers even more prone to work-related injuries and illness (Quigley, 2008).

In fact, duty leave due to injury appears to be at a high rate among public safety workers, a large portion of whom are police officers (Violanti et al., 2013). Because police work can be physically demanding, stressful, and dangerous, officers have among the highest rates of injury and illness of all occupations (BLS, 2014). National accident, injury, and illness data show that 20% of an average police agency's workforce is

responsible for 80% of accident costs, suggesting that this small percentage of least-fit officers is responsible for a large majority of injuries (Quigley, 2008). The leading causes of work injuries for police officers are falls, trips/slips, and mental stress (Ferguson, Prenzler, Sarre, & de Caires, 2011). Lower fitness levels tend to be associated with an increase in injury risk (Orr, Stierli, Hinton, & Steele, 2013), but the impacts of increased levels of fitness are a little less clear (Pronk, 2015). In a study of Milwaukee police officers across a 13-year span, Brandl and Stroschine (2012) found that accidents accounted for the majority of lost time from work when medical attention was sought.

### **Physical Fitness Policies in Law Enforcement**

There are limited sources that define or identify law enforcement agencies in North Carolina that have a fitness policy, and if so, to what level or extent. One recent study in the state found that among 145 police agencies, a significant association between fitness maintenance policies and officer injury existed (Fortenbery, 2016). However, to further explore specific policy requirements and reasons for implementation, each agency would have to be contacted to learn more about standing policies. Research has been conducted in other states that provide a better picture of fitness policy prevalence. For example, among 37 police departments in Michigan, only three (8%) had a policy regulating fitness standards or programs (Williams, 2002). Policies on fitness standards vary; sometimes they are vague, but other times they are quite specific, with noncompliance potentially leading to termination (Burlington Police Department [BPD], 2010; Farley, 2011). The intent of this study was to explore this issue further within the state of North Carolina.

Fitness is something for employers to contemplate because it is directly related to work performance, productivity, and health care costs, which are all factors to consider in operating an effective agency. It is important to the employee because it affects income, health, and other quality-of-life issues. If employers would indeed benefit from fit officers, they should promote fitness backed by supportive policy, adhering to both state and federal regulations (Pronk, 2015).

### **The Legalities of Fitness Standards**

In a general sense, employers are responsible for protecting their employees against physical harm that may reasonably be expected to arise in employment. If the necessary duty of care is not exercised, employers can be at risk for litigation (Rayson, 2000). Yet if certain measures or tests are to be used, those standards need to be job-related. Fitness tests should define the physical abilities needed in police work both objectively and realistically (Anderson et al., 2001) while complying with laws prohibiting discrimination (U.S. EEOC, n.d.). Data need to back up any standards or tests that are used in order to demonstrate that such standards or tests are correlated to job performance. Such data are available and should be used to document certain components of fitness such as body composition, cardiovascular endurance, anaerobic power, flexibility, strength, and agility in relation to the job (Collingwood et al., 2004; FitForce, Inc., 2010; Smith & Tooker, 2011). Ensuring that tasks are relevant to the industry assists in designing specific occupational standards that help to keep officers prepared to meet their job demands and avoid injury (McGill et al., 2013).

Several factors can hamper an employer's use of physical fitness tests because of disputes over the standards used; however, testing is necessary in this work environment

(Adams et al., 2014). One thing that an employer needs to take into consideration is Title VII of the Civil Rights Acts of 1964 and 1991. Title VII states, “it shall be an unlawful employment practice for an employer ... to discriminate against any individual with respect to his compensation, terms, conditions, or privileges of employment, because of such individual’s race, color, religion, sex, or national origin.” This includes discrimination in relation to any aspect of employment, including certain terms and conditions of employment (U.S. EEOC, n.d.). An agency cannot have different fitness standards for men and women if they are doing the same job because this can have a legal effect of invalidating the standards (Means et al., 2011b). If an agency is to terminate police officers based on specific agency fitness standards, the legality of this matter depends on how the court interprets Title VII (Guffey et al., 2014).

Courts are increasingly scrutinizing departmental physical agility requirements, particularly if entry-level officers and incumbent officers are held to different standards; however, health-based standards are more likely to be upheld, as they focus on general fitness assessments (Bissett et al., 2012). The Americans with Disabilities Act (ADA) of 1990 also needs to be considered when making physical or medical inquiries of incumbent employees. If such inquiries are made, they need to be based on objective reasoning (Fischler et al., 2011). In *Tennessee v. Garner* (1985), police use of deadly force to apprehend fleeing felons was restricted. This ruling had an implication that officers should be adequately fit to both pursue and subdue suspects without having to depend on deadly force. A similar ruling in *Parker v. District of Columbia* (1988) found that an unfit officer was unable to affect an arrest and so resorted to the use of deadly

force. Based on these rulings, administrators should consider adequate monitoring of officer fitness levels.

Proper medical and health screenings can help reduce litigation risk (Lee & Mallory, 2004). Employers need to adhere to all regulations that protect the health and safety of its workers (Pronk, 2015). If departments hire officers who possess sub-standard strength and ability skills, they could be held liable as it is the employer's responsibility to demonstrate that the physical standards required are based on essential elements of the job, and that the performance demanded is reasonable (Bissett et al., 2012; Bonneau & Brown, 1995).

### **Physical Fitness Testing**

A consensus says that law enforcement officers should maintain at least some level of physical fitness, but what that level is varies according to who one asks, and how should this be assessed? (Means, Lowry, & Hoffman, 2011a). Recruit training is designed to prepare officers for duty, and so includes tasks that relate to daily police work (Orr et al., 2013). Across the state of North Carolina, law enforcement training academies include a standard fitness component as part of training. Research recommends that academy curricula be based on needs-assessment as well as job-task analysis using the most practical approach to testing content (Bonneau & Brown, 1995; Caro, 2011; Plat et al., 2011). Personal and team accomplishments are usually stressed because it is important for both personal well-being and survival in a profession that comes with high levels of stress and danger (Ebling, 2002). Police officers are taught in ways that correlate to the type of work they do (Zagaria, 2007) but sometimes contrary to what are found once in a place of employment.

Fitness testing in theory is a way to motivate police personnel to maintain a fitness level to promote job readiness (Adams et al., 2014). However, standards first need to be established, and justified as to their significance. Several fitness activities have been identified as commonly being used in police work. These include running, jumping, lifting, carrying, and dragging to name a few. It is critical that testing assesses all physical abilities that are required of the job, or what Bonneau and Brown (1995) refer to as *occupational fitness*. While officers may utilize aerobic endurance on duty, research suggests that physiological demands may also be anaerobic in nature (Orr et al., 2013). Fitness can be measured using various physiological standards, from oxygen consumption to physical strength (Bonneau & Brown, 1995).

It is recommended that fitness assessments are conducted to determine and record officers' fitness levels. Scores can then be compared to norms and standards (Cooper Institute, 2014) and should be evaluated on up-to-date standards (Schulze, 2012). Cooper Institute standards are used by many agencies, as well as academy fitness training. The Cooper Institute is renowned for its history, research, and publication in ability/agility testing. Often a 50<sup>th</sup> percentile is used as a fitness benchmark (Bissett et al., 2012), as minimum fitness standards are directly related to adequate job performance (Pronk, 2015) because higher injury risk was associated with factors such as older age, slower run times, and lower self-rated physical activity (including aerobic exercise) (Knapik et al., 2011).

There is no 'one size fits all' when it comes to required fitness standards for officers. Individual departments need to consider the job demands and the working environment. There is some debate about whether the programs should be voluntary.

Bissett et al. (2012) do not believe that voluntary programs are going to be enough. Williams (2002) agrees and emphasizes that without a policy, even resources provided often go unused without any kind of incentive behind it. That is why a policy would be most beneficial because it regulates fitness of individual officers. However, FitForce, Inc. (2010) would argue that a voluntary fitness/wellness program would be the most effective and cost effective approach. Another approach might be to use a worker's health surveillance (WHS) to detect health effects resulting from occupational exposure. A WHS can assist employees in safely and healthfully meeting job requirements. The goal is to periodically monitor employees and detect adverse health effects as early as possible so preventative measures can be taken (Plat et al., 2011). For these purposes, *wellness* is defined as "those purposeful actions taken to attain and maintain optimal health and fitness" (Smith & Tooker, 2011, p. 3).

To standardize a job-related test, one's ability to perform the physical demands of core police tasks needs to be examined (Strating, Bakker, Dijkstra, Lemmink, & Groothoff, 2010). Both construct and criterion validations are accepted as job-related standards. Criterion such as job descriptions and injury reports can be examined to identify these standards. And because job tasks are not often performed in isolation, utilizing sequence events makes them more real-world situations (Collingwood et al., 2002). Job simulations are often used in testing to measure multiple physical abilities. These types of tests are beneficial because they possess a higher content validity than simple, single ability tests. But, job simulations can only predict performance within its administered context (Courtright, McCormick, Postlethwaite, Reeves, & Mount, 2013). Collingwood et al. (2004) used multivariate regression to demonstrate validity as it

relates to fitness activities. Regression analysis indicated that a group of specific test items can be good predictors of job tasks, and multiple primary physical factors that they analyzed met these criteria. Data must support and demonstrate a correlation between fitness testing and any job criterion performance, thereby establishing continuity in standards. It is incumbent standards that are key to successful job-related testing (Means et al., 2011a).

One concern about testing is that some criteria used by law enforcement agencies are argued to be discriminatory, particularly against sex. Large male-female differences exist within certain physical abilities. Therefore, test validity needs to demonstrate and defend its use, or different performance measures for women and men need to be developed based on normed scores (Anderson et al., 2001; Bissett et al., 2012; Courtright et al., 2013). Yet caution is needed when using gendered tests because separate standards could reinforce biases when it comes to gender since standards tend to establish biological sex and not biologically determined physical ability (Schulze, 2012). But, Means et al. (2011b) argue that whatever levels of fitness are required to perform the essential minimum physical functions of the job, they are achievable by most, regardless of gender or age, with as little as three hours of training per week. Another concern is tests that are used for employment selection generally focus on entry-level skills and ability. But a disjunction seems to exist if certain physical abilities are deemed essential to the job, and incumbent officers are not expected to also maintain these abilities (Bissett et al., 2012). The challenging part is that no matter what the demographics are of the police officer, the fundamental tasks to be performed on the job are the same (Bonneau &



Brown, 1995), even though women and older persons tend to test lower or slower (Strating et al., 2010).

Fitness standards for law enforcement officers should be tested to ensure that both new and incumbent officers possess the physical abilities to perform necessary tasks of the job. Standards should be developed, and training programs should be provided so that all officers have the access to and knowledge of skills needed to maintain personal fitness throughout their career (Means et al., 2011a). Such tests are important because those who do not meet job-related demands tend to perform lower, have more injuries, and more absenteeism (Collingwood et al., 2004; Courtright et al., 2013), all which can equate to reduced resources available. Lower levels of physical activity have been associated with absenteeism in the workplace, therefore employers should implement programs that will promote healthy activity levels (Pronk, 2009; Steinhardt, Greenhow, & Stewart, 1991).

Even administrators have recognized the need not only for officer fitness, but for lasting fitness maintenance programs (Lee & Mallory, 2004). Perhaps mandatory standards are not necessarily the answer, but the solution could be mandatory *testing* (Panos, 2010).

### **Police Officer Physical Abilities Test (POPAT)**

There are no national guidelines for physical fitness tests of police cadets, though most academies require some type of fitness standard (Schulze, 2012). In North Carolina, that standard is POPAT. The POPAT has been scientifically validated as being job specific, as it measures certain abilities that are required for general police duties (Anderson et al., 2001; North Carolina Department of Justice, 2015). In North Carolina,

for over 20 years, BLET students have been required to demonstrate job-related physical ability competencies as a condition of graduation. This test consists of a series of tasks that are designed to assess the physical abilities necessary to effectively perform the job of a police officer. The tasks were developed to mirror real situations that an officer might encounter on the job (North Carolina Department of Justice, 2015).

In 1998 the North Carolina Justice Academy (NCJA, 2000) POPAT subcommittee was specifically tasked with examining and evaluating various options as they related to the proposed POPAT. They were then to develop as well as deliver recommendations for using POPAT as a physical fitness measure (pass/fail) of the BLET program. In April of 2000, the committee agreed to adopt the POPAT report for several reasons. First, they felt such a test was reasonable, fair, and trainable. It was also deemed to be safe, practical, and consistent. The skills included in the POPAT were related to task analysis conducted in 1998 and the committee justified each of the following according to this task analysis. To be completed in seven minutes and twenty seconds (7:20) or less in duty belt and gear, cadets were to do the following:

1. Verbally recall street location
2. Exit police vehicle from seat belted position and run 200 yards
3. Pull a 150-pound person from vehicle and drag them 50 feet
4. Run up and down a five-step staircase three times
5. Push open and go through a 50-pound weighted door
6. Do 20 push-ups and twenty sit-ups
7. Run up and down a five-step staircase three times
8. Crawl through a 25-foot culvert

9. Do 20 push-ups and twenty sit-ups
10. Run 200 yards and return to vehicle
11. Drag a 150-pound person 50 feet
12. Verbally recall street names (NCJA, 2000).

The committee rationalized that the POPAT was reasonable and consisted of tasks that officers might perform while on duty. Officers need to be able to respond to multiple activities that include speed, agility, balance and stamina, and the POPAT was seen as a representation and combination of a variety of skills that may be required of an officer (NCJA, 2000). For example, the Burlington Police Department (2010) utilizes biannual POPAT testing of newly sworn officers as of January 2014. Collingwood et al. (2004) identified many of the same underlying and predictive fitness activities as they pertain to the POPAT. The primary factors identified include absolute upper-body strength (pushups), agility, anaerobic power (1.5 mile run), and anaerobic power (300-meter run). Their data indicates that certain physical activities can help determine a police officer's capability to perform essential tasks.

In 2008 another job analysis gave credence to altering the former POPAT test, which became effective for all BLET students starting in the fall of 2015. The scientific validation of the "new and improved" POPAT yielded a 95% confidence level. The test was designed to differentiate between individuals who can and cannot perform certain physical functions of a police officer's job at an identified adequate level of proficiency (North Carolina Department of Justice, 2015). The new test consists of two scenarios. Scenario 1 (chase and apprehension, to be completed in six minutes (6:00) or less wearing a ballistic vest), is as follows:

1. From a seated position, run 40 feet and back twice
2. Run 60 feet and return, with a 4-foot broad jump, 4 foot “fence” climb, and 2 feet high crawl obstacle in between
3. Roll a 100-pound dummy three times
4. Do 20 push-ups
5. Conduct another three-repetition dummy roll drill
6. Run 60 feet and return, with a 4-foot broad jump, 4 foot “fence” climb, and 2 feet high crawl obstacle in between
7. On step box, take 30 steps up and down
8. Conduct a three-repetition roll drill
9. Do 20 push-ups
10. Conduct a three-repetition roll drill (North Carolina Department of Justice, 2015).

Scenario 2 (rescue, to be completed in three minutes (3:00) or less wearing a ballistic vest), is as follows:

1. Run 50 feet and back twice
2. On step box, take 30 steps up and down
3. Run 50 feet and back twice
4. Drag a 175-pound dummy 25 feet and back (North Carolina Department of Justice, 2015).

Training programs should constantly be assessed to ensure they are both current and relevant. Violence is prevalent in the current environment and so training should be as realistic as possible. Officers should be provided with solid, research-based scenarios

that prepare them for an evolving and changing climate within which they work (Miller, 2015).

### **The Impact of *Fitness for Duty***

Though police work tends to largely be sedentary (Ramey et al., 2014; Steinhardt et al., 1991) and not always physically demanding, when officers need to engage in physical agility, their fitness level may very well be a determining factor of the outcome (Brown et al., 2013). Shiftwork is often an inevitable circumstance of police work that can contribute to this issue. Wirtz and Nachreiner (2012) concluded that the exposure to shiftwork had a significant impact on fitness for duty, particularly after 20-22 years working in this environment. An effective fitness program can help counteract some of the adverse health impacts of sedentary and shift work (Pronk, 2015). The inability to maintain resilience can impair judgment and the ability to make decisions. Results can potentially lead to inappropriate application of force which can carry lasting consequences such as compromising public safety, injuries and even lawsuits (McCarty & Atkinson, 2012; Zimmerman, 2012) as discussed earlier.

An unfit officer increases the probability of injury both to him or herself and to others (Boyce, Hiatt, & Jones, 1992). Unfit officers can be a liability in several ways. First, officers may use excessive force to compensate for an inability to use physical restraints, or second, unfit officers may cause other officers to be injured because they are unable to render adequate assistance. This not only presents potential legal exposure for those officers, but vicarious liability can also be extended to that officer's agency (Guffey et al., 2014).

Improved physical ability profits both the officer and employer. Officers profit from increased job performance, reduced stress and better mental preparation. Agencies benefit in terms of fiscal responsibility and efficiency (Quigley, 2008). Employers are the ones who bear the financial consequences of reduced work productivity and increased medical spending, and therefore are likely to benefit from a healthier workforce. Investing in and providing both means and incentives would seem to give an employer a return on their investment (van Dongen et al., 2011). Boyce, Jones, and Hiatt (1991) set out to investigate this relationship between physical fitness and work absences in police officers. But they found that the extent to which fitness predicts absenteeism is actually low. This is contrary to other and more up-to-date research, but does provide a valid focus to distinguish between absenteeism versus injuries.

Studies involving law enforcement officers indicate that more fit and active officers report 40-70% less absenteeism. This equates to a cost savings to the agency, therefore demonstrating that agency money spent on workplace fitness and wellness saves dollars as fit officers miss fewer work days (Smith, 2010; Smith & Tooker, 2011). These employees are also more highly productive (FitForce, Inc., 2010). Local and state governments across the United States are spending more money on policing than they did several decades ago. In a time where budget cuts are more likely than budget increases, a way to reduce some policing costs is to maximize productivity (Gascon & Foglesong, 2010). Unfit employees cost agencies lost days from work and increased insurance costs (Panos, 2010). Since a lack of fitness standards can be costly it leaves to wonder why departments do not set standards and provide training (Williams, 2002).

But, physical activity and fitness have a preventive effect on these factors (Sassen, Kok, Schaalma, Kiers, & Vanhees, 2010; Wright et al., 2011) which can have implications for the workplace. Therefore, the need to stay healthy requires both diet and exercise in order to maximize fitness level (Guffey et al., 2014; Hartley et al., 2011; McCraty & Atkinson, 2012). For example, interventions such as increasing physical activity and fitness can help improve cardiovascular risks (Sassen et al., 2010) as higher levels of cardiovascular fitness can be related to reduced absenteeism (Steinhardt et al., 1991).

Even though officer fitness is important, fitness alone is not sufficient. The focus should be on more than one risk factor to reap beneficial outcomes (Gerber et al., 2013). A healthy weight and physically active lifestyle are important for general health. But fitness also matters as it pertains to disease and illness prevention, as well as social and economic concerns in the workplace. However, since the workplace is but one component of life, a broader fitness perspective does need to extend beyond the workplace (Pronk, 2015). In fact, Ramey et al. (2014) and Boyce et al. (1992) found that police were more active off-duty, or unsupervised, than at work, or supervised. Work is connected to the home and the community. Health behaviors extend across all environments and are difficult to separate (Hymel et al., 2011).

Injuries pose a public health problem and effective strategies could help decrease this burden. But, public health practice has been a bit slow to address injury prevention (Stier et al., 2012), perhaps because of reluctance. Law enforcement agencies may be reluctant to partner with public health agencies because they are unclear on mandates.

However, North Carolina has taken initiative by partnering with various agencies to identify resources and responsibilities (Stier et al., 2012).

The advantages of a healthier, fitter, and energetic workforce include lowering absenteeism rates related to sickness. This is worth the necessary measures (“Fitness Tests,” 2012). Past studies have demonstrated that a correlation exists between the length of time on the police job and a decline in health and fitness (Panos, 2010) so agencies could benefit from a fit workforce in both performance and health. This leads to greater contributions and enables communities to invest elsewhere (Pronk, 2015). Exercise can help with the stress associated with the law enforcement job and contribute to more positive coping. Agencies recognize that fitness is important for their officers, and encourage maintaining a healthy and adequate fitness level, but many find it difficult to implement some kind of fitness program (Ebling, 2002; Lagestad, 2012). When police officers engage in physical activity on a regular basis, it better prepares them to deal with work-related situations requiring physical force, and helps strengthen their psychological well-being (Lagestad, 2012).

If departments choose to test and evaluate officer fitness, programs need to be put into place that can assist officers to both attain and maintain a necessary fitness level for the job (Bonneau & Brown, 1995). Of several national voluntary fitness and wellness programs, data showed improvements in overall fitness, therefore increasing productivity and reducing both absenteeism and worker’s compensation claims (Quigley, 2008). Health, fitness, and wellness should be included in a program as they are related and complement one another (Smith & Tooker, 2011). A supervised and job-specific exercise program for police officers improved fitness after 6 months in men and women.



However, a continued supervised exercise program is likely needed to maintain long-term health benefits (Rossomanno, Herrick, Kirk, & Kirk, 2012). Fitness and wellness programs also show to increase loyalty, generally improve morale, and reduce turnover (Quigley, 2008; Smith & Tooker, 2011).

Ferguson et al. (2011) suggested that prevention should be a focus of future work, given the critical role that police officers play in preventing crime, maintaining order, and providing emergency services. Prevention begins in the police academy. If police candidates are not screened and fail to successfully perform certain duties, this can result in injury/disability, turnover, and poor productivity which can have both a human and economic cost (Anderson et al., 2001). In total, medical expenses and lost productivity from injuries are estimated to exceed \$400 billion (Stier et al., 2012). Law enforcement agencies take up a piece of this pie.

The Cooper Institute (2014) believes that fitness in law enforcement is necessary because it relates to (1) the ability of officers to perform essential job functions, (2) minimizing excessive force situations, (3) minimizing health risks associate with the police job, and (4) meeting the legal requirements to avoid litigation. To emphasize these points, an agency that does not address officer fitness requirements is susceptible to litigation for negligent (1) hiring of those not fit to do the job, (2) training to help officers maintain their physical capabilities of job demands, and (3) supervision of such individuals (Williams, 2002). Ensuring fitness for work can lead to increased quality of production, both decreased absenteeism and turnover, and lower medical costs which reduces incidence of injury (Rayson, 2000).

### **Fitness Resources for the Workplace**

Once employed officers continue to train in many areas such as legal updates, driving, firearms, and defensive tactics to name a few. Yet most often fitness is not one of those areas of focus (Williams, 2002) although we know its benefits. Pronk (2009) demonstrated that most fitness interventions resulted in positive effects among employees. Research supports that comprehensive, multicomponent physical interventions lead to significant improvements in health, as well as reduce absenteeism (Steinhardt et al., 1991). This generates positive return for the employer (Pronk, 2009). There are potential resources available to agencies within the state, but little is known as to whether agencies are aware of, or are using such resources.

North Carolina is one of seven states that mandate full-scope injury prevention programs. General Statute 130A-224 provides that “the Department of Health and Human Services establish and administer a statewide injury prevention program and designate the Division of Public Health as the lead agency for injury prevention activities.” Injuries are often predictable and preventable, but laws by themselves cannot prevent injuries, action must be taken (Stier et al., 2012). Both health protection and promotional programs need to be intertwined to promote a healthier and safer workforce. A healthier workforce will be safer and a safer workforce will be healthier (Hymel et al., 2011). Program intervention should extend outside the workplace, utilizing community resources as well through incentives (Pronk, 2015).

Under the auspices of the U.S. Department of Health and Human Services (HHS, 2015), the *Prevention and Public Health Fund* provides workforce wellness program opportunities. It emphasizes prevention initiatives and provides grants to small

employers to assist with the implementation of such programs. The pressure is placed on both workers and employers as health costs skyrocket. Health measures aimed at improving the workforce could significantly have a long-term impact and save billions in costs (Hymel et al., 2011). According to Harte, Mahieu, Mallett, Norville, & VanderWerf (2011), health impacts workforce productivity, and if an organization integrates a wellness benefit program, it can achieve a substantial saving between 15-35%.

### **Leadership in Law Enforcement**

Improving the overall health of law enforcement officers can provide economic motivation for an agency. However, an officer who meets physical fitness standards upon initial employment does not necessarily ensure overall health maintenance throughout a career (Bissett et al., 2012). An important part of one's well-being lies within the work environment. Health can be affected by work conditions, and although different types of stress exist, physical stress affects health the most (Phadke et al., 2014). A well-oriented and trained leadership is essential to a successful fitness program (FitForce, Inc., 2010). Workplace health promotion programs should engage employees and show long-term impacts on health and costs, as well as minimize absenteeism. But absenteeism needs to be specifically defined as it is difficult to measure (Steinhardt et al., 1991). Programs should operate in an environment that embodies best practices (Pronk, 2015) but to be successful, physical programs need top management support, exist in a supportive environment, and engage all levels of management (Pronk, 2009).

How officers are managed strongly influence their commitment and employees are more likely to contribute in positive ways, meaning cost benefits through lower

absenteeism and lower turnover rates (Dick, 2011). Police leader management is linked to agency organization and is influenced by norms. These para-military organizations tend to have high levels of organizational commitment because the culture has strong obligational norms. A supervisor that wishes to implement a fitness program has a good chance of earning support from higher up. This type of support may have many benefits, including on-duty benefits (Williams, 2002). Physical fitness is part of a culture and can be supported from the top (i.e.: chief) down (Panos, 2010). Even when it comes to stress, quality work-peer relationships along with organization support are correlated with stress among police officers, and stress can affect the physical health and well-being of officers (Papazoglou & Andersen, 2014). Absence from work can be influenced by work structure. Policy that institutes any kind of health circumstances needs to consider the employer's structural influences and advocate presenteeism and its desirable outcomes. Organizations seeking to minimize absenteeism should perhaps focus on not only is an individual fit for work, but does the work fit the individual (Irvine, 2011).

Because public sector agencies (like law enforcement) have little or no incentive to change, leaders might question the relevance of supporting change. However, hiring processes and training academies change to adapt to the changing needs of the new generation; therefore, administrative practices and leadership also needs to change. Agencies need to balance both constancy and predictability that change must be adapted (Batts, Smoot, & Scrivner, 2012; Dick, 2011).

Within public decision-making, most ethical codes rely on internal, organizational controls (Franklin & Raadschelders, 2004). Franklin and Raadschelders (2004) found that both structural and procedural controls provide guidance to the decision-making

process. The vertical chain-of-command can lend itself to isolated functions and so law enforcement agencies need to be proactive in their leadership to provide continuous and cross-functional development (Putney & Holmes, 2008). Supervisors, particularly executive management needs to both participate and support any fitness program (Quigley, 2008; Smith & Tooker, 2011). They should promote an appropriate culture of wellness that encourages employees to maintain a healthy lifestyle (Zimmerman, 2012). This commences the planning process.

Strategic planning in public sector agencies takes a “big picture” approach. It uses futuristic thinking and analyzes courses of action to ensure that an agency’s effectiveness and abilities add to public value (Poister, 2010). Policy initiation is crucial to decision-making where first identifying background and problems are critical because there is always a gap between a problem and acting based on a decision (Political Science Notes, 2013). Commitment from top-level leadership is essential to successful strategic planning and execution as strategic planning needs to be consistent with top executive management style and the reality of an organization’s decision-making process (Ugboro, Obeng, & Spann, 2011; Williams, 2002).

As good and practical as a fitness program may seem, the budget process may present dilemmas for its progress. Decisions made might favor some but not other values, but choices must be made (Franklin & Raadschelders, 2004). Civil servants play an important role in choices made during policy-making. Since they do not hold political office, they are not held to as intense political pressure because of reelection interests, so they bring a solid perspective to the playing field (Franklin & Raadschelders, 2004). Public agencies need to make an effort to be inclusive of their external stakeholders and

involve them in the decision-making process, for example using surveys, focus groups or even forums (Poister, 2010). When it comes to fitness, levels in the workplace can directly or indirectly impact the community and society as it enhances local as well as national security and safety (Pronk, 2015).

Effective leadership will be critical in order for a police fitness program to be successful (Lee & Mallory, 2004). Strategy needs to be formulated by both top executives and line managers if planning is to be supported. This can be done by monitoring performance measures, aligning budgets with strategic plans, and communicating strategies to all stakeholders (Poister, 2010). Both internal and external partnerships are essential in collaborative efforts to ensure employee quality (Putney & Holmes, 2015).

### **Rational Choice Theory**

Rational choice theory as initially described by Becker (1976) was applied to law enforcement leadership decision-making, attempting to explain the absence (or presence) of physical fitness standards at law enforcement agencies in North Carolina. Rational choice theory holds that individuals act as utility maximizers that include individual preferences and self-interest. More specifically in the social sciences, both individual behavior and social interaction affect the policymaking processes in government (Jones et al., 2006). It can be applied dynamically in which planning for the future and considering the present are included (Green, 2002). Analysis will usually begin with a question and can be worked through in several steps:

1. identifying relevant agents and constraints,
2. determining and applying consistent rules for each agent,

3. exploring predictions and experience, and
4. drawing conclusions (Green, 2002).

Rational is applied in social sciences as meaning that choices made reflect the most preferable and feasible alternatives that are available. The theory can be applied by focusing on three main components. (1) Maximizing *utility* is the assumption of rational choice theory, or in other words, choosing the preferred alternative that benefits the most. (2) Another element of the theory is *constraints*, or things/circumstances that exist in which making a choice is necessary, therefore also taking into the consideration the (3) *environment* in which choices are made. Theory follows the pursuit of specific objectives at an organization (Green, 2002). Even though policy is made by organizations, it is the interacting of human decision makers and individual choice that put such policy into action (Jones et al., 2006).

Rational choice theory contains several characteristics including that decision makers first, hold both ranked and ordered preferences for outcomes, and second, possess the necessary information to connect choices to outcomes to optimize preferred outcomes (Jones et al., 2006). Decisions are not made in a vacuum but they are made to serve definite purposes. Rationality needs to be important in the decision-making process, or public utility will be adversely affected (Political Science Notes, 2013).

Evidence suggests that a supportive organizational work environment has both a positive and direct influence on organizational commitment. In other words, commitment is influenced by the way employees are managed rather than by job demands (Dick, 2011). Rational choice theory, though most often an approach used to explain economics, can be applied to understand human behavior within the social

sciences. It begins with making choices by one or more individual decision-making units and assumes such choices are made based on larger “typical” or “representative” populations. Analysis then examines how individual choices interact with one another to produce outcomes (Green, 2002).

### **Summary**

A clear majority of police academies in the United States use some physical agility test that tests mostly for strength and endurance. Some agencies use agility tests, either as a pre-employment condition and/or a condition of continued employment. The reason is that these tests are most widely accepted as underlying factors that attribute to physical demands placed on police officers. Even though agility tests are commonly used to screen police applicants, the requirements of officers to maintain a standard of health and fitness are fewer (Bissett et al., 2012; Glassman, 2003), particularly among North Carolina agencies (Fortenbery, 2016). Studies consistently show that physical fitness does have a direct impact on reducing injuries as well as improving personal well-being and work performance (Quigley, 2008). Police agency policies do not reflect the findings for various, unknown reasons. Aside from personal health and agency cost benefits, a certain fitness level also portrays a more professional image, and contribute to reducing excessive use of force incidents (Williams, 2002). Both topics are worth pursuing in future research as it relates to officer fitness. But for now, chapter 3 presents the current research’s methodological approach.



## Chapter 3: Research Method

### **Introduction**

The North Carolina Criminal Justice Commission mandates employment and training standards for law enforcement officers in the state. The Commission also regulates the required standards for the BLET program, including physical fitness. However, fitness is not one of the employment guidelines. A foundation for fitness is laid, but only across law enforcement training academies in the state; policy does not mandate fitness once officers are employed. Commission responsibilities do not extend into the agencies themselves when it comes to requiring certain fitness standards to remain employed. Therefore, there is a gap in academic research as to why some agencies continue fitness standards and others do not, particularly given knowledge of the benefits of healthy, fit individuals. Further, although the Department of Labor requires all industries to report work-related injuries to OSHA, it is not known whether there is some kind of connection or correlation between injured officers and set agency fitness standards. If there is, this information could both inform agencies across the state and contribute to the literature pertaining to North Carolina law enforcement agencies. The intent of the current mixed-methods study was to fill this gap in the literature, described in more detail as follows.

### **Research Design**

This research study consisted of a mixed-methods approach using both quantitative and qualitative methodologies. A quantitative approach provided the statistics necessary to determine whether a relationship or correlation existed between fitness policies and work-related absenteeism and injuries among a small sample of law

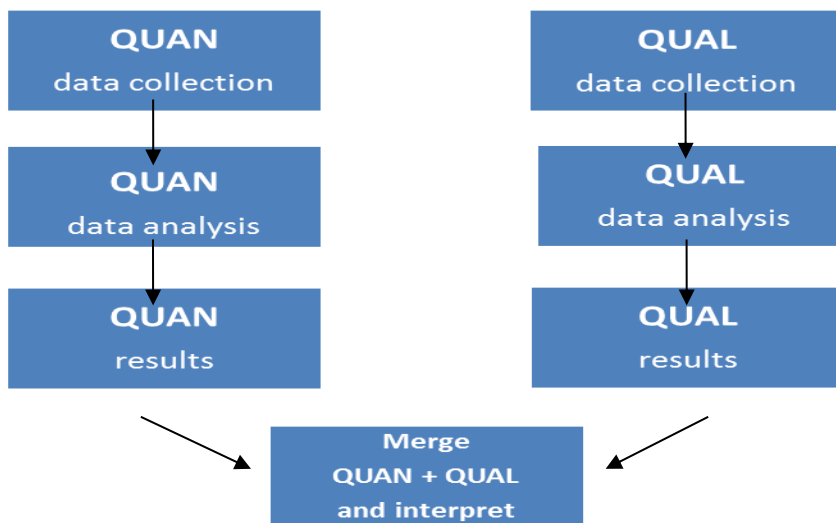
enforcement agencies in North Carolina. It did not provide an explanation as to why some agencies have instituted physical fitness policies and some have not. When research points not only to individual benefits, but agency benefits as well, the question is left unanswered as to why some policies are not in place. Therefore, the second phase of this study used a more detailed case study through a qualitative design to better understand this gap. For example, the use of a questionnaire explores who knows something as well as what is known (Bergman, 2008) within an agency.

### **Case Study**

A multisite case study approach guided this research, as data collection involved multiple sources of information including policy and injury report documents and interview questionnaires (Creswell, 2013). Upon gaining appropriate approval to participate, six law enforcement agencies were examined to try to gain an understanding of why policy differences exist among agencies that have no (or voluntary) fitness policies, agencies that require some participation in fitness activities, and agencies that have very stringent and rigid policy. These agencies were selected purposely according to size and type of policy. In this study, a particular area of interest was determining whether a relationship existed between fitness policy and work injury and absenteeism, so it was necessary to first collect descriptive, quantitative data. The qualitative aspect further entailed examination of policy decision-making and implementation using interviews.

Research questions were considered before determining the order in which elements of the methodology were applied because order can influence results. For the current study, I used a concurrent QUAN -> QUAL design. The quantitative component

was one stage of the concurrent design and was conducted at the same time as the qualitative component, which included the use of interview responses (Nastasi, 2010) to understand administrative roles in policy decision-making. The justification for the quantitative aspect was that I would use a sample to first determine whether a relationship existed between the independent and dependent variables, controlling for level of policy. I then examined how policy decision-making might influence any significant findings (see Figure 1).



*Figure 1.* Concurrent/triangulation design. Adopted from *The Mixed Methods Reader* (p. 380), by V. L. Plano Clark & J. W. Creswell, 2008, Thousand Oaks, CA: SAGE. Copyright 2008 by Sage Publications, Inc.

### Role of the Researcher

Having been a North Carolina BLET fitness instructor for 14 years, I have become aware that a gap exists between police academy fitness standards and law enforcement agency fitness standards in the state. In an effort to address this lack of understanding, I conducted an extensive search of academic and trade literature, looking at studies both within the United States and worldwide that pertained to police officer

fitness, wellness, and job injuries. As I became familiar with this literature, I found that the same questions remained unanswered, and these questions consequently became the focus of this study. First, I sought to determine whether fitness requirements that carried over to law enforcement employment were related in any way to the prevalence of workplace injuries and/or absenteeism. Second, I sought to identify who made agency fitness policy decisions and what the rationale and influences were behind these policies.

To address whether fitness policy correlated with injuries and absenteeism, it was important to narrow down the field of study while remaining focused on law enforcement agencies in North Carolina. Because of time and cost constraints, it was necessary to identify a manageable sample of agencies within the state. Because past qualitative studies in this area had used a sample of six, it was determined that a sample of six agencies would serve the purpose of this study and answer the research questions being sought. First, agency fitness policies and OSHA 300A summary forms were examined and analyzed for significant variance. Second, an interview was conducted with a training officer at each site to gain a better understanding of the policy-making process. This meant first constructing a questionnaire in which the content addressed these questions. Feedback from a local advisory committee was sought to ensure that questions were on target regarding the information being pursued.

The next step was to identify and contact six law enforcement agencies in the Piedmont Triad area that were willing to participate. I explained the study before I gained the necessary permission to review the requested documents. Phone contacts were made until two agencies from each policy level category (voluntary, changed or

progressive, and mandatory over a 5-year period) were identified. Mid-size agencies (serving a population of 50,000 – 500,000) were used for fair comparison purposes.

Creswell (2013) suggested that qualitative researchers collect their own data. Therefore, after gaining appropriate permission from the participating agencies, I made an appointment with each to both review documents and interview training officers. Anonymity was guaranteed, and results will be shared with the agencies after final analysis. It was my responsibility as the researcher to collect and analyze all data once appropriate Institutional Review Board approval had been secured. No individuals or agencies encountered any expenses related to participating in this study. Any expenses incurred because of this research were my responsibility as the researcher, including any supplies, travel, and documentation needed.

### **Research Population and Sample**

According to the North Carolina Justice Academy (NCJA, n.d.), there are approximately 495 police agencies in the state, including state, municipal, county, hospital/healthcare, college, and airport agencies. The state is made up of 100 counties and is geographically divided into three regions: the Mountains, the Piedmont, and the Coastal Plains (see Appendix A). The Piedmont is the middle region of the state. Within this region, the Piedmont Triad consists of 12 counties (Piedmont Triad Regional Council, 2012). This region was the focus of the current study from which a sample was drawn for location and convenience purposes. In selecting a sample of law enforcement agencies located within the Piedmont Triad region (see Appendix B), the focus was on “midsize” populated areas (50,000–500,000 people) as defined by the International Association of Chiefs of Police (IACP, 2014). The IACP (2014) has cited nearly 700

midsize cities in the United States, hosting a combined population of more than 75 million. This is almost twice the population of major cities (those with populations greater than 500,000) and represents nearly one-quarter of the total U.S. population. These jurisdictions comprise a significant proportion of the American urban and suburban landscape. This is a significant presence in the American municipal landscape, and it has not been until recently that midsize cities and their associated police agencies have been a distinct area of focus for research, funding, or advocacy as recognized by the IACP in 2009. Since then, research priorities have focused on the needs and interests of midsized populations. For these reasons, I chose to draw a sample for the current research from this population base. Appendix C identifies the counties, cities, and state agencies that met the above criteria within the Piedmont Triad population base.

A sample of six midsize municipal North Carolina law enforcement agencies in the Piedmont Triad region was used for convenience. Two agencies from each of the following categories were studied: (1) no mandated/voluntary fitness policy over the last 5 years, (2) a changed or progressive fitness policy over the last 5 years, and (3) a continued mandated fitness policy over the last 5 years (2011-2015). Using these midsized agencies provided adequate data and statistics, from which any significant relationships in variance should be evident between policy level and injury and absenteeism reports. Using three categories allowed for comparison across policy type, and a 5-year period allowed for examination across multiple years to ascertain whether trends remained consistent.

### **Instrumentation**

The documents collected at each agency consisted of instituted fitness standards for the years 2011-2015, as well as OSHA 300A forms documenting missed work days due to injuries or absenteeism for the same 5-year period. Hard copies of all documents have been kept in a locked file drawer within my personal home office, with the key located in a place only known to and accessible by me in order to protect confidentiality. Any electronic documents or correspondence related to this study have been saved on a designated research flash drive and kept in my locked possession. Backup electronic documents have been stored in a password-protected folder on my personal home computer. All records will be kept for a minimum of 5 years.

The second part of the study continued with interviews. Interviews are commonly used in qualitative research (Creswell, 2013). Interview questions addressed the following: (1) the rationale for department officer fitness standards, (2) whether policy was intended to address work-related injuries and illnesses, and (3) how policy decisions were made and influenced. Question wording in an interview is important because how questions are asked can affect the responses they elicit (Patton, 2002). The question categories listed above seemed appropriate to explore differences in policies, whether policy might contribute to work-related injury rates, and what influenced policy. The interview process allowed for the flexibility of emergent design with the questions covered. It allowed for both the interviewer and interviewee to include any additional information that emerged and was pertinent to the study through the use of open-ended questions.

### **Ethical Procedures and Considerations**

The Code of Ethics of the Academy of Criminal Justice Sciences (ACJS, n.d.) was the guiding code for this study. This organization addresses the scientific discipline of those who study, research, teach, or practice in the criminal justice field. Criminal justice professionals are expected to adhere to the Code of Ethics when applying ethical behavior in their everyday professional activities. General principles within the code include recognizing the potential for harm, not knowingly placing the well-being of oneself or others in jeopardy within professional work, and ensuring anonymity in research (ACJS, n.d.). These principles guide law enforcement administrators, organizations, and educators, specifically within their policy and field practices.

#### **Protection of Human Participants**

Protecting human participants is important in research. In this study, data collection through interviews required human participation and contact. Because interviews were conducted at law enforcement agencies, physical safety was assumed. Because the content was not of a personal nature, there were no anticipated psychological effects. Participants were briefed on informed consent and privacy and were advised that at any time, they could elect to cease study participation without any repercussions.

#### **Informed Consent**

Informed consent is a process that includes telling participants who is conducting a study as well as why they were selected to take part. Rudestam and Newton (2007) provided practical guidelines on how to proceed with informed consent. When asking subjects to participate, it is appropriate to indicate the time commitment and any benefits that can be expected to arise from the study. In this case, the time commitment was



approximately 2 hours per agency, and participants will be provided with both the data analysis and questionnaire results. Potential risks needed to be addressed, which in this study were minimal to none in relation to participants' agreement to provide policy documentation as well as injury statistics reports. All agencies that agreed to participate were asked to sign and return a letter of cooperation.

### **Right to Privacy**

Participants are entitled to confidentiality (ACJS, n.d.), so it was important to protect the identity of all agencies and any names associated with them. Protection of both agency and individual identities was achieved by assigning each agency a number (e.g., Agency 1, Agency 2, or Training Officer from Agency 1, etc.). Allowing participants to ask questions and ensuring that participation was voluntary were also necessary (Rudestam & Newton, 2007) and were emphasized in the research process, both verbally and in writing.

### **Honesty**

Honest communication and reporting of results is essential to ethical research. I engaged in no intentional misrepresentation or misleading action of any kind during the study. High ethical standards were applied, and the results were reported completely and honestly.

### **Institutional Review Board (IRB)**

To ensure that ethical standards were applied, the IRB process served as a critical step in this research. Walden's IRB ensures that any research conducted under the auspices of the university complies with both ethical standards and federal regulations. Students, along with their committee members, must submit and receive IRB approval

before collecting any data (Walden, 2010). To comply with Walden IRB requirements, I submitted a completed application prior to seeking participants for this study. Once approved, agency participants were contacted to voluntarily participate in this study.

### **Data Analysis**

Statistical Package for Social Sciences (SPSS) was used to record and analyze the quantitative data to test the study's hypotheses. Frequencies, variance, standard deviation, and crosstabs were applied to provide a general distribution of descriptive statistics. Analysis of variance (ANOVA) was used in the data analysis to determine the significance of any variance between the study's variables. If the variables were found to be significantly related, the null hypothesis was rejected. I determined and defined the level of measurement for each variable used, which helped to determine the statistical analyses that were used (Thornton, 2011). In a quantitative analysis in which the aim is to generalize to a larger population, sample size is important. Given that a sample of six was used out of a population of 495, generalization was of course not possible.

### **Dissemination of Study Findings**

The research results in total will be shared with participating agencies as well as the North Carolina Justice Academy and other interested law enforcement agencies in the state. Confidentiality and unanimity were and will be maintained. Personal contact will be made with each agency training officer upon completion of data analysis and results. Law enforcement trade magazines will be solicited for potential publication, making study results available to this targeted audience.

### **Validity and Reliability**

To establish transferability in the qualitative aspect of this study, Creswell (2013) suggested that sampling is essential, particularly to establish external validity. In this study, purposeful sampling was utilized to select police agencies that made up varying levels of fitness policies. One of the most credible manners to ensure internal validity is through triangulation, or collecting data from various sources such as interviews, questionnaires, and assessing different documentation of data. Triangulation uses different research designs to examine data from different perspectives, which is why interviews were also conducted and included in the study evaluation. Every effort was made both verbally and in writing to ensure that all participants and agencies were respected and appreciated for their time and interest.

### **Summary**

This study used a sample of six North Carolina law enforcement agencies to determine whether fitness policy influenced work-related injuries and absenteeism and what factors contributed to policy decision-making. By first using a quantitative analysis, results yielded whether a significant relationship between policy and injuries and absences among the sample agencies existed. If the null hypothesis was rejected because certain policies were related to fewer work-related injuries and absences, this study will provide support for advocating continued fitness beyond the police academy.

Additional analysis through examination of questionnaire responses determined whether rational choice theory supported policy decision-making, focusing on the utility function. This helped determine what factors contributed (at least partially) to policy and whether decisions being made were personal in nature, or representative of larger

objectives. Organizations constantly undergo change, which can impact leadership. The one recognized as the leader is the one who has the potential and capacity to influence the group (Karp & Helgo, 2008). According to Bennis (2007), leadership is a matter of values. The next chapter discusses the results and how both quantitative and qualitative analyses have contributed to this field of study.

## Chapter 4: Results

### Introduction

The purpose of this mixed methods study was to test the utility function component of rational choice theory to determine whether it explains fitness policy implementation and whether such policy affects reported work-related injuries and absenteeism among a sample of midsized law enforcement agencies in the Piedmont Triad region of North Carolina. The quantitative portion of the study examined the stringency of agency fitness policy over a 5-year period (2011-2015; independent variable). Injury and absenteeism rates were calculated from OSHA 300A summary forms for each agency within this time frame (dependent variables). A control variable was also used based on whether an agency's fitness policy changed over this 5-year period, to measure any change in injury and absenteeism rates. The qualitative portion of the study examined the interview responses of training officers at each agency pertaining to fitness policy implementation, decision-making, and rationale. Responses were examined for common themes and whether they represented rational choice theory decision-making.

The research questions that guided this study were the following:

1. What relationship, if any, exists between a North Carolina law enforcement agency's fitness policy and work-related injuries and absenteeism?
2. When research emphasizes the benefits of maintaining a certain fitness level, particularly for first responders, does the utility function within rational choice theory explain why some North Carolina law enforcement agencies mandate physical fitness requirements for officers and others do not?

3. Are data-driven results of injury or absenteeism an agent or constraint as they pertain to the present fitness policy?

An extensive review of the literature was conducted pertaining to the content of interest, focusing on (but not limited to) current research done in this area over the last 5 years. Previous research focused on officer fitness, physical fitness testing, legal standards, policy implications, work injury and absences, and leadership. Very limited studies were found on law enforcement agencies in North Carolina pertaining to fitness policy, and none were found pertaining to OSHA-reported injuries and absences. Thus, this population became the focus for the current study, particularly when it was known that a gap existed involving state police academies requiring a fitness component while many law enforcement agencies had no such requirements as a condition of employment.

In this chapter, I report on my analysis of the findings from a sample of six law enforcement agencies based on fitness policy standards and change over a 5-year period, as well as yearly reported work-related injuries and absences. Additionally, I discuss how rational choice theory may play a role in fitness policy decision-making at an agency level when the utilitarian concept is applied, thereby explaining the data analysis of each research question that guided the study. In the last chapter, I present conclusions and implications of this research.

### **The Researcher**

Creswell (2013) suggested that researchers provide information about themselves, the IRB process, steps to gaining entry to the sample, and ethics. As the researcher in this study, I had 6 years of experience as a sworn law enforcement officer in North Carolina, as well as 17 years as a criminal justice instructor at a community college. In 2001 and

2002, I became a certified general instructor and specialized physical fitness instructor, respectively, for the BLET program in the state. I was taught and administered the state-mandated fitness testing of cadets based on valid and scientifically tested research pertaining to physical activities that police officers are likely to encounter as part of the job. These credentials allowed me to teach any general curriculum block of instruction within BLET as well as oversee and assess physical fitness activities within the police academy. I routinely tested and evaluated police cadets on the required obstacle courses and fitness assessments, all necessary as a condition of graduation. I wondered why cadets were held to such a high standard of fitness in the police academy, whereas, more times than not, these or any physical requirements were not mandatory conditions of employment at a law enforcement agency. Policy was determined at the agency level, yet who was involved in these decisions, and what was the rationale behind them? This interest and concern for the well-being of officers in terms of wellness and safety followed me into my doctoral studies and thus led to the development of the current study. Therefore, it may appear that I had some bias concerning this topic; however, I made every effort in proposing, conducting, and analyzing this research to present the information in an ethical and objective manner.

Before collecting data, the appropriate and necessary steps were taken based on Walden University's IRB requirements. An application was submitted to the IRB outlining each step of the proposed research and my plans to protect both the confidentiality and identity of participants. Conditional approval was granted with the understanding that each participant (agency) would sign a letter of cooperation prior to any data collection. I then began contacting each of the agencies within my proposed

population via telephone, soliciting the agencies' voluntary participation in my study. After an agency agreed to participate, a signed letter of cooperation was obtained and forwarded to the Walden IRB. Once an e-mail confirmation was received from the IRB, data collection at that agency commenced. A consent form as well as a data use agreement form were also collected from each participating agency and filed in that agency's electronic and hard files. After the total sample of six was reached, I had the necessary data to begin analyzing both my quantitative and qualitative data.

### **Setting and Recruitment Process**

The population of midsized law enforcement agencies in the Piedmont Triad region of North Carolina totaled 11. An attempt was made to contact the training officers of all 11 agencies by telephone to ask them to participate in this study after I had briefly explained its intent. Several voicemail messages were left and of those agencies that did not respond, a follow up call was made. After reaching the appropriate contact at an agency and explaining my study, the conversation was followed up with an e-mail detailing the study's purpose, voluntary participation and the necessary information being sought for analysis, along with the need for a signed letter of cooperation if they agreed to participate. If no response was received from an agency within a 2-month period via e-mail, a follow-up e-mail was sent again inviting the agency to participate. After a period of 6 months, six agencies had responded and agreed to participate. For convenience and because of availability, these six law enforcement agencies were used as the nonprobability sample for case study analysis.



## Instruments

Several instruments were used to collect data from the sample in the study. For the quantitative aspect of the analysis, a copy of each agency's fitness policy (see the sample agency fitness policy in Appendix D) was obtained (if such a policy existed) for each of the years 2011-2015. Additionally, a copy of each agency's OSHA 300A summary form (see Appendix E) was collected for the same 5-year period. A short questionnaire was used to analyze the responses pertaining to the qualitative aspect of the study, to gain a better understanding of the process and factors involved in policy decision-making at an agency.

Statistical Package for the Social Sciences (SPSS, 2015) was used for quantitative analysis to address Research Question 1. The rationale for the choice of statistical test and assumptions associated with the statistic were based on the research question and therefore are discussed in more detail below. Line-item data mining in Windows Excel was used for qualitative analysis to address Research Questions 2 and 3. Responses and themes were explored to test rational choice theory.

### Quantitative

Each agency's physical fitness policy for the years 2011-2015 was coded per policy level and assigned a value; 1 (*no policy/voluntary participation*), 2 (*general policy/voluntary participation*), 3 (*annual in-service/testing*), and 4 (*biannual testing*); (Means, Lowry, & Hoffman, 2011c). For analysis purposes, each agency was then placed in a category per the stringency level of its fitness policy (from least to greatest) and assigned a value number. Whether policy changed over the years between 2011 and

2015 was also indicated; 1 (*no change*) and 2 (*increased standards*) for each agency, each year.

Absence and injury rates were computed for each agency's OSHA 300A form for the years 2011-2015. The absence rate was computed by dividing the total number of days away from work by the total number of employees multiplied by 100 and rounded to the nearest hundredth. Absence rates ranged from 0–156.14. The injury rate was computed by dividing the total number of injuries by the total number of employees multiplied by 100 and rounded to the nearest hundredth. Injury rates ranged from .82–14.56. These rate standardizations allowed for comparison across agencies due to the variance in number of employees. See Appendix F for a summary of the quantitative data.

### **Qualitative**

Each training officer (or designee as determined by the agency head) at the six agencies was provided with a questionnaire inquiring about the number of sworn officers within an agency, and whether the agency was accredited by the Commission on Accreditation for Law Enforcement Agencies (CALEA), with the assumption being that those agencies that were CALEA accredited were likely to have some type of fitness policy in place. The questionnaire also included whether an agency had a fitness policy over the 5-year period of 2011-2015, and if so, whether participation in fitness and wellness activities was voluntary or mandated. The remaining five questions were meant to test rational choice theory and address the policy decision-making process. These questions included the following:

- What is the rationale behind having/not having a fitness policy in place, or for changing policy?
- Who are involved decision makers in fitness policy?
- What factors determine or affect fitness policy?
- Was policy intended to address work-related injuries and illnesses?
- Are you aware that North Carolina provides a full public health mandate that includes injury prevention, and if no, would you want more information, or if yes, was this considered in fitness policy implementation? (See Appendix G.)

Qualitative research can be deemed valid using triangulation and member checking (Creswell, 2013), and so at the same time policy and OSHA data were being collected, these questions were reviewed and verified by speaking with the training officer or designee. For data to be considered qualitatively reliable, consistency is important (Creswell, 2013); therefore, the same questions were asked of each agency.

### **Demographics**

For analysis purposes, participants were actual agencies, for which employee demographics were not known, except by raw numbers. This was done to protect the confidentiality of agency employees. Though the questionnaire was completed by one individual employee at the agency, these individual demographics were not recorded, but the employee's agency responsibilities were noted.

#### **Agency 1**

Agency 1 was a county law enforcement agency located in the Piedmont Triad region of North Carolina serving an estimated population of 142,799 (U.S. Census Bureau, n.d.). The number of employees at the agency ranged from 228–262 over the

years 2011–2015. This agency did not have a fitness policy for sworn officers (and so it was voluntary on the employee’s part to participate in any physical fitness activities) during the 5-year period.

### **Agency 2**

Agency 2 was a county law enforcement agency located in the Piedmont Triad region of North Carolina serving an estimated population of 158,276 (U.S. Census Bureau, n.d.). The agency ranged in number of employees from 892–1206 over the years 2011–2015. This agency did not have a fitness policy for sworn officers (and so it was voluntary on the employee’s part to participate in any physical fitness activities) during the 5-year period.

### **Agency 3**

Agency 3 was a municipal law enforcement agency located in the Piedmont Triad region of North Carolina serving an estimated population of 110,268 (U.S. Census Bureau, n.d.). The agency ranged in number of employees from 248–268 over the years 2011–2015. This agency did not have a fitness policy for sworn officers during the 5-year period; however, incentives at either the city or county level were available to employees, though participation to receive these incentives was voluntary.

### **Agency 4**

Agency 4 was a municipal law enforcement agency located in the Piedmont Triad region of North Carolina serving an estimated population of 285,342 (U.S. Census Bureau, n.d.). The agency ranged in number of employees from 881–929 over the years 2011–2015. This agency had a general policy that addressed the necessity of employees maintaining their health to adequately perform job functions. This policy remained the

same over the 5-year period, and several incentives at either the city or county level were available to employees, but participation in these incentive programs was voluntary.

### **Agency 5**

Agency 5 was a county law enforcement agency located in the Piedmont Triad region of North Carolina serving an estimated population of 369,019 (U.S. Census Bureau, n.d.). The agency ranged in number of employees from 230–243 over the years 2011–2015. Over the 5-year period, the agency did require sworn officers to participate in 2 hours of health and wellness in-service training each year, and annual POPAT testing was mandated.

### **Agency 6**

Agency 6 was a municipal law enforcement agency located in the Piedmont Triad region of North Carolina serving an estimated population of 52,472 (U.S. Census Bureau, n.d.). The agency ranged in number of employees from 164–182 over the years 2011–2015. Over the 5-year period, the agency gradually incorporated a mandated biannual POPAT testing of all sworn officers.

All sites had onsite fitness facilities that employees could use at no charge. Several agencies also offered either free or discounted memberships at local fitness facilities. The first three agencies with no fitness policy were not CALEA accredited; the last three agencies with written fitness policies were CALEA accredited, as assumed.

## **Data Collection**

The location of the population of interest in this study—the Piedmont Triad region of North Carolina—was purposely selected for convenience purposes as well as the purpose of collecting data from a similar geographical region. Again for consistency

purposes, midsize agencies were also the focus of this study; the total number of agencies fitting these criteria from which to draw a sample was 11. The purpose was initially to capture a total of six agencies for case study analysis, representing three categories of varying fitness policies: two not having any fitness policy in place, or a voluntary policy; two having increased in policy stringency over a 5-year period; and two having strict, mandated fitness standards required for officers. After I had contacted each agency and explained the study, six of the 11 responded with their willingness to participate; however, the categories of policy that they represented were not what I had initially proposed. After mining through the data, I observed that four levels of policy were distinguishable and would make for a more detailed analysis. The quantitative data were made up of policy level, any change of policy within the 5-year period, and OSHA 300A injury and absenteeism summary reports. This information was analyzed to address Research Question 1. The qualitative data were made up of questionnaire responses and were analyzed for common themes to assess, first, whether the utilitarian function within rational choice theory existed (Research Question 2), and second, whether data served as an agent or constraint to current fitness policy (Research Question 3).

### **Data Analysis**

Three research questions guided this study:

RQ 1. What relationship, if any, exists between a North Carolina law enforcement agency's fitness policy and work-related injuries and absenteeism?

RQ 2. When research emphasizes the benefits of maintaining a certain fitness level, particularly for first responders, does the utility function within rational

choice theory explain why some North Carolina law enforcement agencies mandate physical fitness requirements for officers and others do not?

RQ 3. Are data-driven results of injury or absenteeism an agent or constraint as they pertain to the present fitness policy?

Using these questions, the research data were analyzed both quantitatively and qualitatively. Descriptive statistics, crosstabs, one way ANOVA, and an *F*-test were calculated. Then line analysis data mining with Excel was utilized to test rational choice themes. Per agency policy, agencies were listed in order according to policy stringency, with the first agency listed having no policy or incentives at the top, on down to the last agency listed that had a mandated, biannual testing policy. The policy level (independent variable) for each agency (each of the 5-year period) was coded to form an ordinal variable from 1 – 4; 1 being no fitness policy to 4 requiring biannual fitness testing. Policy change was used as a control variable, to determine if a change in policy over these years affected injury or absenteeism rates. This was coded ordinally where 1 meant no change from one year to the next, and 2 meant an increase in fitness standards required from one year to the next. Both absent rate and injury rate (ratio, dependent variables) were calculated into standardized rates for comparison purposes. Descriptive statistics are provided for each variable as they describe what the data shows (Trochim, 2006). Table 1 shows the six-agency sample arranged per strictness of policy level. Policy change indicates from one year to the next whether policy did not change, or increased in required fitness standards.

Table 1

*Agency Demographics of Sample*

Variable	Labels	Level of measurement	Mean	SD	Range
Agency	1 = Agency 1 2 = Agency 2 3 = Agency 3 4 = Agency 4 5 = Agency 5 6 = Agency 6	ordinal			
Policy level (IV)	1 = no policy/ voluntary participation 2 = general policy/ voluntary participation 3 = annual in-service/ testing 4 = biannual testing	ordinal			
Policy change 2011-2015 (CV)	1 = no change 2 = increased standards	ordinal			
Absence rate (DV)		ratio	31.21	32.91	0-156.14
Injury rate (DV)		ratio	6.90	3.17	.82-14.56

**Research Question 1**

The first research question attempted to determine whether having a strict fitness policy affected work-related injuries or absences. The null hypothesis suggests that no significant relationship exists between the stringency of fitness policy and job-related injuries and absenteeism rates; therefore, the alternative hypothesis suggests that the more stringent a fitness policy is, the lower the job-related injuries and absenteeism rate.



A bivariate correlation could not be conducted because the data violated several assumptions of this analysis. First, variables must be continuous; in the sample both the independent and control variables are ordinal level measurements. A second assumption is that a linear relationship exists between variables, and with this study's data they do not (which also eliminates the use of partial correlation and linear regression). Another assumption of correlational analyses is that no significant outliers exist which was also not true with the data. A fourth assumption assumes homoscedasticity, and upon conducting a scatterplot of the data, heteroscedasticity was detected, so therefore not suggested that correlation be used in analysis (Laerd Statistics, 2013).

When a group comparison of at least one independent variable is being used, analysis of variance (ANOVA) can be used as a statistical test (Creswell, 2013). For this test, the independent variable should be categorical, and the dependent variable should be continuous, which in this study is the case; therefore, ANOVA was selected as the statistical test to answer Research Question 1. Green and Salkind (2011) state that a one-way ANOVA can be used to analyze data from a quasi-experimental study and the *F*-test evaluates whether the group means on the dependent variable differ significantly from each other. Then, an overall analysis of variance test can assess whether dependent variable means are significantly different among groups.

In social research, Trochim (2006) advises a statistical power greater than 0.8 in value as a rule of thumb. This means having at least 80 chances out of 100 of finding a relationship when there is one. Statistical power is the ability to detect effects given the variance and sample size (Vogt & Johnson, 2011). Several factors interact to affect power. One is to use a larger sample size, another is to increase the risk of making a

Type I error, or increasing the chance that a relationship is found when it is not there. This can be done by raising the alpha level (Trochim, 2006). In this study the agency sample size of six is small; however, the total number of employees that the sample represents is over 2700. So, it could be argued that using an alpha level of .05 demonstrates a significant statistical power of .95.

## ANOVA

First, a one-way ANOVA was conducted to evaluate the relationship between policy level of an agency and absenteeism rate. The independent variable, the policy level factor, included four levels of fitness policy: no policy/voluntary participation, general policy/voluntary participation, annual in-service/testing, and biannual testing. The dependent variable was the rate of work days missed each year over the 5-year period of 2011-2015. The ANOVA was significant  $F(3,27) = 5.02, p < .01$ . The strength of relationship between policy and absent rate, as assessed by  $\eta^2$  was strong, with policy level accounting for 36% of the variance of the dependent variable.

Next, a one-way ANOVA was conducted to evaluate the relationship between policy level of an agency and injury rate, which was the rate of injuries each year over the same 5-year period. The ANOVA was significant  $F(3,27) = 6.96, p < .001$ . The strength of relationship between policy and injury rate, as assessed by  $\eta^2$  was strong, with policy level accounting for 44% of the variance of the dependent variable.

Because the overall ANOVA was significant and there were more than two levels in the independent variable, follow-up tests are usually conducted to evaluate pairwise differences (Green & Salkind, 2011). Therefore, it was decided to conduct follow-up tests of Tukey, REGWQ and Dunnett's *C* as suggested by Green and Salkind (2011) to

evaluate pairwise differences among means. Dunnett's *C* test does not assume equal variances among the four groups and so these results were used to assess both absenteeism rate and injury rate between policy level. There was no significant difference in the means between any policy level and absent rate. However, there was a significant difference in the means between the following:

- Level 1 policy (no policy/voluntary participation) and Level 3 policy (annual in-service/testing)
- Level 1 policy (no policy/voluntary participation) and Level 4 policy (biannual testing)
- Level 2 policy (general policy/voluntary participation) and Level 3 policy (annual in-service/testing)
- Level 3 policy (annual in-service/testing) and Level 4 policy (biannual testing).

The agencies that required annual in-service and testing showed a greater decrease in injury rates compared to agencies with other policy types. The 95% confidence intervals for the pairwise differences, along with the means and standard deviations for the four policy groups, are reported in Table 2.

Table 2

*95% Confidence Intervals of Pairwise Differences in Mean Changes of Injury Rates*

Policy level	<i>M</i>	<i>SD</i>	Level 1	Level 2	Level 3
1 – No policy/ voluntary participation	7.25	3.24			
2 – General policy/voluntary participation	7.67	1.97	[-3.84, 3.01]		
3 – Annual in-service/testing	3.13	1.51	[.42, 7.82*]	[.97, 8.11*]	
4 – Biannual testing	10.79	1.05	[-7.02, -.05*]	[-6.49, .25]	[-11.39, -3.93*]

A second set of ANOVA were conducted examining the control variable (change in policy). A one-way ANOVA was conducted to evaluate the relationship between policy change and absent rate. The control variable, whether policy changed from one year to the next, included two levels: no change and increased standards. The dependent variable was the rate of work days missed each year over the 5-year period of 2011-2015. The ANOVA was significant  $F(1,29) = 14.92, p < .001$ . The strength of relationship between policy change and absent rate, as assessed by  $\eta^2$  was strong, with policy change accounting for 34% of the variance of the dependent variable.

A one-way ANOVA was conducted to evaluate the relationship between policy change and injury rate, which was the rate of injuries each year over the same 5-year period. The ANOVA was significant  $F(1,29) = 7.02, p < .01$ . The strength of relationship between policy change and injury rate, as assessed by  $\eta^2$  was strong, with policy change accounting for 20% of the variance of the dependent variable.

The interpretation of the current data has been evaluated on ANOVA analyses. In conclusion, to answer whether a relationship exists between a North Carolina law

enforcement agency's fitness policy and work-related injuries and absenteeism, the analyses assumes there is a relationship, therefore rejecting the null hypothesis and accepting the alternative hypothesis.

## **Research Question 2**

Research Question 2 attempted to test whether the utilitarian function of rational choice theory explained why specific fitness policies were in place. In other words, was policy decision the preferred alternative that would benefit agency employees most? Several questions in the agency questionnaire were designed to address this.

The first question inquired about the rationale behind having/not having a fitness policy in place, or the reason for changing policy. Agencies had varying responses. Of those agencies that had a fitness policy, improving employee wellness and productivity, along with increasing officer safety were common responses. Agency 6 identified several motivational factors to include:

- reducing long-term medical costs for employees
- improving employee wellness and productivity
- increasing officer safety
- increasing the life span of employees

Agency 4 identified a standard operating procedure in which their objective was to “develop and maintain a level of fitness in police personnel and to ensure their ability to accomplish assigned duties and provide satisfactory job performance without undue risk of injury or fatigue.” The change in policy for Agency 5 was due to a Sheriff initiative to improve the overall health of employees. Of the agencies that did not have a fitness policy, one indicated that it was “due to case law, cost, manpower, buy in from

administration, and law suits.” Having no policy may be impacted of Title VII of the Civil Rights Act which requires all employers with more than 15 employees to refrain from policies that discriminate against specified categories of individuals (U.S. EEOC, n.d.). Title VII can be ambiguous and many standards have not been interpreted by the Supreme Court. Even federal circuit courts differ on these decisions. Since the courts cannot clearly define these standards, it can burden administrations with continued monitoring of court decisions and legislation. Under Title VII, physical fitness standards face scrutiny when they might discriminate against a protected group (for example females, individuals over 55 years of age). Employees must demonstrate that the practice is job-related and necessary. Therefore, in justifying physical fitness requirements, can it be justified as a necessity of law enforcement work? To demonstrate this, administrators must show a significant relationship between the physical fitness requirement and job responsibilities (Brooks, 2001). Agency 2 indicated that “the agency was in the process of reviewing and updating several policies and have not addressed this issue yet”, and Agency 3 reported that “physical fitness policy had never been addressed.”

The next question asked who was involved in the policy decision-making process. Not surprisingly, all responded that the agency head (Chief of Police or Sheriff) were the final decision makers. However, of those involved with the input process, responses ranged from few individuals within the agency to larger committees that included members outside of the agency. Four agencies indicated that decision makers on such policy came from within the agency such as executive staff, administration (directors, commanders) and other employees. Two agencies also included decision makers outside of the agency itself such as occupational health staff, human resources director, city

manager, and city attorney. There was no consistency in agency type as far as who was included in decision-making. Or in other words, municipal agencies were just as likely as county agencies to involve personnel outside of the agency in policy decision-making.

The last question asked to address Research Question 2 sought to determine what factors affected fitness policy decision-making. Common responses included manpower, cost, and resources. Some were also concerned with the legality of such a policy and how standards would be enforced or maintained. But, these common theme responses existed within agencies that both had stricter policies and those that had none.

Interestingly, of the two agencies that had the more stringent policies, though cost, training, and manpower were also mentioned, the agencies prioritized these resources to comply with policy. Taking a more holistic approach was also a factor for these agencies. As it pertains to their fitness policy, one stated that they had “to find a balance between stewardship to the taxpayer and providing our employees some opportunities to maintain and improve their health.” All agencies had on-site fitness facilities and equipment and/or community resources such as recreation centers, gyms, or fitness centers. See Table 3 for a summary of agency responses to these questions.

Table 3

*Agency Responses to Policy Rationale*

Question	Agency/Responses
What is the rationale behind having/not having a fitness policy in place, or for changing policy?	<p>1 – the agency is in the process of reviewing and updating policies in order to apply best practices.</p> <p>2 – case law, cost, manpower, buy in from administration, law suits</p> <p>3 – physical fitness policy has never really been addressed</p> <p>4 – the objective of the department is to develop and maintain a level of fitness in police personnel and to ensure their ability to accomplish assigned duties and provide satisfactory job performance without undue risk of injury or fatigue</p> <p>5 – it was one of the Sheriff's initiations in 2002</p> <p>6 – to reduce long-term medical costs for employees, to improve employee wellness and productivity, to increase officer safety, and to increase the life span of officers/ employees</p>
Who are involved decision makers in fitness policy?	<p>1 – Sheriff and Administrative Major who verifies policy changes to ensure it complies with law</p> <p>2 – Sheriff, Chief Deputy, Director Personnel/Training</p> <p>3 – Chief of Police and Executive Staff</p> <p>4 – Chief of Police Bureau Commander, Training Division Commander and/or other departmental employees</p> <p>5 – Sheriff and committee</p> <p>6 – Chief of Police, Occupational Health staff, HR Director, City Manager, City Attorney</p>
What factors determine or affect fitness policy?	<p>1 – resources, manpower, cost</p> <p>2 – resources, manpower, cost</p> <p>3 – time, money, effort, legality, injury, penalty for failure to maintain standards, resources, equipment</p> <p>4 – finding a balance between stewardship to the taxpayer and providing employees some opportunities to maintain and improve their health</p> <p>5 – we have the manpower, a more holistic approach was needed</p> <p>6 – cost, provide training, build a gym/fitness center, staffing was not a major concern</p>



Rational choice theory assumes that individuals interact in a social process as part of decision-making, and in an organization, collective individual actions affect policymaking and input comes from both individual behavior and social interaction (Jones et al., 2006). It examines how individual choices interact with one another to produce outcomes, and how decisions are made by both considering the present and planning for the future (Green, 2002).

The above questions on the agency questionnaire were designed to test this theory to determine why specific policies were in place among a small sample of law enforcement agencies in North Carolina. The meaning of *rational* is applied to mean the most preferable and feasible alternatives available. One component of this theory holds that within a setting, decision makers will choose an alternative that benefits the most. This assumes that first decision makers have ranked preferences for outcomes and possess the necessary information to optimize the preferred outcomes (Jones et al., 2006). A closed-ended question on the questionnaire was asked of the agencies whether they were aware that North Carolina provides a full public health mandate that includes injury prevention. Only one responded yes. This agency had a more general wellness policy, but no specific fitness standards for officers. Two agencies responded no and three agencies did not answer definitively. Perhaps having knowledge or utilizing state resources available could assist agencies in this policy making process, but the question may have been vague or confusing, or maybe more detailed information should have been provided to the agency's before asking this question.

Decisions are made to serve definite purposes and populations. Therefore, rationality is important in the decision-making process otherwise public utility can be

adversely affected (Political Science Notes, 2013). With the responses given, it was not entirely clear on how agencies determined fitness policy. Perhaps questions should have delved into more detail as to *how* each factor was considered, rather than just listing *what* factors were considered in policy. However, in all cases more than one individual was involved in the discussion and input of policy (or policy change), therefore confirming that an interaction process took place with a decision being made as to the best choice for the agency with the resources and information present. It is more difficult to determine whether the utilitarian component outshined other options because of the limited information provided within question responses. So, to apply rational choice theory in general makes sense per the responses from agencies, but not enough is known as to why the utilitarian function of the theory explained fitness policy implementation.

### **Research Question 3**

Research Question 3 attempted to find out whether data-driven results of injury or absenteeism are an agent or constraint as it pertains to fitness policy. One question on the agency questionnaire was asked as to whether policy intended to address work-related injuries and illnesses. Two agencies that had no fitness policy and one agency that did not have a policy but did have employee fitness incentives in place responded negatively to this question. The other three agencies that responded positively had some type of fitness policy in place, with policy ranging from more general to very specific standards.

Applying rational choice theory to these responses make sense as one element of the theory is constraints, or things/circumstances that exist, making a choice necessary. Constraints also take into consideration the environment in which a choice was made (Green, 2002). Within each agency several factors as well as participants are involved in

the decision-making process. Although ultimately it is the agency head who makes the final decision, there is no doubt that influences from others and the environment play a part. It is this interaction among human decision makers and individual choice that put policies into action (Jones et al, 2006).

Serving as constraints to agencies with no fitness policy seemed to be the common factors of cost, legal implications and manpower. These factors seemed to play a part in the policy decision-making process. Something that is not known is how much influence other individual(s) involved in the process had. It was not explored in the initial questioning but could have been valuable in addressing this particular research question.

For those agencies that had some type of fitness policy, common agents seemed to specify the necessity of officer health and safety, ensuring that officers could accomplish their duties. Wellness incentives in written policy emphasized the agency's commitment to the well-being of officers so they could perform essential job tasks. Taking a holistic approach and finding balance between providing public services and providing for employees were common rationale. These agencies sought funds (either through city/county funds or grants) and provided training and facilities to ensure officer needs were met.

With the data that was collected and qualitatively analyzed, it is concluded that the null hypothesis be rejected, assuming that injuries and/or absenteeism rates are an agent of the current fitness policy. This was determined by examining the written policy of the agencies that had a current fitness policy in place. This analysis used several steps

according to rational choice theory; identifying relevant agents and constraints, applying consistency, exploring predictions, and drawing conclusions (Green, 2002).

### **Threats to Internal Validity—Instrumentation**

After conducting the analyses for this research, several observations must be mentioned as it pertains to the validity of the instruments used. The first instrument used, also serving as the independent variable was written agency fitness policy. The information was interpreted at its face value and believed to be represented and interpreted correctly in the study. However, for comparison purposes, I defined four categories in ranked order, from no policy present to the most stringent, mandatory policy. Perhaps another researcher would define or categorize policies differently for analysis purposes.

To control for any differences in policy change over the 5-year period, a binominal variable was created to simply represent that a fitness policy did change from year to year, or did not change from year to year. This again was a discretionary decision, and perhaps others would approach control in a different manner.

The use of OSHA mandated reported injuries and absences on the summary 300A form became questionable as to whether these records could be considered valid. For example, one agency reported employees having 164 days away from work (absenteeism), yet the next year, two days were reported and the year after that zero days were reported. So, whether the OSHA form was the most appropriate measure of injuries and absenteeism is questionable. Perhaps a better, more accurate and valid instrument might better have addressed the research questions, but this information was not initially known and so not observed until after data analyses. In addition, OSHA forms did not

specify or differentiate officer injuries and absences from other agency employees such as nonsworn or civilian. One county agency even included all county employees in the summary form and did not distinguish between officer and other personnel.

The last instrument used was the agency questionnaire designed to test rational choice theory in the policy decision-making process at agencies. I designed the questionnaire, with input from a criminal justice advisory committee, made up of local criminal justice practitioners. Upon qualitative analysis of the data, it became evident that the questionnaires did not delve deep enough into the details of policy input, such as whether agency heads were pressured into having or not having a fitness policy, or if politics in any way played a role in this process. Therefore, one might argue that the questionnaire might pose internal validity threats.

When discussing validity in general, conclusion validity might be worth mentioning. This is essentially whether a relationship between variables is a reasonable one or not, given the data being studied. In this study, it is possible to conclude that, while an overall significant relationship seems to exist between policy and injury and absenteeism rates, the policy itself may not have caused the outcome. Perhaps some other factor(s), and not policy alone was responsible for the results of the study (Trochim, 2006).

### **Trustworthiness**

On 09/01/16 Walden University IRB approved the proposed research study with the condition that each agency provide a signed letter of cooperation prior to data collection (Walden University IRB approval #09-01-16-0316158). Over a period of 5 months (October 2016 – March 2017), the six agencies that agreed to participate were

approved by IRB as data collection sites. I covered all documentation and travel expenses related to the study as not to incur any cost to the agencies. After collecting all documents and speaking to the training officer at each agency, both a verbal and appreciation was voiced and a thank you card was sent to those involved in providing the data from each agency. The information was then reviewed and validated to verify and gain a better understanding of it. This helped to protect the integrity of the research.

A case study was selected for this research to gather some data about fitness policy and injury and absenteeism rates, as well as how policy is decided among a sample of law enforcement agencies in the Piedmont Triad area of North Carolina. Case study is designed to focus on the activities of organizations and to describe rather than generalize. Therefore, transferability of the results outside of the study might be difficult to justify. The collection of data for this study is assumed to be trustworthy as each instrument used (policy, OSHA forms and questionnaires) were reviewed with the training officer of the agency to ensure both the validity of data and to verify any oral and written communication recorded on the questionnaire through confirmability, or a reflective use of participant perspectives. This was used to build justification for themes (Creswell, 2013).

Through the presentation of this study's purpose, data analyses, ethical considerations, and limitations discussion, it is hoped this research is viewed as both dependable and credible. Dependable in that an assessment of the integrated process of data collection, data analysis and theory generation were proposed and conducted; and credible in that every effort and intention was made to accurately interpret the data

collected. All information was carefully documented and reported to provide the necessary details so similar future research might replicate the study if desired.

### **Summary**

This chapter presented information on the recruitment process and instruments used to conduct the study pertaining to law enforcement fitness policies in relation to job injuries and absenteeism. Demographics on the six North Carolina law enforcement agencies in the sample were provided, as were the steps taken in the data collection process. Both qualitative and quantitative analyses were conducted to address the three research questions.

Agency fitness policies and OSHA 300A summary forms of six North Carolina midsized law enforcement agencies over a 5-year period were utilized in this multisite case study to determine whether a relationship existed between policy stringency and injury and absenteeism rates. Based on the quantitative analyses of ANOVA, Research Question 1 was addressed. A greater statistical significance was found between policy levels and injury rates than between policy level and absenteeism rates. When controlling for any change in policy from year to year, the opposite was found to be true.

Research Question 2 was analyzed qualitatively through responses on a questionnaire addressing policy decision-making factors and personnel. An agency's training officer or designee provided the responses. Overall data from participant responses resulted in the emergence of common themes that were then applied to the utilitarian function within rational choice theory. Research Question 3 also utilized specific questionnaire responses and determined that injuries and/or absenteeism rates were an agent of current fitness policy.

Chapter 5 interprets the findings and discusses the implications for social change. It also makes recommendations for further research and provides a conclusion to this study.



## Chapter 5: Discussion, Conclusions, and Recommendations

### **Introduction**

The purpose of this mixed methods multisite case study was to determine whether fitness policy affected reported work-related injuries and absenteeism among a sample of six law enforcement agencies in the Piedmont Triad region of North Carolina, and to test the utility function component of rational choice theory to ascertain whether it explains fitness policy implementation. OSHA-reported injury and absenteeism data were used from years 2011-2015 to examine any effects that may have resulted in policy change. Training officers were then asked about the policy decision-making process at each agency.

### **Interpretation of the Findings**

A large amount of research has been conducted on the topics of law enforcement fitness for duty, as well as work-related injuries and absenteeism, both internationally and in the United States. However, a very limited amount of research has been conducted on agencies in North Carolina, and more particularly on midsize agencies across the state. No similar academic research was found that had been conducted to examine OSHA-reported injuries and absenteeism in relation to fitness policy levels. The findings correlated with much of the existing literature addressing the role that fitness plays in injury prevention.

Three research questions guided this study and were designed to measure the effects of both fitness policy decision-making and work-related injury and absenteeism rates:

1. What relationship, if any, exists between a North Carolina law enforcement agency's fitness policy and work-related injuries and absenteeism?
2. When research emphasizes the benefits of maintaining a certain fitness level, particularly for first responders, does the utility function within rational choice theory explain why some North Carolina law enforcement agencies mandate physical fitness requirements for officers and others do not?
3. Are data-driven results on injury or absenteeism an agent or constraint as they pertain to the present fitness policy?

### **Research Question 1**

To determine whether a relationship existed between a certain fitness policy level and injury and absenteeism rates, participating agencies were asked to provide a copy of their fitness policy for years 2011-2015 as well as a copy of their OSHA 300A summary form for the same 5-year period. For each of the 5 years, a fitness policy was placed in to one of four categories, creating the independent variable *policy level*. The levels included (in increasing order) those agencies with (1) no fitness policy, (2) a general/voluntary fitness policy, (3) annual in-service and mandatory fitness testing, and (4) biannual mandatory testing. If fitness policy changed from one year to the next, it was noted and used as a dummy control variable (*policy change*) to determine whether change in policy made a significant difference in injury or absenteeism rates. It was only noted whether there was no change in policy, or whether an increase in policy level took place. For injury and days missed from work, a standardized rate (per 100 employees) was calculated to allow for comparisons across different agency sizes.

With SPSS, ANOVA was then applied using the *F*-test to evaluate whether group means within the dependent variable differed from each other among injury rates and absenteeism rates. It was found that ANOVA was significant between both policy level and injury rates, as well as policy level and absenteeism rates. The overall ANOVA was significant, and so follow-up tests were also conducted to evaluate pairwise differences among means. No significant difference was found between policy level and absenteeism rate, but a significant difference was found between policy level and injuries, with the agencies that required annual in-service and testing showing a greater decrease in injury rates when compared to agencies with other policies.

### **Theoretical Concepts**

Rational choice theory (RCT) indicates that individual behavior and social interaction affect the policymaking process. This process begins with making choices; under rational choice theory, it is assumed that choices are made based on larger representative populations (Green, 2002). In RCT, rational is meant to reflect the most feasible and preferable alternative through utility maximization or the alternative that has the greatest benefit. The environment in which the choice is made contributes to the constraints or circumstances that exist, as decisions are not made in a vacuum. Then analysis examines how choices interact to produce outcomes (Green, 2002). Jones et al. (2006) contended that even though organizations make policy, the interaction of human decision makers along with individual choice is what puts policy into action because individuals want to maximize their preferences and self-interest. Decision makers hold ordered and ranked preferences for outcomes and possess the necessary information to connect choices to preferred outcomes. Therefore, the rationality component is important

in decision-making; otherwise overall utility will be affected (Political Science Notes, 2013).

The next two research questions were designed to test RCT through qualitative analysis. A multisite case study was used because input from multiple agencies would provide more abundant insight about the decision-making process than input from one or few agencies. It also provided an opportunity to mine for common themes among responses. A questionnaire was designed to ask agency training officers about policy decision-making to determine if policy choice was indeed guided by RCT concepts. The questionnaire consisted of six main questions and four sub questions inquiring further into certain responses. Three of the questions were designed to address Research Question 2.

### **Research Question 2**

To test whether the utility function within RCT explains policy decision-making, three questions were asked of agency training officers. The questions included inquiry about the rationale behind current policy, involved decision makers, and factors affecting policy. After a written record of the responses was received from each agency, member checking was conducted to verify response content. The narrative data were then analyzed, coded, and interpreted. Improving employee productivity and wellness, and increasing officer safety were common themes among agencies that had a fitness policy in place. Case law implications, cost, and lack of manpower and administrative support were common responses among those agencies without a fitness policy in place. Responses to the question inquiring as to who was involved in the decision-making process included both internal as well as external agency employees, with all agreeing

that the agency head had the final say. Common factors affecting fitness policy were cost and resources, similar factors found in the rationale behind current policy.

It could be argued that the responses represent RCT, in that both individual behavior and social interaction played a role in the policymaking process. Of those agencies including input from multiple individuals (both inside and outside the agency), choices were made based on the most feasible option that would have the most benefit (Green, 2002). Those providing input might include agency employees, the public, or both.

### **Research Question 3**

To determine whether results of injury and absenteeism reports served as an agent or constraint to fitness policy, a closed-ended question was asked concerning whether the agency's fitness policy was intended to address this issue. Then responses were compared to the factors given that contributed to current policy. At the agencies with fitness policies in place, policy was intended to address, at least partially, work-related injuries and absences. The agencies without fitness policies saw mainly the cost and resources to oversee such a policy as a constraint. Therefore, from the consistent information presented by agencies either having or not having policies, it was determined that an agent/constraint component of the RCT contributed to the overall decision-making process.

### **Existing Policies and Potential Approaches**

North Carolina law enforcement agencies vary in fitness standards and policies. Policies range from voluntary self-initiation to required fitness participation and testing. Voluntary policies make it optional for officers to participate in fitness activities, either

on their own time or through various agency-sponsored incentives. One example is an agency that provides officers an extended break time to exercise while on duty. Rather than a 30-minute lunch break, officers are allowed 60 minutes, if manpower and call volume allows. The department provides a fully equipped exercise room that is available 24 hours a day. This is a convenient incentive not only for police officers, but also for all agency employees.

Other agencies in the state require fitness training days, which might occur once, twice, or four times a year (for example) as part of an officer's in-service training. Requirements vary but may only necessitate that officers are present and participate in some way. Agencies that include mandated fitness policy ensure that facilities, consultation services, and appropriate resources are available to officers by offering various fitness and educational activities, or individual consultations if desired.

### **Limitations**

Upon completion of this study, I found several limitations that must be disclosed. These limitations included the instruments used, the geographical location selected, ecological fallacies, and sample size. Each is discussed in more detail below.

The instruments used consisted of both primary and secondary resources. The primary resource consisted of the questionnaire that was developed to specifically address policy decision-making at agencies. I validated the questionnaire by using feedback from a local advisory committee made up of local police practitioners, and reliability was assumed, as the same questionnaire was used for each agency. Yet upon qualitative analysis, it was discovered that more in-depth inquiries could have been used to delve deeper into how individual decisions were made or perhaps persuaded.

Secondary data included written policy (if any) for an agency and OSHA 300A summary reports. It was learned that OSHA reporting varied. Not all agency forms distinguished injuries and absences by officers from those by nonsworn employees in the agency. Accountability and methods of data collection were also questioned due to large variance in some of the data recorded from one year to the next.

Because data were collected from midsized law enforcement agencies in the Piedmont Trial Region of North Carolina, the results were limited. Only six of 11 agencies fitting the population criteria were selected for a more in-depth case study analysis. Therefore, statistical results cannot be generalized because of the small sample size. More specifically, the results are unique to this region and might differ from those of smaller, larger, rural, or more urban areas within the state or elsewhere.

Important to researchers is also being aware of potential ecological and individual fallacies (Frankfort-Nachmias & Nachmias, 2008). It should be noted that an agency not having or enforcing a fitness policy or standard does not imply that officers cannot or do not take individual responsibility for their own fitness. It also cannot be inferred that high absentee or injury rates reflect poor officer or agency performance, as absence or injury may not be caused by poor fitness levels. Absence is not just about a day away from work; it is tied to circumstances of an employee's medical and personal life (Harte et al., 2011). Therefore, many factors must be considered when implementing a wellness or fitness program, given that multiple facets of life circumstances contribute to missing work for various reasons.

Findings in this study address the research questions in an effort to contribute to what little is known about the relationship between fitness policies and work-related

injuries and absenteeism, specifically within law enforcement agencies in North Carolina. Information was gained on how and why fitness policies are derived in some agencies, and suggestions derived from the study's findings are made to promote positive social change.

### **Implications for Positive Social Change**

This study has potential to contribute to positive social change at individual, community, and societal levels. The study's most important implications relate to police officers' role as public service responders. Though officers infrequently encounter situations that require them to meet physical demands, the inability to perform can have consequences for the individual officer, the agency, and the community (Means et al., 2011a). Study results suggest that some fitness standard is significantly related to lower injuries and fewer absences. The data should be encouraging to individuals and agencies alike that are seeking to promote the overall wellness and health of employees. More today than ever, organizations have to *do more with less* to maximize work output and increase productivity. This suggests that increasing productivity reduces organizational expense (Harte et al., 2011). According to the U.S. Department of Labor (n.d.), health improvement programs cost 0.5% of payroll, compared to 6.5% in combined costs related to replacement of workers, sick leave, short and long-term disability, and workers' compensation. Employers are challenged by supporting employees' needs (e.g., time off and health insurance) with cost-effective benefits that create a productive workforce. Particularly when an administration aligns organizational goals and employee needs, employees' productivity can be greatly influenced by their general health and well-being



(Harte et al., 2011). In this sense, the individual, agency, and taxpayers/recipients of public services all benefit.

### **Recommendations for Action**

Investing in wellness programs that focus on preventing illness and maintaining health influences medical costs and absenteeism. Such programs can go a long way in helping to create a high-performance environment, lower health care costs, and reduce absences (Harte et al., 2011). Funding for fitness programs could be included within agency budgets or agencies could seek state funding per North Carolina General Statute 130A-224 as it pertains to public health. This statute provides a full mandate for public health issues, including injury prevention (Stier et al., 2012). It is a collaboration worth exploring further. A partnership with the North Carolina Public Health Department would be advantageous to incorporating injury prevention programs. To justify continued funding, it would be necessary to routinely evaluate training methods (Ferguson et al., 2011). Evaluation results can be useful by also pointing out deficiencies or areas where improvements can be made. It is the obligation of criminal justice practitioners and researchers alike to render professional judgment to improve the well-being of those in the field (ACJS, n.d.). Poor health and fitness carry higher risks of injuries and absences, which in turn cost agencies and taxpayers more money. Therefore, to justify standards and funding, evaluation is a necessary component. Data collection that provides evidence-based results would help to justify the continuance (or elimination of) such programs in the future.

The main objectives of fitness policy include reducing the risks of both work-related injury and absenteeism (and therefore increasing the health benefits of officers)

and reducing agency and officer costs by way of fewer medical expenses and less absenteeism. The stipulation is that data should be collected and funding should be contingent upon evidence-based results. This could also be a beneficial form of accountability.

The purpose of providing alternatives is to offer optional approaches in case the initial, intended proposal does not completely work (Bardach, 2012) or needs to be adjusted in some way. The current interest lies in reducing workplace injuries and absences. Employers are aware that health and work are interrelated and that employers have a role in facilitating job retention and wellness (Irvine, 2011). Therefore, they are key players in policy change.

### **Recommendations for Further Study**

The results of this study are limited to what was found among six law enforcement agencies within one region of North Carolina. The intent was to concentrate mainly on the patrol function within policing; however, with OSHA 300A summary statistics, it is difficult to do that. Therefore, it is suggested that actual OSHA 300 forms be analyzed to select out how injuries and absenteeism among patrol officers might differ compared to other sworn or nonsworn positions within an agency. This analysis would require more time and resources because those reported on the OSHA 300 form as injured or absent are listed by name; therefore, confidentiality would first have to be considered, and with the assistance of human resources a role distinction would have to be made among names as to pull out patrol officers. Alternatively, perhaps those patrol officers could be contacted and interviewed to determine whether the injury or absenteeism was indeed work-related.

It might also be interesting to compare differences in fitness levels and requirements for specialty teams (for example, SWAT, K-9) versus patrol as specialty teams generally require more strict fitness levels. Though the responsibilities differ, there may be a significant difference in injury and absenteeism rate when compared to patrol officers. Also, because more stringent requirements are often a condition of belonging to such specialty teams, how or why this policy was rationalized and decided might be explored to further test RCT or to test additional decision-making theories.

### **Conclusion**

This study was conducted to address the gap in the literature regarding why police academy cadets have required fitness standards but not all law enforcement agencies require a maintained fitness level as a condition of employment in North Carolina. In the hiring process, a critical qualifying factor is the use of fitness testing; however, if testing is used agencies need to understand fitness assessments if they are to implement required standards (Cooper Institute, 2014). During this research, very limited studies were found specific to North Carolina agencies and fitness policy, and none were found that specifically examined OSHA-reported injuries and absenteeism compared to various agency fitness policies.

Providing quality public services to the community is demanding and often agency resources are stretched thin. Agencies are trying to find that delicate balance with limited resources, whether dollars, manpower, or time. Agencies discussed varying reasons for having or not having physical fitness policies in place, but regardless; all stressed the importance of officer safety which can be increased by paying attention to officer wellness (Office of Community Oriented Policing Services, 2015).

Research continues to support the importance of a police officer's physical and psychological health, but fitness is only one piece of a larger puzzle. Improving workplace productivity calls for a comprehensive strategy that includes integrating evidence-based measurement because it is important to show that the health and productivity of the workforce directly relates to the health and well-being of the organization (Harte et al., 2011; Office of Community Oriented Policing Services, 2015).

## References

- Academy of Criminal Justice Sciences. (n.d.). Code of Ethics. Retrieved from [http://www.acjs.org/?page=code\\_of\\_ethics&terms](http://www.acjs.org/?page=code_of_ethics&terms)
- Adams, J., Cheng, D., Lee, J., Shock, T., Kennedy, K., & Pate, S. (2014). Use of the bootstrap method to develop a physical fitness test for public safety officers who serve as both police officers and firefighters. *Baylor University Medical Center Proceedings*, 27(3), 199-202.
- Anderson, G. S., Plecas, D., & Segger, T. (2001). Police officer physical ability testing: Re-validating a selection criterion. *Policing: An International Journal of Police Strategies & Management*, 24(1), 8-31.
- Armstrong, J., Clare, J., & Plecas, D. (2014). Monitoring the impact of scenario-based use-of-force simulations on police heart rate: Evaluating the Royal Canadian Mounted Police skills refresher program. *Western Criminology Review*, 15(1), 51-59.
- Bardach, E. (2012). *A practical guide for policy analysis: The eightfold path to more effective problem solving* (4<sup>th</sup> ed.). Thousand Oaks, CA: SAGE.
- Batts, A. W., Smoot, S. M., & Scrivner, E. (2012, July). *Police leadership challenges in a changing world*. Washington, DC: National Institute of Justice. Retrieved from <http://www.nij.gov>
- Becker, G. (1976). "The Economic Approach to Human Behavior," in *The Economic Approach to Human Behavior* (Chicago and London: The University of Chicago Press), pp. 3-14.

- Bennis, W. (2007). The challenges of leadership in the modern world: Introduction to the special issue. *American Psychology*, *62*(1), 2–5.
- Bergman, M. M. (2008). The straw men of the qualitative-quantitative divide and their influence on mixed methods research. In M. M. Bergman (Ed.), *Advances in mixed methods research* (pp. 10-21). Thousand Oaks, CA: SAGE.
- Bissett, D., Bissett, J., & Snell, C. (2012). Physical agility tests and fitness standards: Perceptions of law enforcement officers. *Police Practice and Research*, *13*(3), 208-223.
- Bonneau, J., & Brown, J. (1995). Physical ability, fitness and police work. *Journal of Clinical Forensic Medicine*, *2*, 157-164.
- Boyce, R. W., Hiatt, A. R., & Jones, G. R. (1992). Physical fitness of police officers as they progress from supervised recruits to unsupervised sworn officer programs. *Wellness Perspectives*, *8*(4), 31-37.
- Boyce, R. W., Jones, G. R., & Hiatt, A. R. (1991). Physical fitness capacity and absenteeism of police officers. *Journal of Occupational Medicine*, *33*(11), 1137-1143.
- Brandl, S. G., & Strohshine, M. S. (2012). The physical hazards of police work revisited. *Police Quarterly*, *15*(3), 262-282. doi:10.1177/10986111112447757
- Brooks, M. E. (2001, May). Law enforcement physical fitness standards and Title VII. *FBI Law Enforcement Bulletin*, 26-31.
- Brown, M. J., Tandy, R. D., Wulf, G., & Young, J. C. (2013). The effect of acute exercise on pistol shooting performance of police officers. *Motor Control*, *17*, 273-282.

- Bueermann, J. (2012, March). Being smart on crime with evidence-based policing. *National Institute of Justice Journal*, 269. Retrieved from <http://www.nij.gov>
- Bureau of Justice Statistics. (2016). Law enforcement. Retrieved from <http://www.bjs.gov/index.cfm?ty=tp&tid=7>
- Bureau of Labor Statistics. (2014). *Occupational outlook handbook: Police and detectives*. Retrieved from <http://www.bls.gov/ooh/protective-service/police-and-detectives.htm>
- Burlington Police Department, North Carolina. (2010, January). *General health and physical fitness & wellness programs* (Directive 22.3.2). Retrieved from <http://www.ci.burlington.nc.us/53/Police>
- Caro, C. A. (2011). Predicting state police officer performance in the field training officer program: What can we learn from the cadet's performance in the training academy? *American Journal of Criminal Justice*, 36, 357-370.  
doi:10.1007/s12103-011-9122-6
- Collingwood, T. R., Hoffman, R., & Smith, J. (2004). Underlying physical fitness factors for performing police officer physical tasks. *Police Chief*, 71(3). Retrieved from [http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display&article\\_id=251&issue\\_id=32004](http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display&article_id=251&issue_id=32004)
- Commission on Accreditation for Law Enforcement Agencies. (2010). Homepage. Gainesville, VA. Retrieved from <http://www.calea.org/>
- Cooper Institute. (2014). Homepage. Retrieved from <http://www.cooperinstitute.org/>
- Courtright, S. H., McCormick, B. W., Postlethwaite, B. E., Reeves, C. J., & Mount, M. K. (2013). A meta-analysis of sex differences in physical ability: Revised

- estimates and strategies for reducing differences in selection contexts. *Journal of Applied Psychology*, 98(4), 623-641. doi:10.1037/a0033144
- Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3<sup>rd</sup> ed.). Thousand Oaks, CA: SAGE.
- Dick, G. P. M. (2011). The influence of managerial and job variables on organizational commitment in the police. *Public Administration*, 89(2), 557-576.  
doi:10.1111/j.1467-9299.2010.01874.x
- Dillern, T., Jenssen, O. R., Lagestad, P., Nygard, O., & Ingebrigtsen, J. (2014). Arresting a struggling subject; does the forthcoming police officers physical fitness have an impact on the outcome? *The Open Sports Sciences Journal*, 7(Suppl-1, M2), 2-7.
- Donoghue, S. (1997, May/June). The correlation between physical fitness, absenteeism and work performance. *Canadian Journal of Public Health*, 68(3), 201-203.
- Ebling, P. (2002, October). Physical fitness in law enforcement: Follow the yellow brick road. *FBI Law Enforcement Bulletin*, 1-5.
- Farley, J. (2011, May 5). Suquamish police officers fired after department revamps fitness policy. *Kitsap Sun Newspaper Online*. Retrieved from <http://www.kitsapsun.com/news/local/suquamish-police-officers-fired-after-department-revamps-fitness-policy-ep-418580163-357247991.html>
- Ferguson, P., Prenzler, T., Sarre, R., & de Caires, B. (2011). Police and security officer experiences of occupational violence and injury in Australia. *International Journal of Police Science and Management*, 13(3), 223-233.  
doi:10.1350/ijps.2011.13.3.239
- Fischler, G. L., McElroy, H. K., Miller, L., Saxe-Clifford, S., Stewart, C. O., & Zelig, M.



(2011, August). *The Police Chief*, 78, 72-78.

FitForce, Inc. (2010). Model program: Public safety physical readiness. Salem, MA.

Fitness tests will help police with health and safety compliance. (2012, April). *Safety & Health Practitioner*, 30(4), 8.

Fortenbery, J. (2016). An exploratory study on physical fitness policies among police departments in North Carolina. Doctoral dissertation. Nova Southeastern University. Retrieved from NSUWorks, College of Arts, Humanities and Social Sciences – Department of Justice and Human Services. (4).

[http://www.nsuworks.nova.edu/cahss\\_jhs\\_etd/4](http://www.nsuworks.nova.edu/cahss_jhs_etd/4)

Frankfort-Nachmias, C., & Nachmias, D. (2008). *Research methods in the social sciences* (7<sup>th</sup> ed.). New York: WORTH.

Franklin, A. L., & Raadschelders, J. C. N. (Winter 2004). Ethics in local government budgeting: Is there a gap between theory and practice? *Public Administration Quarterly*, 456-490.

Gascon, G., & Foglesong, T. (2010, December). Making policing more affordable: Managing costs and measuring value in policing. *New Perspectives in Policing*. National Institute of Justice. Washington, DC 20531. <http://www.nij.gov>

Gerber, M., Kellmann, M., Elliot, C., Hartmann, T., Brand, S., Holsboer-Trachsler, E., & Puhse, U. (2013). Perceived fitness protects against stress-based mental health impairments among police officers who report good sleep. *Journal of Occupational Health*, 55, 376-384.

Glassman, G. (2003, March). *CrossFit Journal*. Police training. Retrieved from [http://library.crossfit.com/free/pdf/policetng\\_Mar03.pdf](http://library.crossfit.com/free/pdf/policetng_Mar03.pdf)

- Green, S. B., & Salkind, N. J. (2011). *Using SPSS for Windows and Macintosh: Analyzing and understanding data* (6<sup>th</sup> ed.). Boston, MA: PRENTICE HALL.
- Green, S. L. (2002, May). *Rational choice theory: An overview*. Prepared for the Baylor University Faculty Development Seminar on Rational Choice Theory. Baylor University, Waco, Texas.
- Guffey, J. E., Larson, J. G., & Lasley, J. (2014, June). Police officer fitness, diet, lifestyle and its relationship to duty performance and injury. *Journal of Legal Issues and Cases in Business*, 3, 1-17.
- Harte, K., Mahieu, K., Mallett, D., Norville, J., & VanderWerf, S. (2011). Improving workplace productivity: It isn't just about reducing absence. *Benefits Quarterly*, 27(3), 13-26.
- Hartley, T. A., Burchfiel, C. M., Fekedulegn, D., Andrew, M. E., & Violanti, J. M. (2011). Health disparities in police officers: Comparisons to the U.S. general population. *International Journal of Emergency Mental Health*, 13(4), 211-220.
- Heneweer, H., Picavet, H. S. J., Staes, F., Kiers, H., & Vanhees, L. (2012). Physical fitness, rather than self-reported physical activities, is more strongly associated with low back pain: Evidence from a working population. *European Spine Journal*, 21, 1265-1272. doi:10.1007/s00586-011-2097-7
- Hymel, P. A., Loeppke, R. R., Baase, C. M., Burton, W. N., Hartenbaum, N. P., Hudson, T. W., McLellan, R. K., Mueller, K. L., Roberts, M. A., Yarborough, C. M., Konicki, D. L., & Larson, P. W. (2011). Workplace health protection and promotion: A new pathway for a healthier – and safer – workplace. *Journal of Occupational and Environmental Medicine*, 53(6), 695-702.

- International Association of Chiefs of Police. (2014). *Midsized police agencies: Surviving, thriving, and forging a new business model for law enforcement in a post-recession economy*. Washington, DC: Office of Community Oriented Policing Services.
- Irvine, A. (2011). Fit for work? The influence of sick pay and job flexibility on sickness absence and implications for presenteeism. *Social Policy & Administration*, 45(7), 752-769.
- Jones, B. D., Boushey, G., & Workman, S. (2006). Behavioral rationality and the policy processes: Toward a new model of organizational information processing. In B. G. Peters, & J. Pierre (Eds.), *Handbook of public policy* (pp. 39-64). Thousand Oaks, CA: SAGE.
- Karp, T., & Helgo, T. (2008). The future of leadership: The art of leading people in a “post-managerial” environment. *Foresight: The Journal of Futures Studies, Strategic Thinking and Policy*, 10(2), 30-37.
- Knapik, J. J., Grier, T., Spiess, A., Swedler, D. I., Hauret, K. G., Graham, B., Yoder, J., & Jones, B. H. (2011). Injury rates and injury risk factors among Federal Bureau of Investigation new agent trainees. *BMC Public Health*, 11, 920-935.  
doi:10.1186/1471-2458-11-920
- Laerd Statistics. (2013). Pearson’s product-moment correlation using SPSS statistics. Lund Research Ltd. Retrieved from <https://statistics.laerd.com/spss-tutorials/pearsons-product-moment-correlation-using-spss-statistics.php>
- Lagestad, P. (2012). Physical skills and work performance in policing. *International Journal of Police Science and Management*, 14(1), 58-70.

- Laureate Education Inc. (VSG). (2010). *Sequencing and staging*. Baltimore: Nastasi.
- Lee, J. C., Mallory, S. (Fall 2004). *Smart Online Journal*, 1(1), 15-19. Retrieved from <http://www.thesmartjournal.com/SMART-police%20fitness.pdf>
- Lunenburg, F. C. (2011). Goal-setting theory of motivation. *International Journal of Management, Business, and Administration*, 15(1), 1-6.
- McCraty, R., Atkinson, M. (2012). Resilience training program reduces physiological and psychological stress in police officers. *Global Advances in Health and Medicine*, 1(5), 44-66.
- McGill, S., Frost, D., Lam, T., Finlay, T., Darby, K., & Andersen, J. (2013). Fitness and movement quality of emergency task force police officers: An age-grouped database with comparison to populations of emergency services personnel, athletes and the general public. *International Journal of Industrial Ergonomic*, 43, 146-153.
- Means, R., Lowry, K., & Hoffman, B. (2011a, Apr). Physical fitness standards: Do your officers meet the physical requirements for your department? *Law & Order*, 59(4), 16-17.
- Means, R., Lowry, K., & Hoffman, B. (2011b, May). Physical fitness tests and performance standards, part 2. *Law & Order*, 59(5), 15.
- Means, R., Lowry, K., & Hoffman, B. (2011c, June). Physical fitness tests and performance standards, part 3. *Law & Order*, 59(6), 14.
- Miller, B. (Fall/Winter 2015). Training for reality. *The Federal Law Enforcement Training Centers (FLETC) Journal*, 15, 25-27. Retrieved from <https://www.fletc.gov/read-latest-fletc-journal-magazine-summer-2015>

North Carolina Department of Justice. (2015). *Police Officer Physical Abilities*

*Test (POPAT) Operational Guide*. North Carolina Justice Academy, Salemburg, NC.

North Carolina General Statute §130A-224.

North Carolina Justice Academy. (n.d.). NC police departments. Retrieved

from <http://ncja.ncdoj.gov/Criminal-Justice-Links/NC-Police-Departments.aspx>

North Carolina Justice Academy. (2000, April). POPAT subcommittee

report/recommendations. Retrieved from <http://ncja.ncdoj.gov/NCJAHome.aspx>

Occupational Safety and Health Administration. (n.d.). OSHA injury and illness

recordkeeping and reporting requirements. Retrieved from [www.osha.gov/recordkeeping/](http://www.osha.gov/recordkeeping/)

Office of Community Oriented Policing Services. (2015). *The President's Task Force on 21st Century Policing Implementation Guide: Moving from Recommendations to Action*. Washington, DC: Office of Community Oriented Policing Services.

Orr, R., Stierli, M., Hinton, B., & Steele, M. (2013, November). *The 30-15 intermittent fitness assessment as a predictor of injury risk in police recruits*. Paper

presented at 2013 Australian Strength and Conditioning Association International Conference on Applied Strength and Conditioning, Melbourne, Australia.

Retrieved from [http://epublications.bond.edu.au/hsm\\_pubs/627/](http://epublications.bond.edu.au/hsm_pubs/627/)

Panos, M. (2010). Making a fitness program successful. *Law & Order*, 58(4), 62-66.

Papazoglou, K., & Andersen, J. P. (2014). A guide to utilizing police training as a tool to promote resilience and improve health outcomes among police officers.

*Traumatology: An International Journal*, 20(2), 103-111.

*Parker v. District of Columbia*, 271 U.S. App. D.C. 15, 850 F.2d 708 (U.S. App. D.C. 1988).

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3<sup>rd</sup> ed.). Thousand Oaks, CA: SAGE.

Phadke, S. S. D., Khan, S. A., Iqbal, R., & Ramakrishnan, K. S. (2014). Assessment of endurance, power, and flexibility of Navi Mumbai traffic police. *International Journal of Medical and Pharmaceutical Sciences*, 4(11), 20-25.

Piedmont Triad Regional Council. (2012). Retrieved from <http://www.ptrc.org/>

Plano Clark, V. L., & Creswell, J. W. (2008). *The mixed methods reader*. Thousand Oaks, CA: SAGE.

Plat, M. J., Frings-Dresen, M. H. W., & Sluiter, J. K. (2011). A systematic review of job-specific workers' health surveillance activities for fire-fighting, ambulance, police and military personnel. *International Archives of Occupational and Environmental Health*, 84(8), 839-857. doi:10.1007/s00420-011-0614-y

Poister, T. H. (2010). The future of strategic planning in the public sector: Linking strategic management and performance. *Public Administration Review*, 70(S1), s246-s254. doi:10.1111/j.1540-6210.2010.02284.x

Political Science Notes. (2013). Decision-making theory: Definition, nature and theories. Retrieved from <http://www.politicalsciencenotes.com/articles/decision-making-theory-definition-nature-and-theories/743>

Pronk, N. P. (2009). Physical activity promotion in business and industry: Evidence, context, and recommendations for a national plan. *Journal of Physical Activity and Health*, 6(Suppl. 2), S220-S235.

- Pronk, N. P. (2015). Fitness in the U.S. workforce. *Annual Review of Public Health* 36, 131-149. doi:10.1146/annurev-publhealth-031914-122714
- Putney, D. M., & Holmes, C. L. (2008, October). Designing a law enforcement leadership development program. *The Police Chief*, 75(10). Retrieved from [http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display\\_arh&article\\_id=1652&issue\\_id=102008](http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display_arh&article_id=1652&issue_id=102008)
- Quitley, A. (2008). Fit for duty? The need for physical fitness programs for law enforcement officers. *The Police Chief*, 75(6). Retrieved from [http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display&article\\_id=1516&issue\\_id=62008](http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display&article_id=1516&issue_id=62008)
- Ramey, S. L., Perkhounkova, Y., Moon, M., Tseng, H. C., Wilson, A., Hein, M., Hood, K., & Franke, W. D. (2014). Physical activity in police beyond self-report. *Journal of Occupational and Environmental Medicine*, 56(3), 338-343.
- Rayson, M. P. (2000). Fitness for work: The need for conducting a job analysis. *Occupational Medicine*, 50(6), 434-436.
- Rossomanno, C. I., Herrick, J. E., Kirk, S. M., & Kirk, E. P. (2012). A 6-month supervised employer-based minimal exercise program for police officers improves fitness. *Journal of Strength and Conditioning Research*, 26(9), 2338-2344.
- Royle, M. T., & Hall, A. T. (2012). The relationship between McClelland's theory of needs, feeling individually accountable, and informal accountability for others. *International Journal of Management and Marketing Research*, 5(1), 21-42.
- Rudestam, K. E., & Newton, R. R. (2007). *Surviving your dissertation: A*

comprehensive guide to content and process (3<sup>rd</sup> ed.). Thousand Oaks, CA:  
SAGE.

Sassen, B., Kok, G., Schaalma, H., Kiers, H., & Vanhees, L. (2010). Cardiovascular risk profile: Cross-sectional analysis of motivational determinants, physical fitness and physical activity. *BMC Public Health, 10*, 592-600. Retrieved from <http://www.biomedcentral.com/1471-2458/10/592>

Schulhofer, S. J., Tyler, T. R., & Huq, A. Z. (2011). American policing at a crossroads: Unsustainable policies and the procedural justice alternative. *The Journal of Criminal Law & Criminology, 101*(2), 335-374.

Schulze, C. (2012). The masculine yardstick of physical competence: U.S. police academy fitness tests. *Women & Criminal Justice, 22*(2), 89-107.  
doi:10.1080/08974454.2012.662117

Smith, Jr., J. E. (2010). *FitForce Coordinator Guide, 2<sup>nd</sup> Ed.* Monterey, CA: Coaches Choice, Inc.

Smith, Jr., J. E., & Tooker, G. G. (2011). Health and fitness in law enforcement: A voluntary model program response to a critical issue. *CALEA Update Magazine*, issue 87. Retrieved from <http://www.calea.org/calea-update-magazine/issue-87/health-and-fitness-law-enforcement-voluntary-model-program-response-c>

Statistical Package for the Social Sciences. (2015). Version 23.0. IBM Analytics.

Steinhardt, M., Greenhow, L., & Stewart, J. (1991). The relationship of physical activity and cardiovascular fitness to absenteeism and medical care claims among law enforcement officers. *American Journal of Health Promotion, 5*(6), 455-460.

Stier, D. D., Thombley, M. L., Kohn, M. A., & Jesada, R. A. (2012). The status of legal



authority for injury prevention practice in state health departments. *American Journal of Public Health*, 102(6), 1067-1078.

Strating, M., Bakker, R. H., Dijkstra, G. J., Lemmink, K. A. P. M., & Groothoff, J. W. (2010). A job-related fitness test for the Dutch police. *Occupational Medicine*, 60(4), 255-260. doi:10.1093/occmed/kqq060

*Tennessee v. Garner*, 471 U.S. 1, 105 S. Ct. 1694, 85 L. Ed. 2d 1 (U.S.S.C. 1985).

Thornton, J. R. (2011). Ambivalent or indifferent? Examining the validity of an objective measure of partisan ambivalence. *Political Psychology*, 32(5), 863-884. doi:10.1111/j.1467-9221.2011.00841.x

Trochim, W. M. K. (2006). Research methods knowledge base. Retrieved from <http://www.socialresearchmethods.net/kb/index.php>

Ugboro, I. O., Obeng, K., & Spann, O. (2011). Strategic planning as an effective tool of strategic management in public sector organizations: Evidence from public transit organizations. *Administration & Society*, 43(1), 87-123. doi:10.1177/0095399710386315

U.S. Census Bureau. (n.d.). Retrieved from <https://census.gov/>

U.S. Department of Health and Human Services. (2015). Prevention and Public Health Fund. <http://www.hhs.gov/open/prevention/index.html#>

U.S. Department of Labor. (n.d.). Retrieved from <http://www.dol.gov/>

U.S. Equal Employment Opportunity Commission. (n.d.). Prohibited employment policies/practices. Retrieved from <http://www.eeoc.gov/laws/practices/>

van Dongen, J. M., Proper, K. I., van Wier, M. F., van der Beek, A. J., Bongers, P. M., van Mechelen, W., & van Tulder, M. W. (2011). Systematic review on the

financial return of worksite health promotion programmes aimed at improving nutrition and/or increasing physical activity. *Obesity Reviews*, 12(12), 1031-1049.  
doi:10.1111/j.1467-789X.2011.00925.x

Violanti, J. M., Fededulegn, D., Andrew, M. E., Charles, L. E., Hartley, T. A., Vila, B., & Burchfiel, C. M. (2013). Shiftwork and long-term injury among police officers. *Scandinavian Journal of Work, Environment & Health*, 39(4), 361-368.  
doi:10.5271/sjweh.3342

Vogt, W. P., & Johnson, R. B. (2011). *Dictionary of statistics & methodology: A nontechnical guide for the social sciences* (4<sup>th</sup> ed.). Los Angeles, CA: SAGE.

Walden University. (2010). *Institutional review board for ethical standards in research*. Retrieved from <http://researchcenter.waldenu.edu/Office-of-Research-Integrity-and-Compliance.htm>

Williams, B. (2002). Fitness in law enforcement. Pittsfield Township Police Department. Eastern Michigan University. Retrieved from <http://www.emich.edu/cerns/downloads/papers/PoliceStaff/Shift%20Work,%20%20Stress,%20%20Wellness/Fitness%20in%20Law%20Enforcement.pdf>

Wirtz, A., & Nachreiner, F. (2012). Effects of lifetime exposure to shiftwork on fitness for duty in police officers. *Chronobiology International*, 29(5), 595-600.  
doi:10.3109/07420528.2012.675844

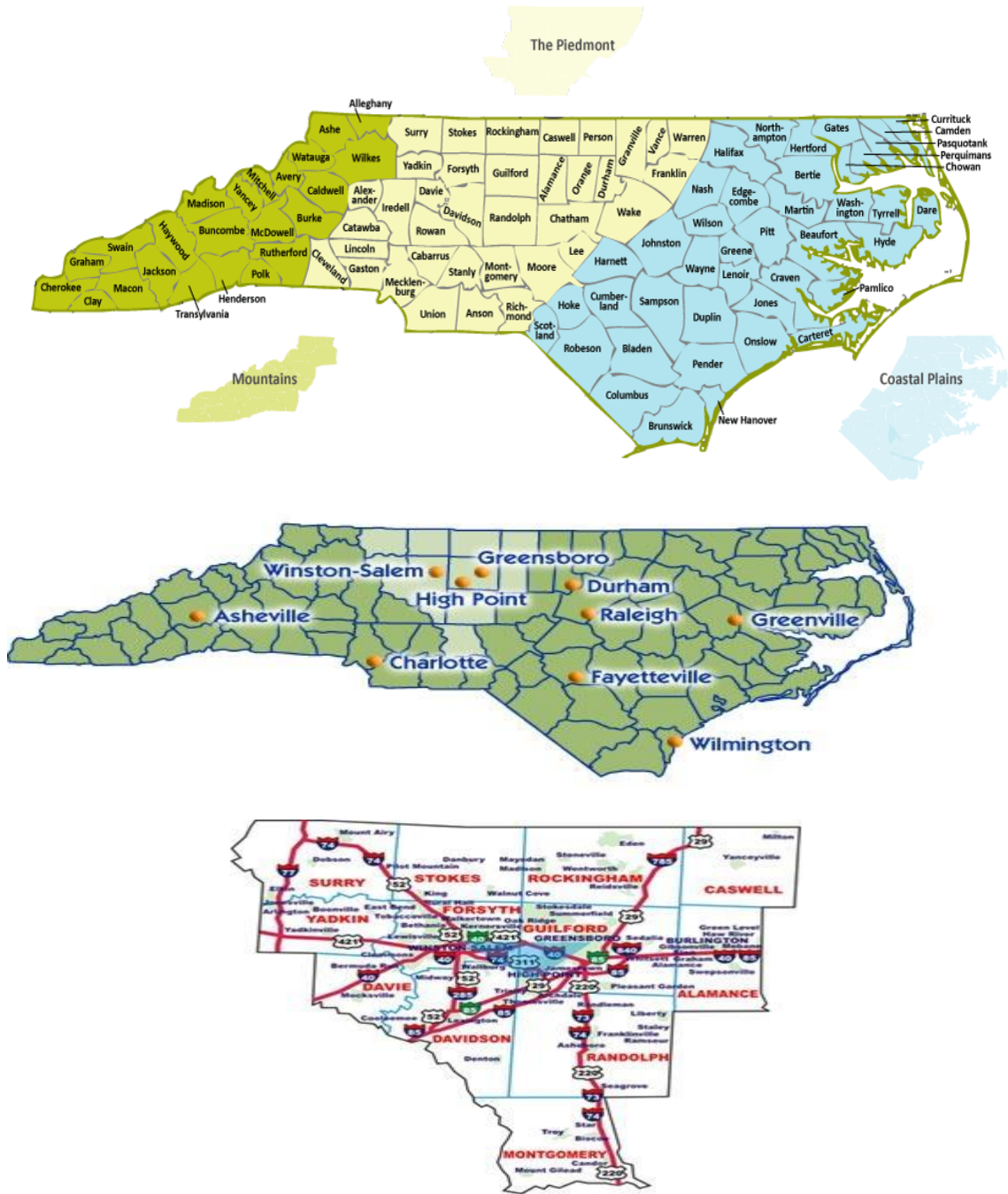
Wright, B. R., Barbosa-Leiker, C., & Hoekstra, T. (2011). Law enforcement officer versus non-law enforcement officer status as a longitudinal predictor of traditional and emerging cardiovascular risk factors. *Journal of Occupational and Environmental Medicine*, 53(7), 730-734.

Zagaria, P. (2007, August 23). Fitness training for law enforcement. *PoliceOne.com*.

Retrieved from <http://www.policeone.com/policeproducts/apparel/articles/1340939-Fitness-training-for-law-enforcement/>

Zimmerman, F. H. (2012). Cardiovascular disease and risk factors in law enforcement personnel: A comprehensive review. *Cardiology Review*, 20(4), 159-166.

### Appendix A: North Carolina Regions



Reference: Piedmont Triad Council. (2012). Retrieved from <http://www.ptrc.org/>

Appendix B: Piedmont Triad Region Law Enforcement Agencies

<u>Agency</u>	<u>Population 50,0000 – 500,000</u>
Alamance County	yes
-City of Burlington	yes
Caswell County	no
Davidson County	yes
Davie County	no
Forsyth County	yes
-City of Winston-Salem	yes
Guilford County	yes
-City of Greensboro	yes
-City of High Point	yes
Montgomery County	no
Randolph County	yes
Rockingham County	yes
Stokes County	no
Surry County	yes
Yadkin County	no

## Appendix C: Population of Midsize Law Enforcement Agencies in the Piedmont Triad

## Region of North Carolina

Agency	2010 census population
██████████ County Sheriff's Office	151,131
██████████ Police Department	49,963
██████████ County Sheriff's Office	162,878
██████████ County Sheriff's Office	350,670
██████████ Police Department	229,617
██████████ County Sheriff's Office	488,406
██████████ Police Department	269,666
██████████ Police Department	104,371
██████████ County Sheriff's Office	141,752
██████████ County Sheriff's Office	93,643
██████████ County Sheriff's Office	73,673

*Note.* From "2010 Census Interactive Population Search," by U.S. Census Bureau, n.d. (<https://census.gov/>).  $N = 11$ . Midsize = areas with 50,000-500,000 population.

Appendix D: Sample Agency Fitness Policy

STANDARD OPERATING PROCEDURE	UNIT: Training Division
SUBJECT: HEALTH AND FITNESS OF SWORN OFFICERS	NUMBER 7.4
EFFECTIVE DATE: 8/1/04	PAGE 1 OF 1
REVISION HISTORY: (Adopted 1/1/96) R1-7/1/99 R2 8/1/04 R3 8/10/07 R4 3.6.09 R5 10.14.13	

**7.4.1 OBJECTIVE**

The objective of the xxxxxxx Police Department is to develop and maintain a level of fitness in police personnel and to ensure their ability to accomplish assigned duties and provide satisfactory job performance without undue risk of injury or fatigue.

**7.4.2 RESPONSIBILITIES**

The Training Division is primarily responsible for the coordination and execution of all tasks pertaining to departmental directive 8.1.3.

**7.4.3 COMPONENTS**

The fitness services, provided at no charge by the department, includes:

1. An optional nutritional assessment. Officers complete a journal about their present health/eating habits.
2. A physical fitness assessment. The assessment consists of the following:
  - Age, Height measurement, Weight measurement
  - Body composition (Body Fat Percentage) – is measured by using skin fold calipers.
  - Blood pressure and heart rate - are measured by a sphygmomanometer.
  - Aerobic fitness - is measured by both a 1.5 mile walk/run and a 300-meter walk/run.
  - Strength fitness - is measured by:
    - Maximum one-time bench press
    - Maximum number of push-ups within one-minute
    - Maximum number of sit-ups within one-minute

Once all tests are computed, each participant is categorized into one of five levels of fitness (age adjusted):

- 1) Very Poor 2) Poor 3) Fair 4) Good 5) Excellent 6) Superior

Each participant receives a synopsis of his/her results.

**7.4.4 ANALYSIS OF RESULTS**

Each officer will be given a copy of their physical assessment synopsis if requested. They may at any time schedule an appointment with the appropriate training coordinator for a free consultation concerning their results.

**7.4.5 DUTIES**

The Training Division will ensure that staff members performing tasks assessments are capable of properly conducting physical fitness assessments, providing fitness counseling and providing a written printout of results on each participant. Testing will be conducted at the Public Safety Training Facility utilizing Departmental equipment.

Retesting – Any participant can be retested upon request of the participant. Portions of any segment or the entire program can be retested.

**7.4.6 FILE MAINTAINANCE**

Any information obtained which pertains to the health and wellness program will be maintained in the Training Division and monitored by the appropriate training coordinator.

## Appendix E: OSHA 300A Form

OSHA's Form 300A (Rev. 01/2004)


### Summary of Work-Related Injuries and Illnesses

All establishments covered by Part 1904 must complete this Summary page, even if no work-related injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the Log. If you had no cases, write "0".

Employees, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR Part 1904.35, in OSHA's recordkeeping rule, for further details on the access provisions for these forms.

Year 20\_\_



**U.S. Department of Labor**  
Occupational Safety and Health Administration

Form approved OMB no. 1224-026

Number of Cases			
Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
(G)	(H)	(I)	(J)

Number of Days	
Total number of days away from work	Total number of days of job transfer or restriction
(K)	(L)

Injury and Illness Types			
Total number of ...			
(M)			
(1) Injuries	_____	(4) Poisonings	_____
(2) Skin disorders	_____	(5) Hearing loss	_____
(3) Respiratory conditions	_____	(6) All other illnesses	_____

**Establishment information**

Your establishment name \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

Industry description (e.g., *Manufacturer of motor truck trailers*) \_\_\_\_\_

Standard Industrial Classification (SIC), if known (e.g., 3715) \_\_\_\_\_

OR \_\_\_\_\_

North American Industrial Classification (NAICS), if known (e.g., 336212) \_\_\_\_\_

**Employment information** (if you don't have these figures, see the Worksheet on the back of this page to estimate.)

Annual average number of employees \_\_\_\_\_

Total hours worked by all employees last year \_\_\_\_\_

**Sign here**

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

\_\_\_\_\_  
Company executive Title

( ) / /  
Date Date

**Post this Summary page from February 1 to April 30 of the year following the year covered by the form.**

Public reporting burden for this collection of information is estimated to average 58 minutes per response, including time to review the instructions, search existing data sources, gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspect of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 300 Constitution Avenue, NW, Washington, DC 20201. Do not send the completed forms to this office.



Appendix F: Participating Agency OSHA-Reported Injuries in Order of  
Fitness Policy Stringency

Agency	Year	# of employees	Days away from work	*Absent rate (per 100)	Total injuries	*Injury rate (per 100)
(1)	2011	228	2	.88	12	5.26
	2012	248	117	47.18	15	6.05
	2013	254	154	60.63	10	3.94
	2014	254	0	0.00	14	5.51
	2015	262	12	4.58	12	4.58
(2)	2011	missing	55	missing	23	missing
	2012	1206	248	20.56	61	5.16
	2013	892	411	46.08	65	7.29
	2014	1023	305	29.81	79	7.72
	2015	954	389	40.78	66	6.92
(3)	2011	248	138	55.65	31	12.50
	2012	261	191	73.18	38	14.56
	2013	268	19	7.09	30	11.19
	2014	266	75	28.20	12	4.51
	2015	279	43	15.41	18	6.45
(4)	2011	901	426	47.28	66	7.33
	2012	900	128	14.22	66	7.33
	2013	929	471	50.70	65	7.00
	2014	881	363	41.20	56	6.36
	2015	881	266	30.19	38	4.31
(5)	2011	230	3	1.30	8	3.48
	2012	238	164	68.71	12	5.04
	2013	240	2	.83	8	3.33
	2014	243	0	0.00	2	.82
	2015	235	18	7.66	7	2.98
(6)	2011	164	15	9.15	17	10.37
	2012	182	5	2.75	18	9.89
	2013	171	25	14.62	15	8.77
	2014	172	52	30.23	17	9.88
	2015	171	267	156.14	20	11.70

\* Absenteeism/injury rate is total number of days away from work (or total number of injuries) divided by total number of employees times 100 (rounded to nearest hundredth)

Appendix G: Agency Questionnaire

Agency:

# of sworn officers:

Title:

Does your agency have a physical fitness policy? (*please include copies of years 2011-2015*)

If YES

is it mandatory or voluntary?

how long has the policy been in place?

What is the rationale behind having/not having a fitness policy in place, or for changing policy?

Who are involved decision makers in fitness policy? Who ultimately decides?

What factors determine or affect fitness policy? (ie: resources, manpower, cost, etc.)

Was policy intended to address work-related injuries and illnesses?

Are you aware that North Carolina provides a full public health mandate that includes injury prevention?

If no, would you want more information?

If yes, is that part of the rationale for having/not having a fitness policy?



RESEARCH

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# Accuracy of peak VO<sub>2</sub> assessments in career firefighters

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## Abstract

**Background:** Sudden cardiac death is the leading cause of on-duty death in United States firefighters. Accurately assessing cardiopulmonary capacity is critical to preventing, or reducing, cardiovascular events in this population.

**Methods:** A total of 83 male firefighters performed Wellness-Fitness Initiative (WFI) maximal exercise treadmill tests and direct peak VO<sub>2</sub> assessments to volitional fatigue. Of the 83, 63 completed WFI sub-maximal exercise treadmill tests for comparison to directly measured peak VO<sub>2</sub> and historical estimations.

**Results:** Maximal heart rates were overestimated by the traditional 220-age equation by about 5 beats per minute ( $p < .001$ ). Peak VO<sub>2</sub> was overestimated by the WFI maximal exercise treadmill and the historical WFI sub-maximal estimation by ~ 1MET and ~ 2 METs, respectively ( $p < 0.001$ ). The revised 2008 WFI sub-maximal treadmill estimation was found to accurately estimate peak VO<sub>2</sub> when compared to directly measured peak VO<sub>2</sub>.

**Conclusion:** Accurate assessment of cardiopulmonary capacity is critical in determining appropriate duty assignments, and identification of potential cardiovascular problems, for firefighters. Estimation of cardiopulmonary fitness improves using the revised 2008 WFI sub-maximal equation.

## Background

Every 23 seconds a fire in the United States requires the services of a career or volunteer fire department [1]. Sudden cardiac death is the most common cause of on-duty death among firefighters and occurs at higher rates than those found in similar occupations, such as police and emergency medical services [2].

A joint task force of the International Association of Firefighters (IAFF) and International Association of Fire Chiefs developed the Fire Service Joint Labor Management Wellness-Fitness Initiative (WFI) in 1997. Revisions in the 1999 and 2008 WFI recognize the firefighter as the “most important asset” in the fire service, and its intent is to improve firefighter function, on-duty effectiveness, and overall quality of life, while reducing morbidity and mortality related to fire fighting [3]. A major component of the WFI is assessment of firefighters’ cardiopulmonary capacity, with a stepmill test, sub-maximal, or a maximal exercise treadmill test. The WFI mandates that firefighters have a maximal exercise

test at age 40 and every other year thereafter. The maximal exercise test is intended to measure peak VO<sub>2</sub> (measured as ml/kg<sup>-1</sup>.min<sup>-1</sup>), which is an objective, clinical measure that defines the limits of cardiopulmonary function. Peak VO<sub>2</sub> reflects an individual’s ability to increase their heart rate and stroke volume, and redirect oxygenated blood to muscles for work on demand. Exercising at levels beyond which the cardiopulmonary system can adequately supply oxygen (commonly termed the anaerobic or ventilatory threshold, or VT) involves progressively greater degrees of oxygen-independent muscle metabolism, which is dramatically less efficient than aerobic metabolism, and can compromise cardiovascular function [4].

Quantifying the energy demands of firefighting during fire suppression is difficult due to the inherent dangers of fire suppression tasks. Most efforts to define the arduous physical work demand requirements during firefighting have been focused on establishing the level of metabolic equivalents (METs) (1 MET ≈ 3.5 ml of O<sub>2</sub>/kg/min) using simulated tasks. A MET is a multiple of the resting metabolic rate and is commonly estimated using standardized equations [4]. 10 METs is roughly equivalent to jogging a 10-minute mile; 14 METs is

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similar to many extended competitive activities such as running or rowing competitively, or bicycle racing at a high level [5]. The estimated METs proposed for firefighting range from 9.6 [6] to 14 [7] (a peak  $\text{VO}_2$  range of  $33.6 \text{ ml/kg}^{-1} \text{ min}^{-1}$  to  $49 \text{ ml/kg}^{-1} \text{ min}^{-1}$ ). Recent analysis of physical aptitude tests among firefighter recruits demonstrated that male recruits' average  $\text{VO}_2$  requirement was  $38.5 \text{ ml/kg}^{-1} \text{ min}^{-1}$  (11 METs) to complete a timed simulated firefighting assessment course [8]. Measurement of functional capacity in 23 firefighters suggested that a mean of  $41.54 \text{ ml/kg}^{-1} \text{ min}^{-1}$  (11.9 METs) is required to complete standard fire suppression tasks while wearing personal protective equipment [9].

Firefighting work demands can be extreme and accurate assessment of cardiopulmonary status, as well as detection and treatment of any underlying cardiovascular disease, is critical to insure firefighter fitness for duty and prevent on-duty cardiac events or death. The 1999 WFI sub-maximal exercise test was found to overestimate true peak  $\text{VO}_2$  in individual firefighters [10]. Concern about overestimation led to a revised equation for estimating peak  $\text{VO}_2$  from sub-maximal exercise treadmill tests in the 2008 WFI.

## Materials and methods

Given that previous sub-maximal exercise test results in the WFI were shown to overestimate peak  $\text{VO}_2$ , and that the WFI maximal exercise treadmill protocol has not been validated for accuracy in the literature, this study was undertaken to assess the validity of both the maximal and revised sub-maximal exercise treadmill peak  $\text{VO}_2$  estimates in firefighters. Specifically, the present study tested the following comparisons: (a) estimated maximal heart rate ( $220 - \text{age}$ ) to actual measured maximal heart rate; (b) WFI maximal exercise estimated peak  $\text{VO}_2$  to directly measured peak  $\text{VO}_2$ ; (c) averaged pre-revision sub-maximal estimated peak  $\text{VO}_2$  to revised sub-maximal estimated peak  $\text{VO}_2$ ; and (d) directly measured peak  $\text{VO}_2$  to revised WFI sub-maximal estimated peak  $\text{VO}_2$ .

## Study Setting and Participants

The study setting was a medium-sized suburban fire department in the eastern region of the San Francisco Bay Area in northern California. This department serves approximately 163,000 citizens and covers 46 square miles. All firefighters ( $N = 105$ ) assigned to suppression duties were recruited, including firefighters, firefighter/paramedics, firefighter/engineers, firefighter/captains and battalion chiefs. There were no women suppression firefighters in the department studied. This is consistent with national career firefighter statistics as women only represent approximately 4.5% of the fire service [11]. All testing took place during a five-week period between December 2008 and January 2009.

Inclusion criteria for participation required that each participant had successfully completed a WFI examination within the previous nine months and achieved a minimum of 10 METs (peak  $\text{VO}_2$  of  $35 \text{ ml/kg/min}$ ), on either a sub-maximal (using the pre-2008 equation), or maximal exercise treadmill test. Exclusion criteria included injury, illness, or scheduling conflicts that precluded testing during the study period. The final study population consisted of 83 male career firefighters from all suppression ranks in this department.

The study was conducted with approval of the University of California San Francisco Committee on Human Research. Signed informed consents were obtained and all testing was conducted during on-duty hours with the approval of the department and union local.

Testing occurred at an occupational health clinic where previous WFI examinations for this fire department had been conducted. A physician board certified in internal medicine and occupational medicine, and a nurse practitioner experienced in exercise testing, performed all treadmills and direct  $\text{VO}_2$  measurements. Participants arrived on the day of scheduled testing with their assigned duty crew, with gym clothes and running shoes appropriate for completing a maximal exercise test.

## Measurements

Data collection consisted of medical record abstraction for demographics, cardiovascular risk factors and exercise test information. Demographic characteristics included age, rank, and years of fire service. Definitions of cardiovascular risk factors were obtained from the American Heart Association, Adult Treatment Panel III (ATP III), The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC7), and the Centers for Disease Control and Prevention [12-15]. All serum samples were analyzed at the same hospital-based certified laboratory (Centers for Medicare and Medicaid Services Clinical Laboratory Improvements Amendments (CLIA)). Cardiovascular risk factors of the participants are summarized in Table 1.

### Maximal Heart Rates

Maximal estimated heart rates were calculated as  $220 - \text{age}$ . Directly measured maximal heart rates were determined from the electrocardiogram at the point of volitional fatigue as determined by the firefighter and corroborated by the direct  $\text{VO}_2$  assessment indicating that they had crossed the VT.

### Maximal Exercise Treadmill with Direct Peak $\text{VO}_2$ Assessment

All 83 participants completed a maximal exercise test using the 2008 WFI Protocol with concurrent direct peak  $\text{VO}_2$  measurements. Maximal exercise treadmill

**Table 1 Participant Cardiovascular Risk Factor Profile - Maximal Exercise Treadmill-Peak VO<sub>2</sub> Assessment (n = 83)**

Risk Factor	Mean, SD
Body Mass Index (kg/m <sup>2</sup> )	28.2 (± 3.9)
Systolic BP	117 (± 10)
Diastolic BP	69 (± 7)
Total Cholesterol* (mg/dL)	197 (± 38)
HDL** (mg/dL)	47 (± 11)
LDL** (mg/dL)	126 (± 36)
Cholesterol/HDL Ratio	4.35 (± 1.17)
Triglycerides (mg/dL)	118 (± 70)

\*-fasting

\*\*- HDL - high density lipoprotein; LDL - low density lipoprotein

tests were considered complete when the firefighter indicated volitional fatigue ( $n = 83$ , see above), or if terminated by the testing physician due to concerns about cardiopulmonary distress ( $n = 0$ ). The WFI protocol is a modified ramp protocol comprised of a 3-minute warm-up period at 3 mph - 0% grade, followed by fifteen 1-minute stages. Stage 1 begins at 4.5 mph and 0% grade, with the treadmill incline increasing 2% and speed increasing by 0.5 mph alternately in stages 2 through 15. The WFI maximal exercise treadmill estimates peak VO<sub>2</sub> based on the American College of Sports Medicine metabolic equation for running [16].

Peak VO<sub>2</sub> was obtained using the Cardio Coach CO<sub>2</sub><sup>TM</sup> VO<sub>2</sub> Fitness Assessment System, Model 9001-RMR (Korr Medical Technologies, Salt Lake City, Utah). The Cardio Coach CO<sub>2</sub><sup>TM</sup> is an economical, portable metabolic testing device that is feasible for use in a clinic and has been previously validated for measurement of peak VO<sub>2</sub> levels [17,18]. The Cardio Coach CO<sub>2</sub><sup>TM</sup> is a dual gas analyzer (O<sub>2</sub> and CO<sub>2</sub>) that automatically calibrates to standard temperature and pressure, dry at the beginning of each testing cycle. The Cardio Coach CO<sub>2</sub><sup>TM</sup> measures heart rate using the Polar T-31 heart monitor (Polar, Inc., Lake Success, NY). Heart rate and VO<sub>2</sub> (ml/kg<sup>-1</sup> · min<sup>-1</sup>), VCO<sub>2</sub> (ml/kg<sup>-1</sup> · min<sup>-1</sup>), VE/VO<sub>2</sub>, VE/VCO<sub>2</sub>, VE in L/min, FeO<sub>2</sub>%, Fe CO<sub>2</sub>%, and respiratory exchange ratio are graphically reported every 15 seconds. The Cardio Coach CO<sub>2</sub><sup>TM</sup> uses the ventilatory equivalents method (Ve/VO<sub>2</sub>) to detect VT (Korr Medical Technologies, 2009).

#### Revised Sub-maximal Exercise Treadmill Assessments

In the latter part of 2008, the WFI introduced a revised equation for estimating peak VO<sub>2</sub>: peak VO<sub>2</sub> = 56.981 + (1.242 × TT) - (0.805 × BMI), where TT is the test time required to achieve target heart rate, and BMI is Body Mass Index. The 2008 WFI calculates target sub-maximal heart rate (208 - (0.7 × age) × 0.85, whereas previous sub-maximal heart rates were based on (220-age) × 0.85 [3,19].

Of the 83 firefighters who volunteered for the maximal exercise treadmill tests and directly measured peak VO<sub>2</sub>, 63 subsequently completed their annually scheduled WFI examination, which included a sub-maximal exercise treadmill test, within the subsequent four to eight weeks. These subsequent WFI sub-maximal exercise treadmill tests, using the revised equation, took place under identical conditions as the study WFI maximal exercise treadmill tests but without the direct VO<sub>2</sub> measurement. The sub-maximal test uses the WFI treadmill protocol (see above) but terminates 15 seconds after the firefighter reaches their target heart rate.

#### Pre-revision Sub-maximal Exercise Treadmill Assessments

Prior to the 2008 WFI revision there was no published equation for the estimation of peak VO<sub>2</sub> from the sub-maximal exercise treadmill. The estimated peak VO<sub>2</sub> was determined by duration of the test and stage achieved [19]. Between one and seven historical sub-maximal test results were available for each of the 63 participants, and were averaged to create comparative historical variables.

#### Procedure

Participant's height, weight and resting blood pressure was measured. A resting electrocardiogram (ECG) was completed, using the Welch-Allyn Schiller AT-10 6-Channel electrocardiograph/treadmill (San Diego, California). Upon completion of the resting ECG the Mason-Likar lead configuration was modified to accommodate the exercise treadmill [4]. The participant was then fitted with the appropriate 2-way non-rebreathable mask (Hans-Rudolph, Inc., Shawnee, Kansas). The mask completely covered the nose and mouth of the participant and was checked for air leaks to eliminate extraneous room air from affecting the interpretation of peak VO<sub>2</sub>. A standing electrocardiogram was obtained and the treadmill was initiated. At test termination the firefighter recovered in the supine position. Available data from the maximal exercise treadmills is detailed in Table 2.

#### Statistical Analyses

Prior to all analysis all data were examined using stem and leaf plots and found to have normal distribution.

**Table 2 Maximal Exercise Treadmill Data (n = 83)**

	Minimum	Maximum	Mean, SD
Resting Systolic	102	164	122 (±10)
Resting Diastolic	60	100	73 (±8)
Resting Heart Rate	42	91	63 (±10)
Maximal Heart Rate	130	194	174 (±10)
Peak VO <sub>2</sub> Actual	26.3	69.5	43.6 (±9.1)
RER* - Peak Exercise	0.90	1.28	1.09 (± .07)

\* - Respiratory Exchange Ratio

Dependent *t*-tests were conducted on all 83 participants to test for differences between:

- 1) Estimated maximal heart rate (220 - age) and directly measured maximal heart rate.
- 2) WFI maximal exercise treadmill estimated peak VO<sub>2</sub> and directly measured peak VO<sub>2</sub>.

Additional dependent *t*-tests were conducted on the results of the 63 participants who subsequently performed a revised WFI sub-maximal exercise treadmill test for differences between:

- 1) Averaged pre-revision WFI sub-maximal exercise treadmill estimated peak VO<sub>2</sub> mean (converted to METs) to revised WFI sub-maximal exercise treadmill estimated peak VO<sub>2</sub> (converted to METs).
- 2) Directly measured peak VO<sub>2</sub> (converted to METs) to revised WFI sub-maximal exercise treadmill estimated peak VO<sub>2</sub> (converted to METs).

All dependent *t*-tests were two tailed, with  $\alpha = 0.05$  used for statistical significance. Statistical analyses were performed using SPSS Version 15.0 (SPSS, Inc., Chicago, Illinois).

## Results

There were 105 active suppression male career firefighters eligible for participation in the study. Of those, five were new hires who had not completed a WFI examination. Six firefighters chose not to participate; of the 94 choosing to participate 11 could not be scheduled for maximal exercise tests due to injury, illness or scheduling conflicts resulting in an  $n = 83$  for this study. The participants' ages ranged from 26 to 57 years with a mean of 41.1; 94% of the participants were Caucasian, and 6% were Hispanic or African-American. The years of firefighting ranged from 2 to 34 with a mean of 15.6.

### Maximal Estimates and Measurements

The traditional maximal heart rate estimation (220 - age) was significantly higher than measured maximal heart rate (178.6 vs. 173.6 with a mean difference of 4.96 beats/min,  $p < 0.001$ , 95% CI: 3.03, 6.90). Estimated peak VO<sub>2</sub> was significantly higher than directly measured peak VO<sub>2</sub> (47.7 vs. 43.6, with a mean difference of 4.06 ml/kg/min, (1.16 METs)  $p < 0.001$ , 95% CI: 2.88, 5.23).

### Sub-maximal Estimates and Measurements

Within four to eight weeks of the maximal exercise treadmill tests 63 participants completed a sub-maximal exercise treadmill test (using the revised 2008 WFI equation). Their average age was 40.19 years ( $\pm 6.9$ ) and

average years of firefighting was 14.4 ( $\pm 6.8$ ). All firefighter suppression ranks were represented in this subgroup. The subsequent examination allowed for comparison of the revised sub-maximal exercise treadmill peak VO<sub>2</sub> estimate to an averaged pre-revision (comparative historical variable) sub-maximal exercise treadmill peak VO<sub>2</sub> estimate and the recently obtained directly measured peak VO<sub>2</sub>. For simplicity in reporting sub-maximal results all peak VO<sub>2</sub> results were converted to METs (peak VO<sub>2</sub>/3.5).

A statistically significant difference was found between pre-revision sub maximal exercise treadmill peak METs mean estimates and revised sub-maximal peak METs estimates (14.81 vs. 12.58, with a mean difference of 2.23 METs,  $p < 0.001$ , 95% CI: 1.86, 2.59) These findings support previous research determining that WFI sub-maximal peak METs estimates prior to the 2008 revision were overestimated [10]. Revised sub-maximal treadmill METs estimates did not differ from directly measured maximal exercise treadmill METs, indicating that the revised 2008 estimating equation is a reasonable estimate of METs (12.64 vs. 12.58 with a mean difference of .07 METs,  $p \leq .76$ , 95% CI: -.39, .54) This represents additional validation of the accuracy of the new estimating equation [3]. All maximal and sub-maximal comparisons are summarized in Table 3.

## Discussion

Fire departments often struggle to determine fitness for duty for their members who return from an injury or illness, prepare to embark on wildland strike teams, heavy rescue missions, or for daily work assignments. There are ongoing efforts to define minimally acceptable and safe fitness levels; levels that should be informed by the energy requirements needed during a firefighter's tour of duty. Maximum directly measured METs for the firefighters in this study ranged from 7.5 to 19.9, indicating that some participants might have a difficult time meeting the demands of the job while others appear adequately fit. Four different methods of cardiopulmonary assessment are compared here: direct measurement of peak VO<sub>2</sub>, estimated peak VO<sub>2</sub> derived from a maximal exercise treadmill equation, historical average of pre-revision estimated peak VO<sub>2</sub> sub-maximal exercise treadmills, and estimated peak VO<sub>2</sub> derived from the revised (2008) sub-maximal exercise treadmill equation. Directly measured peak VO<sub>2</sub> is the most objective and considered the "gold standard" of the four methods [4].

The difference observed in maximum heart rate between directly measured maximum heart rate (while wearing a non-rebreathable mask), and a 220-age estimated maximum heart rate (part of the maximal exercise treadmill estimation equation) provides some explanation for the over-estimation. Estimated maximal



**Table 3 Comparisons: Heart Rate, Peak VO<sub>2</sub>, Estimated METs**

	<i>n</i>	Mean	SD	SEM	95% CI Lower	95% CI Upper	<i>t</i>	<i>d</i>	Sig(2-tailed)
Estimated Max.									
HR: Actual Max.	83	4.96	8.87	.97	3.03	6.9	5.09	82	.00
HR									
Estimated peak VO <sub>2</sub> : Direct measure peak VO <sub>2</sub>	83	4.06	5.39	.59	2.88	5.23	6.85	82	.00
Pre-revision METs									
Est.: Revised METs estimate	63	2.23	1.46	.18	1.86	2.59	12.14	62	.00
Direct METs:									
Revised Sub-maximal METs estimate	63	.07	1.85	.23	-.39	.54	.31	62	.76

heart rates were about 5 beats per minute higher than those measured during peak exercise. Heart rates are a method used on the fire ground to evaluate a firefighter's capability to re-enter the fire scene. Using target heart rates that exceed true maximums, or percentages of estimated maximum heart rates that are inaccurate, could result in dangerous duty assignments.

Assessment of direct peak VO<sub>2</sub> and maximal exercise treadmill results indicate that the equation utilized by the WFI maximal treadmill over-estimates peak VO<sub>2</sub> by an average of 4.06 ml/kg<sup>-1</sup> · min<sup>-1</sup>, or approximately 1 MET. If a firefighter's fitness level is less than optimal, or if they have underlying cardiovascular disease, this overestimation could lead to on-duty clearances that could prove compromising.

Revised sub-maximal exercise treadmill peak VO<sub>2</sub> estimates were compared to averaged pre-revision historical sub-maximal exercise peak VO<sub>2</sub> estimates. The average overestimation of the historical mean was approximately 2 METs. This finding supports the Mier and Gibson report (2004) that the pre-revision WFI sub-maximal treadmill equation overestimated peak VO<sub>2</sub>, and that those equation results should be used with caution for duty assignment decisions.

The comparison of directly measured peak VO<sub>2</sub> to the revised sub-maximal exercise treadmill peak VO<sub>2</sub> estimates (*n* = 63) found that there were no differences between the two assessment methods. When comparing revised WFI sub-maximal exercise treadmill peak VO<sub>2</sub> estimates to previous years of testing, or to reports in the literature, careful consideration must be given to which estimation method was used. The same task, measured with different estimating equations, can result in different results as demonstrated herein.

#### Limitations and Strengths

The limitations of our study include the self-selection bias of the participants, the limited gender and ethnic demographics of the group (all male, predominantly Caucasian), and the range in number of historical sub-

maximal exercise treadmill VO<sub>2</sub> estimates, resulting in a less than ideal comparison group. While testing was completed within a four month period, it included the winter holiday season which may have had a seasonal influence on fitness behavior (resulting in an increase or decrease in exercise intensity). The composition of the sample is reflective of the department in terms of gender and ethnicity. There is an average four to eight week gap between the direct measure peak VO<sub>2</sub> and the sub-maximal exercise treadmill peak VO<sub>2</sub> assessment without any documentation of fitness behaviors. However, any fitness improvement on the part of firefighters in the interim would have directed the results towards the null.

The strengths of our study include the number of participants, their range in age, rank, firefighting experience, and their experience with the WFI protocol. The availability of seven years historical data can be viewed as a strength. Use of the mask to measure peak VO<sub>2</sub> was familiar to the participants as they routinely work with self-contained breathing apparatus. The ability to perform all testing components while on duty encouraged participation. There were no incentives offered for participation. All testing was completed in the same facility using the same equipment and personnel, thus increasing consistency of testing and inter-rater reliability.

#### Clinical Implications

Firefighters who have been tested using earlier estimation equations may require careful explanation as to a noticeable drop in test results when using the revised 2008 WFI equation. Participants are likely to be disappointed to see a reduction in their "fitness level" when they have not changed their patterns, nor workout habits, between testing cycles. Again, if a fire fighter falls into the lower fitness categories, or has underlying cardiovascular disease, inaccurate estimates could contribute to cardiac compromise.

#### Conclusions

In order to protect firefighters from potentially life-threatening cardiac situations it is imperative that

exercise testing results are accurate, whether the test is being used for duty assignment or part of a comprehensive risk assessment. The results from the revised sub-maximal exercise treadmill estimation equation appear to accurately reflect directly measured peak  $\text{VO}_2$  results. WFI maximal treadmill peak  $\text{VO}_2$  estimates should be interpreted with caution, especially as they appear to over-estimate METs by an average of 1. Given the potential for over-estimation of fitness, providers who make fitness-for-duty assessments should consider the energy requirements of the job, any underlying cardiovascular risk factors, and the method of testing used when recommending return to, or continuation of, duties. These findings support the continuation and further expansion of reliable exercise testing of firefighters, within the context of a cardiovascular disease prevention program such as the WFI.

Performing measured peak  $\text{VO}_2$  and maximal exercise treadmill tests can be challenging for fire departments to accomplish due to limited resources. The 2008 WFI sub-maximal exercise treadmill test can be safely administered outside of a medical setting using tools that are often available within the fire department (treadmill, stopwatch, and Polar heart monitor). Disadvantages of the sub-maximal treadmill test are the limited means for assessing underlying cardiovascular conditions, and the inability to determine maximal cardiovascular performance directly. However, the revised 2008 sub-maximal treadmill peak  $\text{VO}_2$  estimation equation is a valid tool to assess interim progress in cardiovascular training programs.

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#### Authors' contributions

All of the authors contributed substantially to the conception, design, data acquisition and analysis, manuscript drafts and revisions of this study. Each has given final approval for publication.

#### Competing interests

Dr. Drew-Nord and Dr. Nord own the occupational medicine practice where this research was conducted and contract with various fire agencies to provide WFI services. This relationship was determined to represent no

conflict of interest by the Institutional Review Board of the University of California, San Francisco. The remaining authors declare that they have no competing interests.

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#### References

1. **Firefighter Statistics.** [http://www.usfa.dhs.gov/statistics/estimates/nfpa/index.shtml], retrieved August 3, 2011.
2. United States Fire Administration: **Firefighter Fatality Retrospective Study, April 2002/FA-220.** Edited by: Corporation T: Firefighter Fatality Retrospective Study 2006.
3. **Fire Service Joint Labor Management Wellness-Fitness Initiative.** [http://www.iaff.org/HS/Well/wellness.html].
4. Froelicher VF, Myers J: **Exercise and the heart.** Philadelphia: Saunders Elsevier, 5 2006.
5. Fletcher GF, Froelicher VF, Hartley LH, Haskell WL, Pollock ML: **Exercise standards. A statement for health professionals from the American Heart Association.** *Circulation* 1990, **82**:2286-2322.
6. Sothmann MS, Saupe K, Jasenof D, Blaney J: **Heart rate response of firefighters to actual emergencies. Implications for cardiorespiratory fitness.** *J Occup Med* 1992, **34**(8):797-800.
7. Malley KS, Goldstein AM, Aldrich TK, Kelly KJ, Weiden M, Coplan N, Karwa ML, Prezant DJ: **Effects of fire fighting uniform (modern, modified modern, and traditional) design changes on exercise duration in New York City Firefighters.** *J Occup Environ Med* 1999, **41**(12):1104-1115.
8. Williams-Bell FM, Villar R, Sharratt M, Hughson RL: **Physiological demands of the firefighter candidate physical ability test.** *Medicine and Science in Sports and Exercise* 2009, **41**:653-662.
9. Adams J, Roberts J, Simms K, Cheng D, Hartman J, Bartlett C: **Measurement of functional capacity requirements to aid in the development of an occupation-specific rehabilitation training program to help firefighters with cardiac disease safely return to work.** *American Journal of Cardiology* 2009, **103**:762-765.
10. Mier CM, Gibson AL: **Evaluation of a treadmill test for predicting the aerobic capacity of firefighters.** *Occup Med (Lond)* 2004, **54**(6):373-378.
11. **Women in the fire service.** [http://www.nfpa.org/itemDetail.asp?categoryID=955&itemID=23601&URL=Research/Fire%20statistics/The%20U.S.%20fire%20service&cookie%5Ftest=1], retrieved August 3, 2011.
12. **Men and cardiovascular disease risk factors.** [http://www.heart.org/HEARTORG/Conditions/HeartAttack/UnderstandYourRiskofHeartAttack/Understand-Your-Risk-of-Heart-Attack\_UCM\_002040\_Article.jsp], retrieved August 3, 2011.
13. **Healthy weight - it's not a diet, it's a lifestyle!** [http://www.cdc.gov/healthyweight/assessing/bmi/adult\_bmi/index.html#Interpreted].
14. **Third report of the expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (ATP III).** [http://hp2010.nhlbi.nih.net/atpIII/calculator.asp?usertype=prof].
15. National Institute of Health National Heart Lung and Blood Institute: **JNC7 Guidelines.** 2006.
16. American College of Sports Medicine: **Guidelines for exercise testing and prescription.** Baltimore: Lippincott, Williams & Wilkins, 6 2000.
17. Jensky NE, Vallejo AF, Ong MD, Schroeder ET: **Validation of the Cardio Coach for sub-maximal and maximal metabolic exercise testing.** *Medicine and Science in Sports and Exercise* 2005, **37**(5):S231.
18. Dieli-Conwright CM, Jensky NE, Battaglia GM, McCauley SA, Schroeder ET: **Validation of the CardioCoach CO2 for submaximal and maximal metabolic exercise testing.** *The Journal of Strength and Conditioning Research* 2009, **23**:1316-1320.
19. International Association of Fire Fighters: **The Fire Service Joint Labor Management Wellness-Fitness Initiative.** Washington, D.C.: International Association of Fire Fighters, 2 1999.

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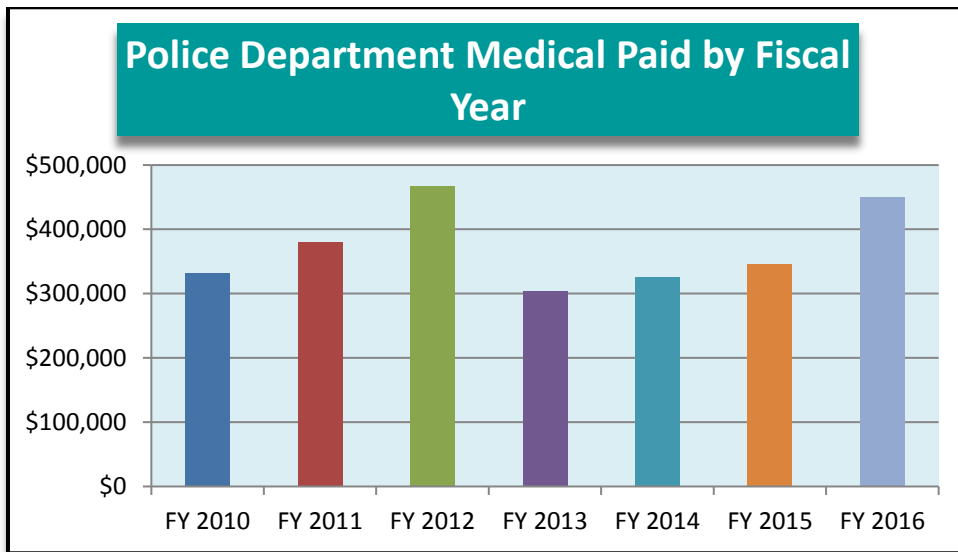
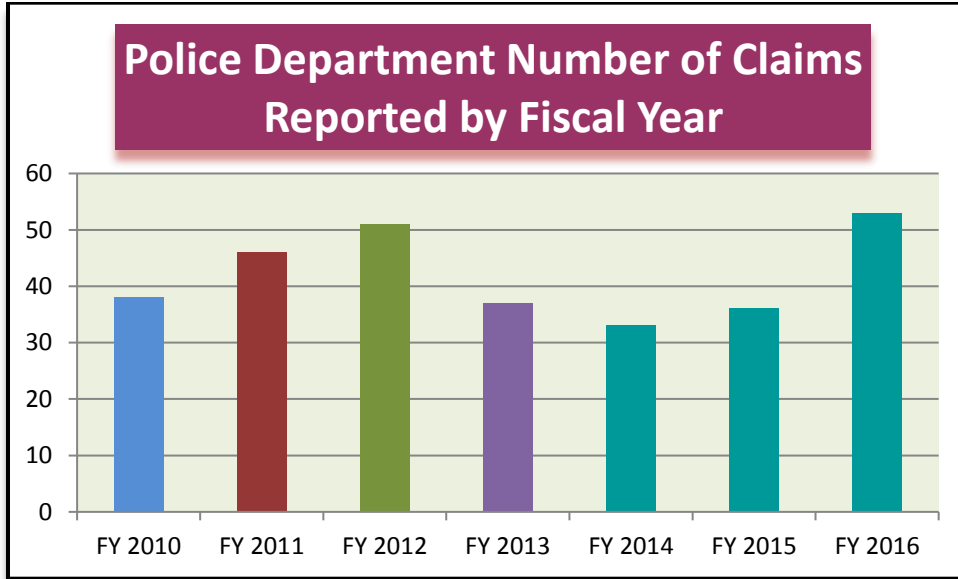
## Program Effectiveness

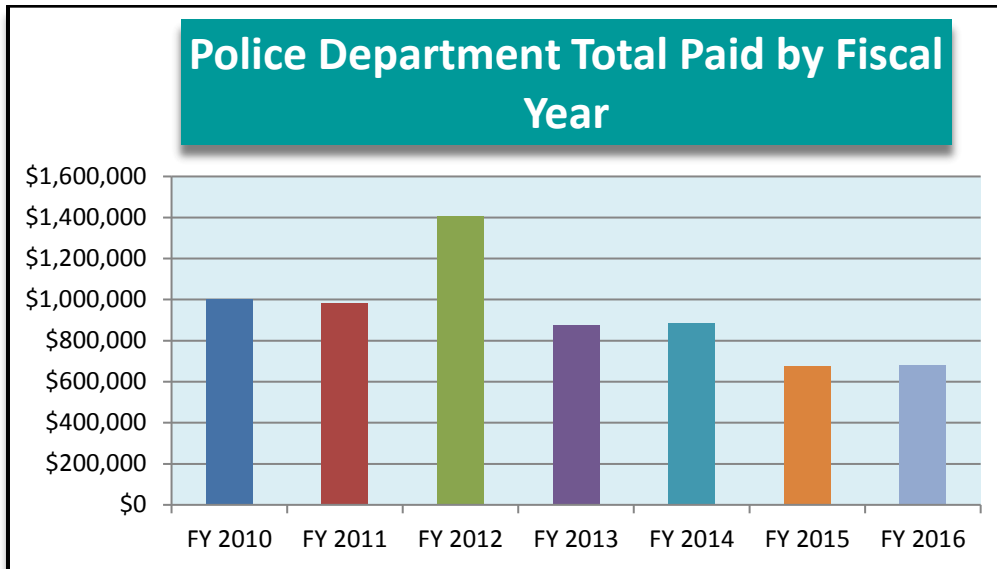
### Case Study – Clovis Police Department



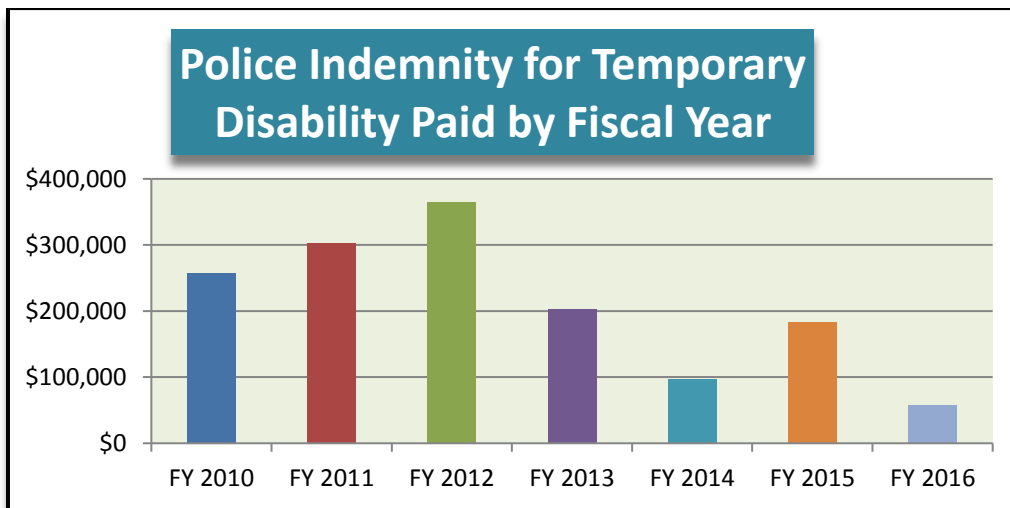
### Clovis Police Department

In 2008, the Clovis Police Department suspended their health screening and fitness testing program. As illustrated below, the number of claims increased until 2012 when Pinnacle Training Systems began a wellness program for these officers.





There has been a 50% reduction in total dollars paid from 2012-2016.



Despite the increase in the number of claims in 2016 and the medical dollars paid per fiscal year (the first increase since 2012), the total number of dollars paid and the dollars paid for temporary disability is still lower since the implementation of our program. This demonstrates the effectiveness of a well implemented program. While claims might increase in any given year, fit officers will return to work more quickly than those who are unfit reducing indemnity dollars paid. The Clovis Police Department has implemented a non-voluntary, incentivized, yet potentially punitive MOU for officers based on their overall health and fitness levels. Since the implementation of this program, the culture within the department has changed and more officers are motivated to engage in healthy behaviors. Furthermore, 4 officer's lives have been saved due to identifying abnormal EKG rhythms.

Based on the cost of the program and the total dollars paid since 2012 to 2016, the return on investment for this department is 17.5:1



## Original Contribution

### The Association of Aerobic Fitness With Injuries in the Fire Service

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The aim of the present study was to understand the risk of injury in relation to fitness in a retrospective occupational cohort of firefighters in Tucson, Arizona, from 2005 to 2009. Annual medical evaluations and injury surveillance data were linked to compare levels of aerobic fitness in injured employees with those in noninjured employees. The individual outcomes evaluated included all injuries, exercise-related injuries, and sprains and strains. Time-to-event analyses were conducted to determine the association between levels of fitness and injury likelihood. Fitness, defined by relative aerobic capacity ( $VO_{2max}$ ), was associated with injury risk. Persons in the lowest fitness level category ( $VO_{2max} < 43$  mL/kg/minute) were 2.2 times more likely (95% confidence interval: 1.72, 2.88) to sustain injury than were those in the highest fitness level category ( $VO_{2max} > 48$  mL/kg/minute). Those with a  $VO_{2max}$  between 43 and 48 mL/kg/minute were 1.38 times (95% confidence interval: 1.06, 1.78) more likely to incur injury. Hazard ratios were found to be greater for sprains and strains. Our results suggest that improving relative aerobic capacity by 1 metabolic equivalent of task (approximately 3.5 mL/kg/minute) reduces the risk of any injury by 14%. These findings illustrate the importance of fitness in reducing the risk of injury in physically demanding occupations, such as the fire service, and support the need to provide dedicated resources for structured fitness programming and the promotion of injury prevention strategies to people in those fields.

aerobic capacity; fire service; injury

Abbreviation:  $VO_{2max}$ , relative aerobic capacity.

The work demands for fire service employees are well documented as requiring considerable physical abilities. In 1992, Sothmann et al. (1) recommended that these workers have a relative aerobic capacity ( $VO_{2max}$ ) between 38 and 42 mL/kg/minute in order to meet the measured workload demand for firefighters while also maintaining a reserve capacity to respond to other unanticipated events. Since then, most fire departments have adopted minimum fitness standards, often emphasizing aerobic capacity as a definitive measure of overall fitness. Standard fitness assessments for the general population typically have a set of norms that are scaled to age and sex, and results can range from poor to superior (2).

Opportunities for injury in the fire service are diverse. Persons with higher aerobic capacities should be able to consume more oxygen than those with lower aerobic capacities, and their bodies are likely to be more efficient at circulating oxygen

to all systems and producing energy. Persons in the top levels of a fitness spectrum may not be as susceptible to microtraumas and may recover better from injury than their less-fit counterparts (3–9). Hence, those with higher  $VO_{2max}$  should have a lower potential for fatigue and subsequent injury. Conversely, a high fitness level may also be an indicator that a person has an increased risk of injury, as these persons likely have greater exposure time to exercising hazards. In some fire departments, exercise has been shown to be the leading activity associated with on-duty injuries (10).

The objectives of the present study were to establish and understand the relationship between fitness status and the risk of injury in a 5-year occupational cohort of career fire service members. We hypothesized that firefighters deemed to be on the lower end of the fitness spectrum would be more susceptible to injury than their more fit colleagues.

## MATERIALS AND METHODS

### Population description, data sources, and years

As previously described (10), the present study includes data from commissioned employees of a medium-sized metropolitan fire department in the southwestern United States. Briefly, the fire department operates 21 fire stations and responds to nearly 520,000 permanent residents (with seasonal increases nearing 720,000 residents). Like many other municipal fire departments, this fire department requires an annual physical examination to assess fitness levels and provide medical clearance for each commissioned employee. Between 2005 and 2009, data for this study were obtained from 2 sources: physical assessments from annual clinic visits and department injury surveillance reports. The present study included all commissioned (noncivilian) employees of the fire department who were employed at some point in time during the study period. Approval for and oversight of the use of human subjects was provided by the University of Arizona's Institutional Review Board.

### Physical fitness measures

Information collected from annual exams included anthropometric measures (e.g., height, weight, body fat percentage),  $VO_{2max}$ , muscular strength, muscular endurance, and flexibility. Aerobic capacity can be defined as the highest rate at which oxygen can be taken up and utilized by the body during rigorous exercise (11). Aerobic capacity is expressed as a rate that is referenced in either absolute terms (L/minute) or by relative measures (mL/kg/minute) to account for individual size variations. In this study, we refer to studied relative aerobic capacity.  $VO_{2max}$  was categorized into 3 levels of fitness, using the 25th and 50th percentiles as the cutoff points between the "less fit" (<43 mL/kg/minute) and "high fit" (>48 mL/kg/minute) aerobic capacity categories, respectively. The use of a percentile as the cutoff was also used in 1999 by Lee et al. (12), who studied the relationship between cardiorespiratory fitness and cardiovascular disease in a large observational cohort of men. In addition, the 25th percentile closely relates to the recommended minimum level of aerobic capacity (42 mL/kg/minute) suggested by Sothmann et al. (1) that has been adopted by the National Fire Protection Association and most municipal fire departments in the United States (including those in this study's population). The 50th percentile was chosen as the cut off for the high fit designation because of the distributional characteristics of the population's data and to remain in accordance with current annual physical assessment methods used by the department. Neither age nor sex was directly considered when assigning aerobic fitness levels, as fire departments institute a minimum standard for aerobic fitness to help ensure that all commissioned fire personnel are capable of performing the myriad of critical job tasks and responses regardless of age or sex. Maximum aerobic capacity was estimated using the submaximal incremental treadmill protocol developed by Gerkin et al. (13) and guidelines suggested by the Wellness Fitness Initiative of the International Association of Fire Fighters and the International Association of Fire Chiefs

(14). In brief, each participant is hooked up to a heart rate monitor and made to walk on a standard treadmill. The treadmill's speed and incline are increased at prespecified time points until the subject's target heart rate is reached and  $VO_{2max}$  can be estimated. Direct measurement of  $VO_{2max}$  using oxygen and carbon dioxide analyzers and monitoring of electrocardiogram output is generally limited to specific indications because of its higher cost.

### Injury defined

Injuries that occurred on the job were recorded either if they were reportable to the Occupational Safety and Health Administration or if they were deemed nonreportable but were documented internally because of the potential for the injury to progress to the point of requiring an insurance claim (e.g., due to cumulative or repeated trauma). It should be noted that field personnel work 24-hour shifts. For the purposes of these analyses, reported injuries known to be only internally documented incidents with no loss of function or ability to perform duties (by review of injury report details) were excluded. In addition, cardiac events (e.g., stroke, heart attack), along with heat exhaustion, stress, and other medical issues, were excluded from injury analysis. These events were considered more likely to be indicative of an underlying set of symptoms, conditions, or diseases than to be related to an injury sustained on the job.

### Statistical analyses

Data from annual physical examinations and injury surveillance reports were merged utilizing unique identifiers, which enabled a direct comparison of persons with and without injury. Quantitative methods, notably time-to-event regression models, were used to evaluate the relationship between aerobic fitness and injury. Analyses were conducted for 3 separate injury outcomes: 1) any recorded injury; 2) injuries resulting from physical exercise; and 3) any reported sprain or strain.

For time-to-event (i.e., first injury) analyses, cumulative incidence was estimated using the life table and Kaplan-Meier methods, which allow for censoring (i.e., no injury). Incidence rates were assessed with respect to established fitness measures. These levels were set using methods similar to those used for establishing aerobic fitness levels (as previously explained); however, in this case, sex was taken into account for measures of body fat percentage, grip strength, and flexibility. The time-to-event analysis utilized repeated measures in which each time point (observation) corresponded to a person's annual medical examination until the occurrence of injury or censoring. This method accounted for variable observation periods because some employees were introduced later in the study period (e.g., new employees), whereas others dropped out (e.g., retired, transferred), and it enabled a single person to contribute time at risk to each of the fitness levels based on his or her most recent physical assessment. Survival analyses were completed using Cox proportional hazard regression models. Statistical analyses were conducted using Stata software, version 11.2 (StataCorp LP, College Station, Texas).

**Table 1.** Mean Values of Person-Level Descriptive Statistics, Tucson, Arizona, 2005–2009

Variable	No.	Mean	Minimum Mean	Maximum Mean	Mean Difference
VO <sub>2max</sub> , mL/kg/minute	782	49.6	43.6	55.8	12.2
Resting heart rate, beats per minute	797	62.9	57.2	69.2	12.0
Total grip strength, lbs <sup>a</sup>	797	229.5	211.4	247.5	36.1
Flexibility, inches <sup>b</sup>	782	5.8	4.5	7.0	2.5
% body fat	790	18.3	15.4	20.9	5.5

Abbreviation: VO<sub>2max</sub>, relative aerobic capacity.

<sup>a</sup> 1 lb = 0.45 kg.

<sup>b</sup> 1 inch = 2.54 cm.

## RESULTS

At the end of each calendar year from 2005 to 2009, there were between 577 to 694 commissioned employees within this metropolitan fire service. During that time period, 799 employees underwent at least 1 physical examination and follow-up until their first injury event or censoring. On average, the clinic database accounted for approximately 87% of the workforce population, and the mean age was 39.2 (standard deviation, 9.6) years. Table 1 displays select summary fitness measures of the study population across the study period. The mean for VO<sub>2max</sub> for the overall population across time was 49.6 mL/kg/minute, with a 12.2-unit difference between the minimum and maximum mean values. In total, 773 injuries were reported (Table 2). There were 357 persons who sustained at least 1 injury of any type, 174 who sustained at least 1 exercise-related injury, and 294 who sustained at least 1 sprain or strain injury. The median lengths of follow-up were 2.5, 3.2, and 2.8 years, respectively. A previous descriptive analysis of this population (for the years 2004–2009) demonstrated that 67% of all injuries were sprains and strains, and that number increased to 89% among exercise injuries. Thirty percent of all injuries were reported to have resulted in lost time on the job (10).

Kaplan-Meier analyses (data not shown) indicated that the incidence rate for injury decreased and the median time to injury increased with increasing age (stratified into 10-year categories) ( $P < 0.001$ ). There were no significant differences identified between sexes; however, women accounted for only 5% of the study population (as is common for the fire service (15)). Increases in body fat percentage were related

**Table 2.** Annual Frequency of Injury Outcomes, Tucson, Arizona, 2005–2009

Year	No. of Employees	No. of Recorded Injuries	No. of Sprains and Strains	No. of Exercise-related Injuries <sup>a</sup>
2005	577	128	84	30
2006	625	148	100	50
2007	659	174	120	62
2008	694	199	128	81
2009	667	124	89	45

<sup>a</sup> Of all exercise-related injuries, 85.2% were sprains and strains.

to increased incidence rate, driven most notably by those in the highest tier (>36% body fat).

Table 3 displays the general summary characteristics of the incidence of injury outcomes for VO<sub>2max</sub> levels and repeated measures modeling. Log-rank tests indicated that there were statistically significant increases in incidence rate with a decline in VO<sub>2max</sub> for each of the 3 injury outcomes. In addition, persons with lower VO<sub>2max</sub> levels were likely to sustain any injury sooner than were those who were more fit, as indicated by a median time to injury of 2.24 years in level III (least fit category) compared with 4.07 years for level I (most fit category);  $P < 0.001$ ).

### Cox proportional hazard modeling

Results from Cox proportional hazards models are presented in Table 4. The dependent variables in these models utilized time to first injury as a function of fitness. The hazard ratios for fitness are shown with respect to 2 modeling strategies: 1) VO<sub>2max</sub> adjusted for age and sex and 2) VO<sub>2max</sub> adjusted for other measures of fitness (i.e., resting heart rate, grip strength, flexibility, body fat percentage, number of continuous sit-ups and push-ups, age, and sex). With a hazard ratio of 0.959 for all injuries, a 1-mL/kg/minute increase in VO<sub>2max</sub> decreased the risk of injury 0.041 times ( $P < 0.001$ ). The amount of work needed to complete a given task in relation to the amount of energy expended during 1 minute of seated rest is referred to as the metabolic equivalent of task. For VO<sub>2max</sub>, a single metabolic equivalent of task is approximately 3.5 mL/kg/minute. Thus, these results suggest that improving one's aerobic capacity by 1 metabolic equivalent of task would reduce the risk for any injury by approximately 14%.

Table 5 shows the relationship between the categorical levels of aerobic fitness (VO<sub>2max</sub>) for the repeated measures analyses. For each injury outcome, persons with a lower fitness status (e.g., level III) had a higher hazard ratio for injury than did those in the most-fit category. For example, persons with a VO<sub>2max</sub> between 43 and 48 mL/kg/minute (level II) were 1.38 times more likely to sustain any injury than were those in the top category of VO<sub>2max</sub> (>48 mL/kg/minute). The risk of injury increased with decreasing fitness level, as those with a VO<sub>2max</sub> less than 43 mL/kg/minute (level III) were 2.2 times more likely to have any injury than were those in the top VO<sub>2max</sub> fitness category. The hazard ratios were also found to



**Table 3.** Time-to-Event Summary Statistics Between Fitness Levels and Injury Outcomes, Tucson, Arizona, 2005–2009

Fitness Level <sup>a</sup>	Injury Type								
	All Injuries			Physical Exercise			Sprains and Strains		
	IR <sup>b</sup>	No. at Risk	Years at Risk <sup>c</sup>	IR	No. at Risk	Years at Risk	IR	No. at Risk	Years at Risk
I	17.5	460	921	7.3	532	1116	12.2	482	996
II	21.1	287	442	7.2	332	541	17.2	312	483
III	29.9 <sup>d</sup>	235	338	13.3 <sup>d</sup>	263	407	25.1 <sup>d</sup>	242	355

Abbreviation: IR, incidence rate.

<sup>a</sup> The relative aerobic capacity for each level was as follows: I, >48 mL/kg/minute; II, 43–48 mL/kg/minute; and III, <43 mL/kg/minute.

<sup>b</sup> Incidence rate per 100 person-years.

<sup>c</sup> Contributed time at risk (person-years).

<sup>d</sup> Statistical significance ( $P < 0.05$ ) between levels using log-rank test for equality of survival functions.

be greater when the event outcome was restricted to time to first reported sprain or strain.

### Effect modification

To assess the potential of effect modification of the relationship by age, a simple age-stratified analysis was completed for all injury outcomes, as well as for sprains and strains. Age proved to be a significant modifier of  $VO_{2max}$  ( $P < 0.001$ ). Table 6 presents the crude hazard ratios for the all-injury model and the sprain and strain model in relation to age (<30 and  $\geq 30$  years of age) and overall, stratified by aerobic fitness level. For both outcome types, the risk of injury among those with decreased  $VO_{2max}$  was higher in persons younger than 30 years of age than in those 30 years of age or older. Thirty years of age was chosen as our demarcation value primarily based on incidence rates resulting from the Kaplan-Meier analysis described above. In addition, persons 30 years of age or younger had a consistently increased incidence rate, regardless of the injury type. Our previous descriptive study of injury distributions demonstrated that firefighters (median age, 31 years) sustained the most injuries (30.7%), with lower injury rates for engineers, paramedics, captains, etc. (10). Given the strong relationship between age and rank and the results from Kaplan-Meier estimates, it seemed suitable to use 30 years of age as our cutoff value for assessing potential effect modification.

### DISCUSSION

In the present study, we sought to better understand the association between levels of aerobic fitness and the incidence of injury using a retrospective occupational cohort. The findings were consistent with our original hypothesis that lower fitness levels, as defined by  $VO_{2max}$ , would be associated with increased risk of injury. Furthermore, these increased risks were modified by age, with a larger association between fitness level and subsequent injury in those 30 years of age or younger. The reduction in injury risk was significant for all injuries, sprains and strains, and physical exercise injuries. These findings are especially noteworthy considering that one third of work-related injuries in this population resulted from exercise activities (10), further indicating the need for fitness programs with improved structure and management relevant to the high physical demands of the job.

A number of studies have assessed the relationship between various measures of fitness and the performance of a given task, with varying results. However, in contrast to our present study, few studies have focused on assessing the association among fitness, performance, and injury risk.

Two published studies have demonstrated an increase in injuries associated with fitness or the implementation of fitness programs (9, 16). After a baseline treadmill test to assess  $VO_{2max}$ , participants of the Aerobic Center Longitudinal Study had their physical activity levels assessed over a

**Table 4.** Cox Proportional Hazard Models for Assessing Aerobic Fitness and Risk of Injury, by Injury Type, Tucson, Arizona, 2005–2009

Injury Outcome	Model					
	$VO_{2max}$ <sup>a</sup>			$VO_{2max}$ Full Model <sup>b</sup>		
	No. of Observations	HR	95% CI	No. of Observations	HR	95% CI
All <sup>c</sup>	716	0.959	0.946, 0.972	710	0.953	0.939, 0.968
Exercise-related	718	0.960	0.941, 0.979	714	0.953	0.933, 0.973
Sprains and strains	718	0.952	0.937, 0.967	712	0.947	0.932, 0.963

Abbreviations: CI, confidence interval; HR, hazard ratio;  $VO_{2max}$ , relative aerobic capacity.

<sup>a</sup> Adjusted for sex and age.

<sup>b</sup> Includes independent variables: resting heart rate, grip strength, flexibility, % body fat, number of sit-ups performed, number of push-ups performed, age, and sex.

<sup>c</sup> There were fewer subjects in this category because of lacerations that occurred during the first clinic visit, which precluded follow-up for those subjects.

**Table 5.** Hazard Ratios<sup>a</sup> for Injuries by Levels Aerobic Fitness in Repeated Measures Modeling, Tucson, Arizona, 2005–2009

VO <sub>2max</sub> Level <sup>b</sup>	All Injuries (n = 716)		Exercise Injuries (n = 718)		Sprains and Strains (n = 718)	
	HR	95% CI	HR	95% CI	HR	95% CI
I		Referent		Referent		Referent
II	1.38	1.06, 1.78	1.20	0.81, 1.77	1.61	1.21, 2.13
III	2.22	1.72, 2.88	2.53	1.76, 3.64	2.63	1.98, 3.50

Abbreviations: CI, confidence interval; HR, hazard ratio, VO<sub>2max</sub>, relative aerobic capacity.

<sup>a</sup> All models were adjusted for sex and age.

<sup>b</sup> The relative aerobic capacity for each level was as follows: I, >48 mL/kg/minute; II, 43–48 mL/kg/minute; and III, <43 mL/kg/minute.

12-month period (16). Increased risk of musculoskeletal injury was associated with increases in cardiorespiratory fitness (as measured by a treadmill test), as well as increases in the amount of reported weekly physical activity. Stratified analyses by physical activity type suggested that the association between cardiorespiratory fitness and musculoskeletal injury was potentially driven by unmeasured intensity levels of exercise. After instituting a new fitness program among United States Air Force service members to increase fitness and participation in fitness-related activities, the mean relative VO<sub>2max</sub> increased significantly (6.04 and 3.24 mL/kg/minute among men and women, respectively) over 3 years of the program (9). The number of injuries also increased during that time, which was likely a result of increased participation in exercise activities with no embedded injury prevention program.

Two studies failed to find an association between fitness and injuries. During an 8-week basic military training regimen, musculoskeletal injuries were assessed in relation to baseline body composition (or body mass index), aerobic fitness (determined by the time participants took to run 3,000 meters), health assessment measures, and age (17). Significant associations were observed at a univariate level between

injury and a variety of variables, including age greater than 23 years, increased body mass index, slow run times, and dysfunction of back or lower limbs. Multivariate logistic regressions showed no relationship between injury and aerobic fitness level; however, increased body mass index, minor back and lower limb dysfunctions, and mental dysfunctions were predictive of injury. In a study of manual material handlers, McSweeney et al. (18) found no difference between exercisers and nonexercisers in terms of the likelihood of reporting an injury. However, the authors noted that increased or regular exercise was likely to reduce absenteeism occurrence and duration. In another study among male material handler employees at 3 separate facilities, no association was observed between injury occurrence and absolute aerobic capacity; however, a significant increase in injury risk was related to a decreased VO<sub>2max</sub>, in addition to increased body fat percentage (19). It is important to note that none of the studies described above used repeated measures of fitness, unlike the present study. The added strength of being able to capture time-series data for the population increased statistical power of our study and our ability to control for confounding effects both within and across cohort members.

**Table 6.** Age-Stratified Hazard Ratios<sup>a</sup> for All Injuries and Sprains and Strains by Fitness Level, Tucson, Arizona, 2005–2009

Fitness Level by Injury Type <sup>b</sup>	Total		Age <30 Years		Age ≥30 Years	
	HR	95% CI	HR	95% CI	HR	95% CI
All injuries						
I		Referent		Referent		Referent
II	1.38	1.06, 1.78	2.28	1.41, 3.71	1.15	0.85, 1.57
III	2.22	1.72, 2.88	3.43	2.10, 5.58	1.86	1.36, 2.53
Sprains and strains						
I		Referent		Referent		Referent
II	1.61	1.21, 2.13	2.27	1.32, 3.90	1.40	1.00, 1.95
III	2.63	1.98, 3.50	4.48	2.63, 7.64	2.10	1.49, 2.96

Abbreviations: CI, confidence interval; HR, hazard ratio.

<sup>a</sup> All models were adjusted for sex and age within the strata.

<sup>b</sup> The relative aerobic capacity for each level was as follows: I, >48 mL/kg/minute; II, 43–48 mL/kg/minute; and III, <43 mL/kg/minute.



Results from our study indicated that there was a modification of injury risk based on age of the person. In particular, younger employees (30 years of age or younger) with a  $VO_{2max}$  below that of the high fit group (i.e.,  $VO_{2max} < 48$  mL/kg/minute) had a higher risk of injury than did their older, less fit counterparts. This effect modification may be due to changes in job rank (and presumably job duties and exposure to external conditions) with increasing age in firefighters. Typically, younger personnel hold the rank of firefighter, whereas promotion or career progression tends to lead into ranks of paramedic, engineer, and captain. For most emergency responses, firefighters are the first to enter an emergency scene and are thus subject to greater hazards, known and unknown emergent threats, and time-limiting stresses. One exception includes the risks to which paramedics are exposed during calls involving advanced life support. Nevertheless, the hazard profile and exposure risk for those with the rank of firefighter can be considered greater than those of their team counterparts (e.g., engineer, captain, chief).

### Limitations

Although injury events that occurred before the first observed clinic visit were removed to avoid left-censoring bias (a product of data merging), there was no knowledge of previous injury history. In addition, analyses were restricted to the first specified injury event; therefore, recurrent injuries were not assessed. Future studies on recurrent injuries should enhance the understanding of injuries in this population by differentiating between the risks of repeated injuries (i.e., the same injury type suffered multiple times by a person) and those of the repeatedly injured (i.e., persons who suffer from multiple injury types). The data assessed for this study also did not permit evaluation of intrinsic factors, such as central motor control (i.e., balance), skeletal abnormalities, alignment of joints, and ligamentous laxity (3–5, 20–29). Ideally, inclusion of these factors would improve future studies (30–32), as intrinsic risk factors each influence local anatomy and biomechanical limitations.

Although  $VO_{2max}$  is linearly related to heart rate and energy expenditure, it is an indirect measurement of a person's maximal capacity to do work aerobically (33). In the present study population,  $VO_{2max}$  was estimated using a submaximal test protocol that was previously validated and has been used widely in the fire service (13). Two recent studies, however, have indicated the potential for submaximal tests to overestimate true aerobic capacity (34, 35). If true, any overestimation of  $VO_{2max}$  should not influence the regression modeling because the potential bias would be nondifferential. Of note, the distribution of  $VO_{2max}$  values in our study is considered higher than that in the general population. Standard fitness assessments classify midrange (“good”) aerobic fitness at 40 years of age to be 35–38 mL/kg/minute for women and 42–45 mL/kg/minute for men (2). The notion that firefighters are more fit than the general population is supported by the characteristics of this study's firefighting population, who had an average age of 39 years and a mean  $VO_{2max}$  of 49.6 mL/kg/. These differences are likely due to the use of an employed population and the active nature of the job. As previously mentioned, the cutoff values established for the aerobic

fitness levels in these analyses were based on the range of distributions within this active population in addition to methods used in other research.

When compared with the results from a previous study that described exercise-related injuries, which accounted for one third of all reported injuries, as the most common (10), the present findings may appear somewhat counterintuitive. It was not clear if the injuries sustained during exercise periods were the result of overexposure (i.e., fit people exercising too intensely or for too long while on duty) or if the types of exercises being completed were not appropriately structured and evaluated in an effort to minimize the chances for overexertion. The present study's results regarding increased risks of injury among those deemed less fit suggests that the structure and management of exercise within the fire service needs to be considered more intently and that employees without a physical training background should not necessarily be left to exercise without some level of appropriate programming, training, and oversight. Most professional fire departments promote or require some level of exercise among their employees in an effort to assure their ability to complete job tasks with high physical demands (e.g., rescues). Persons in the fire service, much like the majority of the general population, can benefit from exercise instruction and from resources aimed at maintaining or improving their functional fitness levels, thus reducing the potential injury loss. Given the limited financial and personnel resources, a challenge for all fire departments (and similar occupational settings) will be determining the best measures for assessing each component of functional fitness that are 1) consistent and reliable and 2) feasible for implementation.

### Conclusions

Findings from the present study provide empirical evidence that lower fitness levels are associated with increased risks of injury among career fire service employees. Furthermore, these increased risks were modified by age, which is likely due to the fact that rank, job task, and risk profile are often associated with age in this population. As injuries continue to be of relevant health concern in the fire service, the contribution of fitness to the likelihood of injury is significant. Given that injuries are often the result of a multitude of factors and the efficiency of every response activity in the fire service is dependent on the health and fitness of those responders, comprehensive and multifaceted solutions need to be devised, applied, and distributed in order to prevent further injury loss.

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## REFERENCES

- Sothmann MS, Saupé K, Jasenof D, et al. Heart rate response of firefighters to actual emergencies: implications for cardiorespiratory fitness. *J Occup Med*. 1992;34(8):797–800.
- Heywood VH. *Advanced Fitness Assessment and Exercise Prescription*. 6th ed. Champaign, IL: Burgess Publishing Company and Human Kinetics; 2010.
- Kaufman KR, Brodine S, Shaffer R. Military training-related injuries: surveillance, research, and prevention. *Am J Prev Med*. 2000;18(3S):54–63.
- Croisier JL. Factors associated with recurrent hamstring injuries. *Sports Med*. 2004;34(10):681–695.
- Crill MT, Hostler D. Back strength and flexibility of EMS providers in practicing prehospital providers. *J Occup Rehabil*. 2005;15(2):105–111.
- Anderson CK. Relationship between aerobic capacity, injury risk and tenure for new-hire delivery drivers. *Ergonomics*. 2010;53(11):1395–1401.
- Hennig PC, Khamoui AV, Brown LE. Preparatory strength and endurance training for U.S. Army basic combat training. *Strength Cond J*. 2011;33(5):48–57.
- Hollander I, Bell NS. Physically demanding jobs and occupational injury and disability in the U.S. Army. *Mil Med*. 2010;175(10):705–712.
- Giovannetti JM, Bembén M, Bembén D, et al. Relationship between estimated aerobic fitness and injury rates among active duty at an Air Force base based upon two separate measures of estimated cardiovascular fitness. *Mil Med*. 2012;177(1):36–40.
- Poplin GS, Harris RB, Pollack KL, et al. Beyond the fireground: injuries in the fire service. *Inj Prev*. 2012;18(4):228–233.
- Bassett DR Jr, Howley ET. Limiting factors for maximum oxygen uptake and determinants of endurance performance. *Med Sci Sports Exerc*. 2000;32(1):70–84.
- Lee CD, Blair SN, Jackson AS. Cardiorespiratory fitness, body composition, and all-cause and cardiovascular disease mortality in men. *Am J Clin Nutr*. 1999;69(3):373–380.
- Gerkin R, Kelley P, Perry R. Correlation of VO<sub>2</sub>-max During Maximal Treadmill Stress Testing With VO<sub>2</sub> at 85% Predicted Maximal Heart Rate: a Retrospective Review of the Phoenix Fire Department Treadmill Protocol. Technical Report to the Medical Director of the Phoenix Fire Department Medical Center. Phoenix, AZ: City of Phoenix; 1997:1–4.
- International Association of Fire Fighters. *The Fire Service Joint Labor Management Wellness Fitness Initiative*. 3rd ed. Washington, DC: International Association of Fire Fighters; 2008.
- United States Department of Labor, Bureau of Labor Statistics. *Current Population Survey: Labor Force Statistics*. Washington, DC: Government Printing Office; 2013.
- Hootman JM, Macera CA, Ainsworth BE, et al. Association among physical activity level, cardiorespiratory fitness, and risk of musculoskeletal injury. *Am J Epidemiol*. 2001;154(3):251–258.
- Heir T, Eide G. Age, body composition, aerobic fitness and health condition as risk factors for musculoskeletal injuries in conscripts. *Scand J Med Sci Sports*. 1996;6(4):222–227.
- McSweeney KP, Congleton JJ, Kerk CJ, et al. Correlation of recorded injury and illness data with smoking, exercise and absolute aerobic capacity. *Int J Ind Ergon*. 1999;24(2):193–200.
- Craig BN, Congleton JJ, Kerk CJ, et al. Correlation of injury occurrence date with estimated maximal aerobic capacity and body composition in a high-frequency manual materials handling task. *Am Ind Hyg Assoc J*. 1998;59(1):25–33.
- Lavender SA, Conrad KM, Reichelt PA, et al. Designing ergonomic interventions for EMS workers—part II: lateral transfers. *Appl Ergon*. 2007;38(2):227–236.
- Lavender SA, Conrad KM, Reichelt PA, et al. Designing ergonomic interventions for emergency medical services workers—part III: bed to stairchair transfers. *Appl Ergon*. 2007;38(5):581–589.
- Conrad KM, Reichelt PA, Lavender SA, et al. Designing ergonomic interventions for EMS workers: concept generation of patient-handling devices. *Appl Ergon*. 2008;39(6):792–802.
- Chaffin DB. The evolving role of biomechanics in prevention of overexertion injuries. *Ergonomics*. 2009;52(1):3–14.
- Clemes SA, Haslam CO, Haslam RA. What constitutes effective manual handling training? A systematic review. *Occup Med*. 2010;60(2):101–107.
- Mehta RK, Agnew MJ. Analysis of individual and occupational risk factors on task performance and biomechanical demands for a simulated drilling task. *Int J Ind Ergon*. 2010;40(5):584–591.
- Hamonko MT, McIntosh SE, Schimelpfenig T, et al. Injuries related to hiking with a pack during National Outdoor Leadership School courses: a risk factor analysis. *Wilderness Environ Med*. 2011;22(1):2–6.
- Hewett T, Myer GD. The mechanistic connection between the trunk, hip, knee, and anterior cruciate ligament injury. *Exerc Sport Sci Rev*. 2011;39(4):161–166.
- Fields KB, Sykes JC, Walker KM, et al. Prevention of running injuries. *Curr Sports Med Rep*. 2010;9(3):176–182.
- O'Neill BC, Graham K, Moresi M, et al. Custom formed orthoses in cycling. *J Sci Med Sport*. 2011;14(6):529–534.
- Beynon BD, Murphy DF, Alosa DM. Predictive factors for lateral ankle sprains: a literature review. *J Athl Train*. 2002;37(4):376–380.
- Willems TM, Witvrouw E, Delbaere K, et al. Intrinsic risk factors for inversion ankle sprains in females—a prospective study. *Scand J Med Sci Sports*. 2005;15(5):336–345.
- Willems TM, Witvrouw E, Delbaere K, et al. Intrinsic risk factors for inversion ankle sprains in male subjects. *Am J Sports Med*. 2005;33(3):415–423.
- American College of Sports Medicine. *ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*. 8th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010.
- Mier CM, Gibson AL. Evaluation of a treadmill test for predicting the aerobic capacity of firefighters. *Occup Med*. 2004;54(6):373–378.
- Tierney MT, Lenar D, Stanforth PR, et al. Prediction of aerobic capacity in firefighters using submaximal treadmill and stairmill protocols. *J Strength Cond Res*. 2010;24(3):757–764.

# Firefighter Fitness: Improving Performance and Preventing Injuries and Fatalities

Denise L. Smith, PhD

## Abstract

Firefighting is dangerous work. Each year, approximately 80,000 firefighters are injured and about 100 firefighters lose their lives in the line of duty. Firefighters face multiple dangers in the course of their work; they encounter toxic fumes, dangerous products of combustion, high radiant heat loads, and a chaotic work environment. Despite the myriad dangers, the leading cause of line-of-duty death among firefighters is sudden cardiac event, accounting for approximately 45% of duty deaths. Firefighting requires high levels of aerobic fitness, anaerobic capacity, and muscular strength and endurance; however, data suggest that many firefighters do not possess high aerobic or anaerobic capacity. Furthermore, many firefighters are overweight and have one or more modifiable risk factors for cardiovascular disease. The safety of the public and the health and safety of firefighters would be enhanced if firefighters followed well-designed fitness programs to improve overall health and fitness.

## Introduction

Firefighters perform strenuous work in hostile, chaotic, and unpredictable conditions. Thus, firefighting is widely recognized as dangerous work. In 2009, there were 1.35 million fires in the United States, resulting in 3,010 civilian deaths, 17,050 civilian injuries, and an estimated total property loss of \$12.5 billion (25). There are approximately 1.2 million firefighters in more than 30,000 departments providing local communities with protection from fire and other hazards. Roughly 29% of the U.S. Fire Service is made up of career, paid firefighters, while the remaining 71% are volunteer firefighters (25).

Firefighters are a unique occupational group, and they face multiple dangers in the course of their work; firefighters encounter toxic fumes, dangerous products of

combustion, high radiant heat loads, and a chaotic work environment. In addition to hazards encountered at the scene of a fire, firefighters also perform rescues, extrications, emergency medical system (EMS) calls, and respond to natural disasters and hazardous materials spills. Attesting to the dangerous nature of the job, approximately 80,000 firefighters are injured on the job each year. More than 40% of the injuries occur on the fireground, despite the fact that firefighters spend a very small percentage of their time engaged in fire suppression activities. When expressed relative to the type of call they are responding to, approximately 23 to 25 firefighters are injured per 1,000 fires,

whereas only 0.6 to 0.7 injuries occur per 1,000 non-fire emergencies (24).

Firefighting also results in approximately 5.7 firefighter fatalities per 100,000 structure fires (13). A retrospective study, performed between 1995 and 2004, revealed that 1,006 firefighters had died in the line of duty during that period. Approximately 45% of those fatalities were the result of cardiovascular events. While most people recognize that firefighting is dangerous, many believe that fire or the products of combustion account for most of the fatalities in the Fire Service. As seen in Figure 1, the percentage of fatalities attributed to sudden cardiac events far outnumbered the deaths due to burn or asphyxiation on a consistent basis.

## Physical Demands of Firefighting

Firefighting involves a unique set of stressors (Fig. 2). Firefighters perform strenuous muscular work; they must climb stairs and ladders, carry and use heavy tools, often above their head or in awkward positions, and they may be called upon to perform difficult rescue operations. Firefighters work in dangerous environments; they encounter extreme temperatures, toxic smoke (including carbon monoxide and hydrogen cyanide), and chaotic conditions that include loud noise and low visibility. Further, this work must be done with time urgency and is often performed under the psychological stress of knowing that civilians are

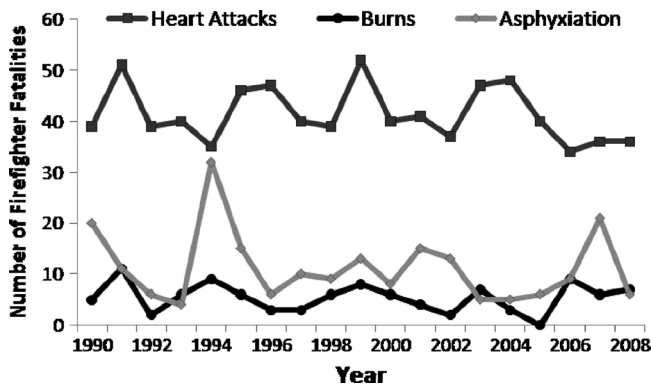
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**Figure 1:** Firefighter casualty statistics from 1990 to 2008. Based on data from The National Fire Protection Association (NFPA).

in imminent danger. Additionally, firefighters must perform their work while wearing personal protective equipment (PPE), equipment that is necessary to protect the firefighter but that also imposes a considerable physiological burden because of its weight, insulative properties, and restrictiveness. The unique set of stressors that are encountered during firefighting results in substantial physiological strain, particularly to the thermoregulatory and cardiovascular systems.

**Physiological Strain of Firefighting**

Considering the work that is done and the environment in which it is performed, firefighting is among the most arduous work that humans undertake. Not surprisingly then, firefighting affects every system of the body. Figure 3 summarizes some of the major effects of firefighting on the body.

While firefighting results in significant physiological strain affecting nearly every system of the body, statistically the greatest risks to the firefighter come from the cardiovascular and thermal strain associated with firefighting. Strenuous firefighting activities lead to near maximal heart rates (HR) that can remain elevated for extended periods of time (1,38). Stroke volume decreases following strenuous firefighting activity (38). Firefighting may result in high blood pressures

that quickly drop below resting values following cessation of work (21).

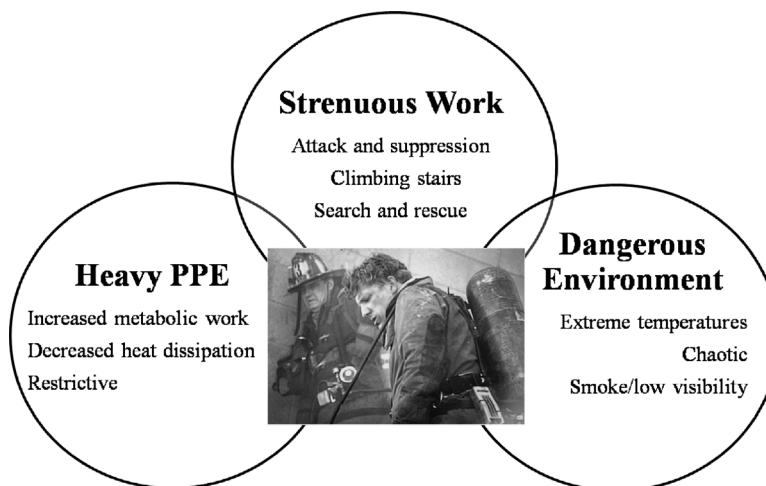
Firefighting is associated with profuse sweating and hence a decrease in plasma volume. A 15% reduction in plasma volume has been reported after 18 min of strenuous firefighting drills (38). The decrease in plasma volume contributes to the reduction in stroke volume noted above and leads to hemoconcentration. Hemoconcentration causes a change in blood electrolytes and increases blood viscosity (39). Platelet number increases (more than can be explained by hemoconcentration) and platelet aggregability increases following firefighting activity (41).

Given that firefighters wear heavy, insulative PPE that often weighs in excess of 22 kg and are called upon to perform strenuous muscular work in very hot environments, it is no surprise that firefighting leads to thermal strain. Challenges to the thermoregulatory system include elevated core temperature (hyperthermia) and dehydration. Hyperthermia and dehydration are very serious problems in the Fire Service because these twin challenges can hasten the onset of fatigue and limit work time, add to cardiovascular strain, lead to fatal heat illnesses (including heat stroke), impair cognitive function, and increase the risk of injury.

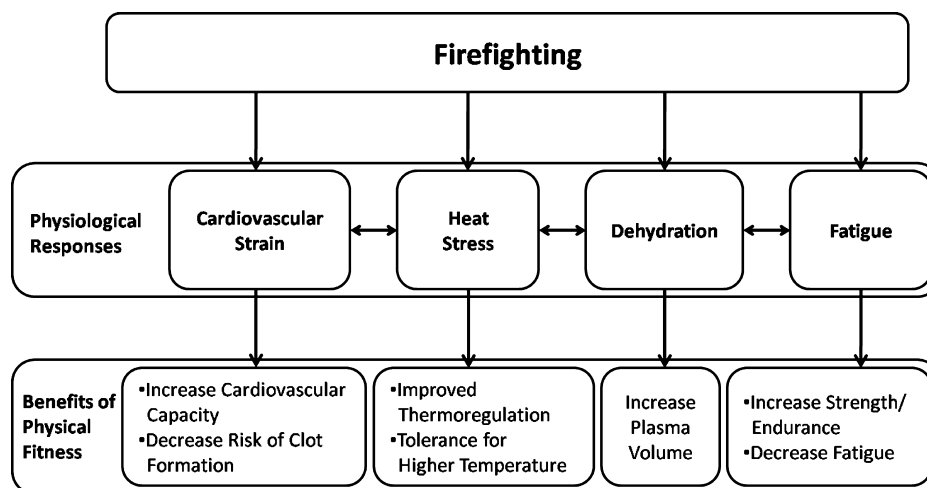
Core temperature increases rapidly but does not reach drastically high levels during short-term firefighting. Periods of 18 to 20 min of firefighting have been reported to cause an average increase in body temperature of 1.5 to 2.5°F (21,40). Prolonged firefighting or repeated evolutions of training would cause greater elevations in body temperature. Firefighting, like other strenuous activity, leads to fatigue. The fatigue may be due to neural, metabolic, or muscular factors and is likely hastened by work in the heat. Fatigue can impair the firefighting mission and may increase susceptibility to injury.

**Performance Requirements**

Firefighting requires high levels of aerobic fitness, anaerobic capacity, and muscular strength and endurance. Additionally, given the detrimental effects of excess body fat, firefighters also should possess an appropriate body composition. Several studies have attempted to quantify the aerobic



**Figure 2:** Unique job stressors. Stressors associated with firefighting include strenuous muscular work, heavy personal protective equipment (PPE), and a hot and dangerous environment.



**Figure 3:** Primary physiological responses to firefighting and the benefits of physical fitness. Firefighting results in considerable physiological strain. A well-designed fitness program provides multiple benefits and helps prepare the firefighter for the demands of firefighting.

requirements of firefighting. A limitation to all of these studies is that they “simulate” firefighting activity. Further, the work that must be performed varies greatly based on the work assignment (*e.g.*, officer, venting, advancing a charged hose line, performing a rescue). Studies have reported the estimated oxygen consumption associated with firefighting to range between 33.6 and 49.0 mL·kg<sup>-1</sup>·min<sup>-1</sup> (17,26,28,44). Sothmann and colleagues (1990) devised a simulated set of firefighting drills that took approximately 9 min to complete (44). The participants had an average  $\dot{V}O_{2max}$  of 39.9 mL·kg<sup>-1</sup>·min<sup>-1</sup> and worked at approximately 76% of their  $\dot{V}O_{2max}$  to complete the simulated drills (44). To validate a minimum  $\dot{V}O_{2max}$  requirement, the researchers recruited another group of firefighters ( $\dot{V}O_{2max}$  range 26–51 mL·kg<sup>-1</sup>·min<sup>-1</sup>) and had them perform the fire-suppression drills. Seven of 10 firefighters with a  $\dot{V}O_{2max}$  of 33.5 to 41.0 mL·kg<sup>-1</sup>·min<sup>-1</sup> were able to successfully complete the drills within the allotted time. All participants with a  $\dot{V}O_{2max}$  greater than 41 mL·kg<sup>-1</sup>·min<sup>-1</sup> were able to complete the fire-suppression activities within the acceptable timeframe. Based on research findings, the National Fire Protection Association (NFPA) Standard on Occupational Medical Programs for Fire Departments recommends that firefighters have a minimal aerobic capacity of 42 mL·kg<sup>-1</sup>·min<sup>-1</sup> (metabolic equivalent of task score, 12) (31).

Firefighters also must have a high anaerobic capacity to perform certain job tasks. Strenuous firefighting relies on anaerobic energy sources (in addition to aerobic sources) and high lactate values (6–13 mmol) have been reported following demanding firefighting simulations (2,17,26).

Muscular strength and endurance also are important to meet the physical demands placed on firefighters. Muscular strength and endurance are necessary for forcible entry, advancing the fire hose, chopping tasks, and victim rescues. Sothmann and colleagues (2004) have sought to validate minimally acceptable standards for muscular strength and endurance necessary to successfully perform firefighting tasks (43). Participants completed a simulated set of firefighting tasks and a battery of tests of physical abilities. The

researchers found that physical ability tests (hose drag/high rise pack carry, arm lift, and muscle endurance) combined to significantly predict performance time on the simulated firefighting tasks. Rhea and colleagues (2004) investigated the relationship between several fitness scores and job performance (assessed by performance time on a simulated hose pull, dummy drag, stair climb, and hose hoist) (34). These authors reported high correlations between measures of muscular strength, muscle endurance, anaerobic performance, and performance times.

### Fitness Profile of U.S. Firefighters

Given the heterogeneous nature of the U.S. Fire Service, it is difficult to get an accurate, generalizable assessment of the “typical” firefighter. Firefighter fitness profiles are likely to vary greatly depending upon region of the country, career or volunteer status, the age of the firefighter, and the hiring, medical, and fitness policies of the department.

### Aerobic Capacity

Despite the physically demanding aspects of the job, several studies have reported that firefighters do not possess above-average aerobic capacity. Again, caution must be used when interpreting the literature because many articles report fitness values on a small number of firefighters, from a single department or small group of departments. Furthermore, many of the aerobic fitness values reported in the literature are based on submaximal exercise tests. In general, reported aerobic fitness values for firefighters range from 35 to 56 mL·kg<sup>-1</sup>·min<sup>-1</sup> (9,35,37,49). An early study that randomly sampled 150 firefighters from a large metropolitan city found that aerobic capacity significantly decreased from the 20- to 25-yr-old group (47.7 mL·kg<sup>-1</sup>·min<sup>-1</sup>) to the 30- to 35-yr-old group (37.9 mL·kg<sup>-1</sup>·min<sup>-1</sup>) and from the 35-yr-old group to the 40- to 45-yr-old group (31.5 mL·kg<sup>-1</sup>·min<sup>-1</sup>). In each case, however, the firefighters’ aerobic capacity was similar to that predicted for sedentary individuals (37). In contrast, Davis and colleagues (2002) studied a small municipal fire department on the West Coast and found that firefighters in the 20- to 29-yr age

group had an aerobic capacity of  $55.9 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  and that the oldest group, 50–59 yr, had an oxygen uptake of  $40.4 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  (9). In every decade-group, the firefighters' aerobic capacity was higher than age-predicted values (9). While it is tempting to hope that the improvements in aerobic capacity cited in the more recent study reflect positive changes relative to fitness patterns among the Fire Service, other evidence suggests that firefighters possess modest aerobic capacity (7,9,49). A study of over 100 recruit firefighters in a metropolitan fire department found that recruit firefighters entered the fire service with an aerobic capacity of  $35 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  (9). Encouragingly, the study went on to document a 28% increase in aerobic capacity following a 16-wk fitness program.

### Muscular Strength and Endurance

In general, firefighters have high levels of muscular strength and endurance (2,9,29,34,35,43). Muscular strength and endurance are necessary to perform common firefighting activities, such as carrying ladders, advancing charged hose lines, and using heavy equipment. Firefighters rely on upper- and lower-body strength to perform their jobs. Further, core muscular strength also may serve to reduce the incidence of injuries (48). The high level of strength reported in the fire service also may reflect cultural values within the Fire Service.

### Obesity

There is considerable evidence of a high prevalence of obesity among U.S. firefighters (7,12,16,42,46,50). Clark and colleagues (2002) investigated the body mass index (BMI) and health status of a group of municipal firefighters and reported that 80% of the firefighters were overweight or obese and that there was a significant increase in systolic blood pressure, diastolic blood pressure, cholesterol, and triglycerides as firefighters increased in fatness category (7). Conversely,  $\dot{V}O_{2\text{max}}$  and METS decreased with increasing fatness (7). A study involving a large group of career firefighters ( $N = 332$ ) found that at baseline testing, 53% of firefighters were overweight (BMI between 25 and 29.9), with an additional 35% classified as obese (BMI  $\geq 30$ ). Additionally, obese firefighters were more likely to have hypertension and low levels of high-density lipoprotein-cholesterol (42). A study of more than 100 career and volunteer firefighters with no known history of cardiovascular disease, stationed throughout Illinois, found an average BMI of 28.1 and that 75% of the participants had a BMI greater than 25 (12). Furthermore, Fahs and colleagues (2009) reported that increased BMI was associated with increased arterial stiffness (12). In addition to the high prevalence of overweight and obesity in the Fire Service, there is evidence that firefighters are getting heavier over time. Soteriades *et al.* (2005) found that over a 5-yr follow-up period, the prevalence of obesity increased from 35% to 40%, and the proportion of firefighters with extreme obesity increased fourfold (from 0.6% to 2.4%) (42).

### Cardiovascular Risk

Most studies that have compared the overall cardiovascular mortality of firefighters with the general public have found that firefighters do not have an increased risk

for cardiovascular death, except in instances where the careers of firefighters included significant time on the job before the use of respiratory protection (11). Studies in Boston, Connecticut, New Jersey, San Francisco, Seattle, Edmonton/Calgary and Florida all have found no association between cardiovascular mortality and occupation (3,10,14,18,27,30,36,47). Similarly, a recent review found that firefighters have similar risk profiles for obesity, hypertension, and hyperlipidemia compared with the general population (11).

### Mismatch Between Fitness Demands and Fitness Profiles

Given that so much of a firefighter's time is sedentary, perhaps it is not surprising that they do not differ from the general population in fitness, obesity, or other cardiovascular risk factors. However, considering that their work is punctuated by periods of intense activity, these risk profiles may explain why sudden cardiac events are the leading cause of line-of-duty deaths among firefighters; essentially, there is a mismatch between the fitness and health requirements of strenuous firefighting and the current fitness profile of the U.S. Fire Service.

### Fitness Recommendations

Current standards recommend that firefighters participate in a fitness program (22,32), but it is the responsibility of each individual department to determine whether to institute a fitness program. The NFPA 1583 Standard recommends a program that is positive, nonpunitive, and does not set fitness standards. Of the 440 firefighter fatalities investigated by the National Institute of Occupational Safety and Health (NIOSH) during the period from 1995 to 2004 (44% of fatalities during that period; 440 of 1,006), 39% of the departments offered a voluntary fitness program, but only 8% had mandatory participation (33).

Cardiovascular events are by far the leading cause of line-of-duty deaths among firefighters. Additionally, cardiac events are disproportionately related to fire suppression activities, with firefighters having a 10- to 100-fold increased risk of experiencing a fatal cardiac event after fire suppression versus normal duties at the station (23). Thus firefighters should have a high level of cardiovascular fitness in order to improve performance and decrease the risk of on-the-job fatalities associated with strenuous activity. Additionally, nearly 80,000 firefighters are injured each year, with a large percentage of these injuries occurring during fireground operations. Clearly, fitness has an important role to play in preparing firefighters for the strenuous activity they encounter during firefighting activity. Appropriate fitness programs can enhance overall health, improve performance, and lessen the risk of firefighter injury or fatality. Firefighters and the public they serve will benefit from more fitness programming in the Fire Service.

### Fitness Prescription for Firefighter Health and Safety

Firefighting is strenuous physical work and places considerable strain on the body. In order to meet the unique physical demands of firefighting and to perform firefighting in a safe manner, firefighters must be physically fit. Like soldiers and elite athletes, firefighters should be physically



prepared to meet the unique physical challenges they face. Figure 3 depicts the direct ways in which a fitness program can mitigate against the physiological strain of firefighting.

Fitness prescriptions for firefighters must meet certain criteria in order to adequately serve the U.S. Fire Service. Prescriptions need to address the unique and specific physiological demands of firefighting. This is difficult to accomplish because of the current diversity in fitness and health status of firefighters. Fitness prescriptions must recognize the unique structure and culture of volunteer and career fire departments. These prescriptions also must include individual and progressive programs to meet the individual needs of low-fit to highly-trained firefighters.

### Aerobic Training

Aerobic training provides several health benefits, including improved body composition, serum lipids, glucose metabolism, and maximal aerobic capacity (20). While moderate-intensity aerobic exercise (50%–70% HR<sub>max</sub>) is widely recommended for health benefits, research suggests that higher-intensity aerobic exercise training may promote weight loss and cardiovascular improvements to a greater extent (8). Given the physical demands of firefighting, and the high proportion of line-of-duty deaths attributed to cardiac events, it is essential that a training program for firefighters include endurance training.

### Sprint Interval Training (SIT)

SIT is a type of high-intensity interval training (HIT) that is designed to improve endurance, increase anaerobic threshold, and improve maximal performance. This type of training has been shown to be effective at increasing aerobic capacity (6), improving endurance capacity when working at 80% of aerobic capacity (4), enhancing aerobic metabolism (19), and increasing muscle glycogen content and the maximal activity of citrate synthase (5). Given the effectiveness and efficiency of these workouts and the degree to which they mimic actual energy expenditure during an emergency, it is reasonable to include SIT in exercise prescriptions for firefighters. However, given the high intensity of the workouts and the heterogeneity of fitness levels in the Fire Service, it may be prudent to initiate exercise programs at a lower intensity and increase progressively.

### Functional Training

Functional training targets movements that are necessary for activities of daily living (45). Functional training utilizes full-body, dynamic movements to increase muscular strength and endurance as well as aerobic capacity using equipment such as medicine balls, physioballs, and exercise bands to provide resistance. This type of exercise mimics the high-intensity demands of firefighting. In fact, functional training workouts have been gaining popularity among progressive Fire Departments. CrossFit workouts are now embraced by many members of the Fire Service.

### Resistance Training

Resistance training increases muscle mass and function. Muscle strength and endurance routinely have been found to predict performance on simulated firefighting activities and are unquestionably important for firefighters. Additionally, resistance training is associated with a decreased risk of

all-cause mortality, the development and maintenance of lean muscle mass, and enhanced glucose metabolism (15,20). Resistance training should be part of every firefighter's fitness program. Not only will it improve work capacity, it is likely to provide protection against injuries, especially muscular strains, on the fireground.

### Lifestyle Modifications

There must be a cultural change within the U.S. Fire Service in order to improve fitness and decrease injuries and cardiac events. Changes should include a fitness program designed to improve aerobic capacity, muscle strength and endurance, and functional capacity. The fitness program and a sound dietary plan also should seek to promote healthy weight for firefighters. The development of a social support system with adequate leadership and incentives should promote healthy lifestyle changes. Each individual firefighter and Fire Department must set short- and long-term goals that are realistic and measureable as well as easy to implement within the constraints of space, equipment, and other duties.

### Conclusion

Firefighting is strenuous and dangerous work with a unique set of stressors. In order to meet the physical demands of firefighting, firefighters must be physically fit. Firefighters who possess high levels of cardiovascular and muscular fitness are better able to serve the public by performing their job more effectively. Fit firefighters have increased mobility, energy, and endurance, allowing them to better perform job duties efficiently and safely, and fit firefighters also are less likely to jeopardize the safety of their fellow firefighters or the public they serve.

The safety of the public and the health and safety of firefighters would be greatly enhanced if firefighters followed well-designed fitness programs to improve overall health and fitness. Exercise scientists can play an important role in enhancing firefighter's fitness, thereby improving public health and safety. Specific fitness programs that meet the needs of a broad range of individuals within the Fire Service must be developed that are tailored to the specific job requirements that firefighters face. These fitness programs should be geared toward improving health, safety, and performance. In order to be adopted, these programs must be sensitive to the diverse needs in the Fire Service.

### References

1. Barnard RJ, Duncan HW. Heart rate and ECG responses of fire fighters. *J. Occup. Med.* 1975; 17:247–50.
2. Barr D, Gregson W, Reilly T. The thermal ergonomics of firefighting reviewed. *Appl. Ergon.* 2010; 41:161–72.
3. Beaumont JJ, Chu GS, Jones JR, et al. An epidemiologic study of cancer and other causes of mortality in San Francisco firefighters. *Am. J. Ind. Med.* 1991; 19:357–72.
4. Burgomaster KA, Hughes SC, Heigenhauser GJF, et al. Six sessions of sprint interval training increases muscle oxidative potential and cycle endurance capacity in humans. *J. Appl. Physiol.* 2005; 98:1985–90.
5. Burgomaster KA, Heigenhauser GJF, Gibala MJ. Effect of short-term sprint interval training on human skeletal muscle carbohydrate metabolism during exercise and time-trial performance. *J. Appl. Physiol.* 2006; 100:2041–7.
6. Burgomaster KA, Howarth KR, Phillips SM, et al. Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans. *J. Physiol.* 2008; 586:151–60.

7. Clark S, Rene A, Theurer WM, Marshall M. Association of body mass index and health status in firefighters. *J. Occup. Environ. Med.* 2002; 44:940–6.
8. Cornelissen VA, Fagard RH. Effects of endurance training on blood pressure, blood pressure regulating mechanism and cardiovascular risk factors. *Hypertension.* 2005; 46:667–75.
9. Davis SC, Jankovitz KZ, Rein S. Physical fitness and cardiac risk factors of professional firefighters across the career span. *Res. Q. Exerc. Sport.* 2002; 73:363–70.
10. Demers PA, Heyer NJ, Rosenstock L. Mortality among firefighters from three northwestern United States cities. *Br. J. Ind. Med.* 1992; 49:664–70.
11. Drew-Nord DC, Hong O, Froelicher ES. Cardiovascular risk factors among career firefighters. *AAOHN J.* 2009; 57(10):415–22.
12. Fahs CA, Smith DL, Horn GP, et al. Impact of excess body weight on arterial structure, function, and blood pressure in firefighters. *Am. J. Cardiol.* 2009; 15:1441–5.
13. Fahy RF, LeBlanc PR. Fire fighter fatalities in 2001. *NFPA J.* 2002; 96:69–80.
14. Feuer E, Rosenman K. Mortality in police and firefighters in New Jersey. *Am. J. Ind. Med.* 1986; 9:517–27.
15. FitzGerald SJ, Barlow CE, Kampert JB, et al. Muscular fitness and all-cause mortality: prospective observations. *J. Phys. Act. Health.* 2004; 1:7–18.
16. Gerace TA, George VA. Predictors of weight increases over 7 years in fire fighters and paramedics. *Prev. Med.* 1996; 25:593–600.
17. Gledhill N, Jamnik VK. Characterization of the physical demands of firefighting. *Can. J. Sport Sci.* 1992; 17:207–13.
18. Guidotti TL. Mortality of urban firefighters in Alberta, 1927–1987. *Am. J. Ind. Med.* 1993; 23:921–40.
19. Harmer AR, McKenna MJ, Sutton JR, et al. Skeletal muscle metabolic and ionic adaptations during intense exercise following sprint training in humans. *J. Appl. Physiol.* 2000; 89:1793–803.
20. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med. Sci. Sports Exerc.* 2007; 39:1423–34.
21. Horn GP, Gutzmer S, Fahs C, et al. Physiological recovery from fire-fighting activities in rehabilitation and beyond. *Prehosp. Emerg. Care.* 2011; 15:214–25.
22. International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC). The fire service joint labor management wellness/fitness initiative. Washington, DC: 2007.
23. Kales SN, Soteriades ES, Christophi CA, Christiani DC. Emergency duties and deaths from heart disease among firefighters in the United States. *N. Engl. J. Med.* 2007; 356:1207–15.
24. Karter MJ, Molis JL. U.S. firefighter injuries in 2009. *NFPA J.* 2010; 4:70–6.
25. Karter MJ. Fire loss in the United States during 2009. *NFPA J.* 2010; 3:56–61.
26. Lemon PW, Hermiston RT. The human energy cost of fire fighting. *J. Occup. Med.* 1977; 19:558–62.
27. Ma F, Fleming LE, Lee DJ, et al. Mortality in Florida professional firefighters, 1972 to 1999. *Am. J. Ind. Med.* 2005; 47:509–17.
28. Malley KS, Goldstein AM, Aldrich TK, et al. Effects of fire fighting uniform (modern, modified modern, and traditional) design changes on exercise duration in New York City firefighters. *J. Occup. Environ. Med.* 1999; 41:1104–15.
29. Michaelides MA, Parpa KM, Thompson GB, Brown BS. Predicting performance on a firefighter's ability test from fitness parameters. *Res. Q. Exerc. Sport.* 2008; 79:468–75.
30. Musk AW, Peters JM, Bernstein L, et al. Pulmonary function in firefighters: a six-year follow-up in the Boston Fire Department. *Am. J. Ind. Med.* 1982; 3:3–9.
31. National Fire Protection Association. *NFPA 1582: standard on comprehensive occupational medical program for Fire Departments. Technical Committee on Fire Service Occupational Safety and Health.* Quincy, MA: 2007, p. 66.
32. National Fire Protection Association. *NFPA 1583: standard on health-related fitness programs for Fire Department members. Technical Committee on Fire Service Occupational Safety and Health.* Quincy, MA: 2008, p. 21.
33. National Institute for Occupational Safety and Health. *Preventing fire fighter fatalities due to heart attacks and other sudden cardiovascular events. Department of Health and Human Services.* Cincinnati, OH: 2007, p. 32.
34. Rhea MR, Alvar BA, Gray R. Physical fitness and job performance of firefighters. *J. Strength Cond. Res.* 2004; 18:348–52.
35. Roberts MA, O'Dea J, Boyce A, Mannix ET. Fitness levels of firefighter recruits before and after a supervised exercise training program. *J. Strength Cond. Res.* 2002; 16:271–7.
36. Sardinas A, Miller JW, Hansen H. Ischemic heart disease mortality of firemen and policemen. *Am. J. Public Health.* 1986; 76:1140–1.
37. Saupe K, Sothmann M, Jasenof D. Aging and the fitness of fire fighters: the complex issues involved in abolishing mandatory retirement ages. *Am. J. Public Health.* 1991; 81:1192–4.
38. Smith DL, Manning TS, Petruzzello SJ. Effects of strenuous live-fire drills on cardiovascular and psychological responses of recruit firefighters. *Ergonomics.* 2001; 44:244–54.
39. Smith DL, Petruzzello SJ, Chludzinski MA, et al. Effects of strenuous live-fire drills on hematological, blood chemistry, and psychological measures. *J. Therm. Biol.* 2001; 26:375–80.
40. Smith DL, Petruzzello SJ, Chludzinski MA, et al. Selected hormonal and immunological responses to strenuous live-fire firefighting drills. *Ergonomics.* 2005; 48:55–65.
41. Smith DL, Petruzzello SJ, Goldstein E, et al. Effects of live-fire training drills on platelet number and function. *Prehosp. Emerg. Care.* 2011; 233–39.
42. Soteriades ES, Hauser R, Kawachi I, et al. Obesity and cardiovascular disease risk factors in firefighters: a prospective cohort study. *Obes. Res.* 2005; 13:1756–63.
43. Sothmann MS, Gebhardt DL, Baker TA, et al. Performance requirements of physically strenuous occupations: validating minimum standards for muscular strength and endurance. *Ergonomics.* 2004; 47:864–75.
44. Sothmann MS, Saupe KW, Jasenof D, et al. Advancing age and the cardiorespiratory stress of fire suppression: determining a minimum standard for aerobic fitness. *Hum. Perform.* 1990; 3:217–36.
45. Tsauo JY, Chen WH, Liang HW, Jang Y. The effectiveness of a functional training programme for patients with chronic low back pain – a pilot study. *Disabil. Rehabil.* 2009; 31:1100–6.
46. Tsimenakis AJ, Christophi CA, Burrell JW, et al. The obesity epidemic and future emergency responders. *Obesity (Silver Spring).* 2009; 17:1648–50.
47. Vena JE, Fiedler RC. Mortality of a municipal worker cohort: IV. Firefighters. *Am. J. Ind. Med.* 1987; 11:671–84.
48. Wilson JD, Dougherty CP, Ireland ML, Davis IM. Core stability and its relationship to lower extremity function and injury. *J. Am. Acad. Orthop. Surg.* 2005; 13:316–25.
49. Womack JW, Green JS, Crouse SF. Cardiovascular risk markers in firefighters: a longitudinal study. *Cardiovasc. Rev. Rep.* 2000; 21:544–8.
50. Yoo HL, Franke WD. Prevalence of cardiovascular disease risk factors in volunteer firefighters. *J. Occup. Environ. Med.* 2009; 51:958–62.



## ARTICLE

# Cardiovascular Strain of Firefighting and the Risk of Sudden Cardiac Events

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<sup>1</sup>Health and Exercise Sciences, Skidmore College, Saratoga Springs, NY; <sup>2</sup>University of Illinois Fire Service Institute, Champaign, IL; <sup>3</sup>Department of Environmental Health, Harvard TH Chan School of Public Health, Boston, MA; <sup>4</sup>Occupational Medicine, Cambridge Health Alliance/Harvard Medical School, Cambridge, MA

SMITH, D.L., J.P. DEBLOIS, S.N. KALES, and G.P. HORN. Cardiovascular strain of firefighting and the risk of sudden cardiac events. *Exerc. Sport Sci. Rev.*, Vol. 44, No. 3, pp. 90–97, 2016. *Approximately 45% to 50% of line-of-duty deaths in the fire service are caused by sudden cardiac deaths, which most often occur during or shortly after firefighting duties. We present a theoretical model linking the cardiac, vascular, and hematological responses of firefighting to the triggering of sudden cardiac death in susceptible individuals.*

**Key Words:** firefighting, cardiac, vascular, coagulatory, cardiovascular disease, sudden cardiac death.

## Key Points

- The leading cause of duty-related death within the fire service is a sudden cardiac event, accounting for approximately 50% of line-of-duty deaths.
- Sudden cardiac events are much more likely to occur after firefighting activities than other duties and may be the result of primary arrhythmias or myocardial infarction.
- Firefighting leads to significant cardiovascular strain, including alterations in cardiac function, vascular function, and hemostasis.
- Most firefighters recover from the stress of firefighting without incident. However, the cardiovascular strain of firefighting may trigger a cardiovascular event in firefighters with an underlying disease.
- Increased cardiac work, vascular dysfunction, tissue ischemia, and a procoagulatory state may be important causal links that increase the risk of sudden cardiac events in the vulnerable firefighter.

## Club

Editor's note: Go online to view the Journal Club questions in the Supplemental Digital Content: see <http://links.lww.com/ESSR/A19>.

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## INTRODUCTION

Firefighters respond to multiple types of emergencies, such as fires, vehicle/machinery accidents, medical calls, calls for public assistance, technical rescue, and hazardous materials spills to protect the communities they serve. However, statistics show that firefighting (*i.e.*, those activities directly related to fire suppression) results in the greatest risk of injury or fatality (8). Firefighting activities often are conducted in immediately dangerous to life or health conditions that may expose firefighters to extreme environmental temperatures and to multiple chemical and particulate hazards. These conditions necessitate that firefighters wear heavy, insulated, and restrictive personal protective equipment (PPE). Hence, it comes as no surprise that firefighting results in high levels of cardiovascular strain.

Fire service statistics reveal that despite all the acute traumatic risks that firefighters face (*e.g.*, burn injuries, smoke inhalation, structural collapse), by far, the leading cause of line-of-duty death is cardiac related. In fact, approximately 45% to 50% of all firefighter duty-related fatalities are caused by sudden cardiac death (SCD) — a proportion that is relatively stable and stubbornly high. This point is highlighted in Figure 1, which compares SCD with fatalities from burns and asphyxiation since 1990. The number of cardiac fatalities seems to be trending downward during the past 10 years. This encouraging trend may be caused by efforts by the International Association of Firefighters, the International Association of Fire Chiefs, and the National Volunteer Fire Council, all of which have undertaken rigorous campaigns to increase medical evaluations and to promote firefighter wellness and fitness. However, as the numbers indicate, considerable work remains to further reduce cardiac fatalities in the US Fire Service (Fig. 1).

Importantly, sudden cardiac events are disproportionately more likely to occur during or after a firefighting activity than other duties. Although firefighters spend a small percentage of their time (1%–5%) engaged in fire suppression activities, more

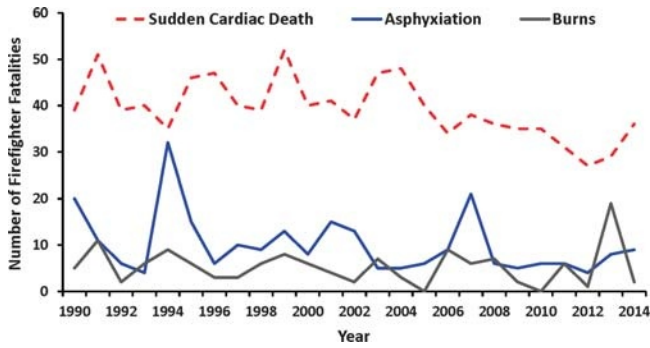


Figure 1. Line-of-duty deaths by major cause since 1990.

than 30% of cardiac fatalities occur during or shortly after firefighting activity, resulting in a 10 to 100 times greater risk of sudden cardiac events after firefighting versus station duties (19). Furthermore, there are approximately 17 to 25 duty-related nonfatal cardiovascular events (heart attacks and strokes) for every fatal event (8,15).

Cardiac events are devastating for individual firefighters and their families, but because firefighting relies on a coordinated team effort, duty-related cardiac events also can jeopardize job performance and the safety of other firefighters and may compromise the ability of firefighters to protect civilians during emergencies. Cardiac injuries likewise often will require significant time away from the fire department at significant cost and burden to the local fire department. Hence, there is an important public safety concern about cardiovascular events in the fire service. We recently have published a review that proposed a theoretical model highlighting the interaction of occupational, medical, and behavioral risk factors in contributing to underlying cardiovascular disease (CVD) (coronary heart disease (CHD) and/or structural heart disease) and where the strenuous duties of firefighting may trigger a cardiovascular event (Fig. 2) (32). In the current review, we extend the previous model by detailing results of translational research

documenting the cardiovascular strain of firefighting and further highlighting the potential mechanisms by which cardiovascular responses to firefighting may lead to pathophysiologic changes that can trigger fatal arrhythmias or myocardial infarction, thus leading to a sudden cardiac event (Fig. 3).

### FACTORS AFFECTING THE CARDIOVASCULAR STRAIN OF FIREFIGHTING

Firefighting involves performing a complex series of physically demanding tasks under psychologically stressful conditions within arduous environments. As depicted in Figure 3, the cardiovascular strain of firefighting results from multiple interacting factors including 1) sympathetic nervous system activation; 2) the strenuous physical work (aerobic and anaerobic); and 3) exposure to environmental conditions and pollutants contained in fire smoke.

#### Sympathetic Nervous System Activation

Sympathetic nervous activation begins with the alarm and continues throughout a fire call. The sudden sounding of an alarm increases psychological/mental stress, activating the sympathetic nervous system. While on the call, sympathetic activation continues because the fire scene is a dynamic cluttered environment in which fire behavior can change rapidly and where loud noises, time urgency, and potential danger produce powerful sympathetic arousal. Several studies have shown a fivefold to sevenfold risk of sudden cardiac events *during alarm response* versus nonemergencies (19,20). The increased relative risk of a cardiac event during this period can be attributed largely to sympathetic arousal and a putative surge in catecholamines because there is not yet exposure to the fire environment or the requirements for large amounts of physical work.

#### Physical Work

Structural firefighting requires a combination of static work and aerobic exertion, such as stair and ladder climbing (while

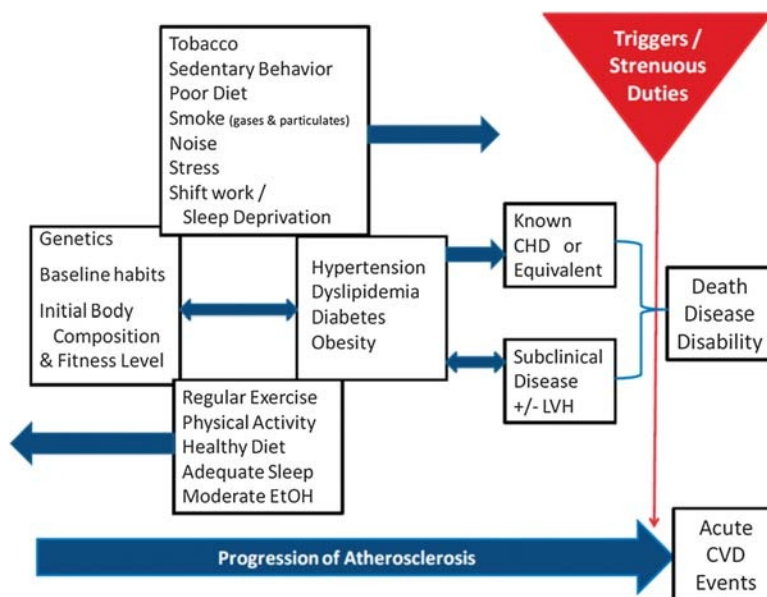
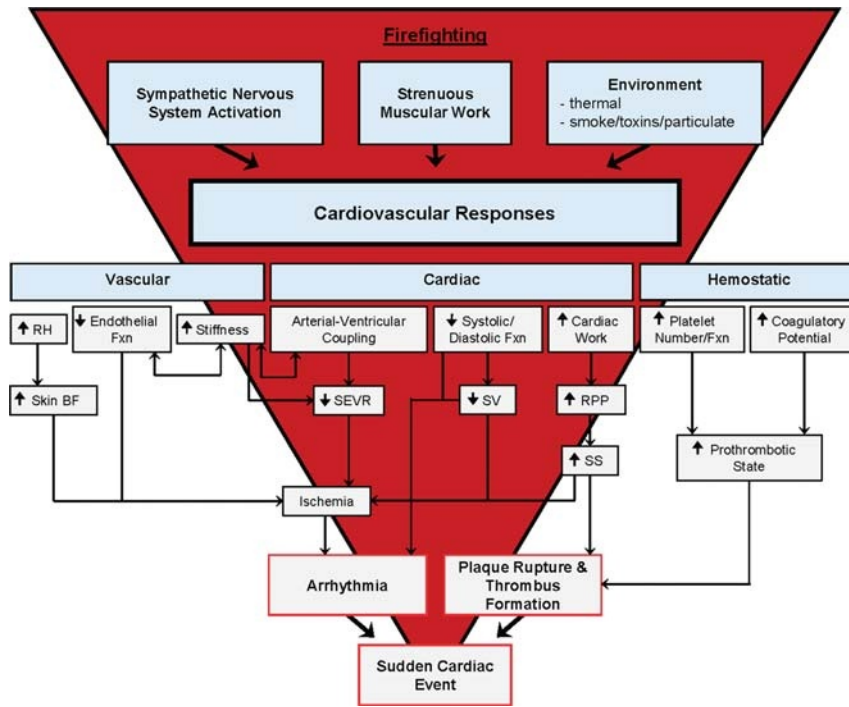


Figure 2. Theoretical model of occupational, medical and behavioral risk factors that contribute to sudden cardiac events following firefighting activities. Note that there is overlap between occupational and lifestyle risk factors. Arrows indicate that factors can be associated with progression or regression of risk factors and subclinical disease. EtOH, alcohol; CHD, coronary heart disease; LVH, left ventricular hypertrophy; CVD, cardiovascular disease. (Reprinted from (32). Copyright © 2011 Wolters Kluwer Health. Used with permission.)



**Figure 3.** Theoretical interplay between cardiac, vascular, and hemostatic responses to firefighting and sudden cardiac events in susceptible individuals. RH, reactive hyperemia; BF, blood flow; Fxn, function; SEVR, sub-endocardial viability ratio; SV, stroke volume; RPP, rate pressure product; SS, shear stress.

carrying heavy equipment), forcible entry, victim search and rescue, building ventilation, and fire attack and suppression. Although it is known that different firefighting tasks require different levels of energy expenditure, firefighting often results in oxygen consumption of greater than of  $40 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  (24). The strenuous work of firefighting is performed while wearing heavy ( $\geq 25 \text{ kg}$ ) and fully encapsulating PPE that provides range-of-motion restrictions, heavy insulation, and limited breathability and adds to the metabolic demands of firefighting. In addition, firefighters perform a great deal of upper body work (lifting and carrying heavy equipment, hose movement and control, chopping, ceiling overhaul), and upper body work (such as wood chopping or snow shoveling) leads to an exaggerated blood pressure response and an increased cardiac work and is associated with an increased risk of a sudden cardiac event (12).

### Environmental Conditions

Radiant heat from a fire adds considerably to the heat stress experienced by firefighters. We have reported an increase in core temperature ( $T_{\text{co}}$ ) of approximately  $1.5^{\circ}\text{C}$  after short-term ( $\leq 20 \text{ min}$ ) firefighting activity (30), and the rate of  $T_{\text{co}}$  change increased with subsequent firefighting activities (17). Both heat stress and dehydration exacerbate cardiovascular strain associated with heavy work (9).

Although firefighters regularly use self-contained breathing apparatus to protect their airways while operating inside the structure, firefighters routinely are exposed to fire smoke (outside of the structure and during overhaul/cleanup operations), which contains toxic and asphyxiant gases such as carbon monoxide, hydrogen cyanide, hydrogen sulfide, and particulate matter among a myriad of other chemicals (5). When inhaled, carbon monoxide reduces the availability of oxygen, thus, potentially resulting in tissue hypoxia. Tissue hypoxemia caused

by carbon monoxide and other asphyxiants (e.g., hydrogen cyanide, hydrogen sulfide) may lead to myocardial ischemia in susceptible individuals. Fire smoke also contains particulate matter associated with the promotion of arrhythmias, decreased heart rate variability, and increased blood pressure (23). Such particulates also may increase the formation of free radicals leading to activation of proinflammatory and prothrombotic pathways that may cause endothelial dysfunction and increased blood coagulability.

### CARDIOVASCULAR RESPONSES TO FIREFIGHTING

Firefighting operations are complex, and no fire scene is identical to another. The magnitude of the cardiovascular strain is affected by the fuel that is burning (e.g., heat release rate, products of combustion), the size of the fire (amount of fuel involvement), dimensions and layout of the structure, the resources (human and equipment) that are available to fight the fire, the tactics that are used (e.g., interior, exterior, or combination attack), and the firefighter's assigned task. For example, a firefighter who is responsible for operating the pump on the engine at a small fire would have a different level of cardiac strain than a firefighter who is performing search and rescue activities on the interior of a large structure during fire suppression activities. The following sections detail research efforts to characterize systematically the effects of firefighting on the various components of the cardiovascular system — the heart, vasculature, and hemostatic system.

#### Cardiac Responses

During strenuous fire suppression activities, heart rates (HR) increase and rise to maximal or near maximal levels and  $T_{\text{co}}$  increases rapidly (18,29). Studies that have focused on long-term firefighting activities that require more than 1 cylinder of air (supporting heavy firefighting work for approximately 12–16 min) have shown that the rate of increase in  $T_{\text{co}}$  is



augmented in later bouts of activity, further exacerbating cardiovascular strain and leading to higher HR (17). HR responses to firefighting vary tremendously depending on the type of work the firefighter is doing and multiple other factors (ambient temperature, length of time engaged, fitness level, etc.). Furthermore, firefighters' HR vary throughout a given emergency because of the intermittent nature of the work (17).

Although HR is the most frequently documented cardiovascular variable because of its ease of measurement, alterations in other cardiac variables are likely even more important to describe the cardiovascular risk associated with firefighting. We have reported a 35% reduction in stroke volume (seated position) after three short bouts of strenuous firefighting activity that lasted a total of approximately 20 min (29). More recently, we performed a full echocardiographic examination (supine position) before and after a 3-h training period that included multiple training evolutions/drills, each lasting approximately 15 to 30 min (11). The firefighting training resulted in near maximal HR (mean,  $192 \pm 15$  beats  $\text{min}^{-1}$ ) and an increase in  $T_{\text{co}}$  from  $37.1 \pm 0.5^{\circ}\text{C}$  to  $38.9 \pm 0.6^{\circ}\text{C}$ . Echocardiographic measurements were obtained within 30 min of firefighting, and mean HR had decreased to  $90 \pm 13$  beats  $\text{min}^{-1}$  at the time of measurement. In this study, we found a 13% reduction in stroke volume (11). Furthermore, the repeated bouts of training resulted in significant reductions in left ventricular diastolic size and volume, transmitral flow velocities, mitral E/A (the ratio of passive ventricular filling to active atrial filling of the ventricle), and left ventricular shortening fraction and ejection fraction. The changes in left ventricular function observed in this study may reflect changes in preload after the firefighting activity. However, there is some evidence that intrinsic systolic and diastolic function also may be depressed after firefighting activity. TDI-E', an indicator of rate of ventricular relaxation, decreased by 19% when measured at the lateral wall but was unchanged when measured at the septal wall (11). The decline in the lateral wall TDI-E' is a marker of lusitropic function that is less load dependent than other measures of diastolic function. Although the clinical significance of the cardiac changes presented above are not fully comprehended, it is important to consider these changes in the context of overall cardiovascular function, especially given that these results were noted in apparently healthy firefighters with no known CVD. Indeed, this study found that, in addition to decreased left ventricular function, there was a decrease in systemic arterial compliance (11). These findings raise the possibility that arterial-ventricular coupling may be altered with firefighting and reinforces the importance of investigating vascular function after firefighting.

### Vascular Responses

The myocardium and vasculature work together in a concerted effort to deliver blood to body tissues. Changes in vascular function and/or the interaction between the myocardium and the vasculature may lead to tissue ischemia/hypoxia, precipitating a sudden cardiac event. We have conducted several studies to investigate the effects of firefighting activities and heat stress on the vasculature and its function.

Yan *et al.* (35) reported changes in arterial-ventricular coupling after repeated bouts of firefighting during a 3-h period of live-fire training in a group of young ( $28 \pm 1$  yr) firefighters. Arterial-ventricular coupling was measured on the right

common carotid artery using wave intensity analysis, a hemodynamic index in which changes in blood pressure and blood flow provide insights into cardiovascular stress (25). In response to live-fire training, wave 1 amplitude, an indicator of cardiac contractility, was reduced by approximately 28%, suggesting that systolic function decreased (35). In a laboratory study designed to further investigate the role of heat stress in changing arterial-ventricular coupling, Smith *et al.* (26) examined 11 young ( $22 \pm 3$  yr) men before and after a 100-min exercise/rest treadmill task (alternating 20-min walk/20-min rest in structural firefighting PPE) and found a nearly 32% increase in wave 2 amplitude. This measure of end-systolic/early-diastolic ventricular function from wave intensity analysis indicates increased afterload on the myocardium after heat stress (26).

We also have examined the influence of firefighting on vascular structure and function. Fahs *et al.* (6) examined the acute effects of live-fire training drills on arterial stiffness and limb blood flow in a group of 69 male firefighters (mean age,  $28 \pm 1$  yr). After 3 h of live-fire training, hemodynamic proxies (wave reflection time and augmentation index) influenced by aortic stiffness increased by approximately 3%. Despite a possible increase in aortic stiffness, a concomitant increase in peripheral forearm vascular conductance (80%) and hyperemia (32%) also were observed (6). It is suggested that the unique combination of thermal, metabolic, psychological, and mental stress that occurs with firefighting activities might explain the increased aortic stiffness and forearm blood flow.

As a follow-up to live-fire studies, Lefferts *et al.* (22) conducted a laboratory-based study to isolate the influence of thermal stress on vascular and central hemodynamic changes. Controlling for hydration status, Lefferts *et al.* (22) reported that exercise-induced moderate heat stress ( $T_{\text{co}}$  of  $37.8 \pm 0.1^{\circ}\text{C}$  caused by treadmill walking in firefighting PPE) did not change aortic stiffness (pulse wave velocity, pre:  $5.0 \pm 0.1$   $\text{m}\cdot\text{s}^{-1}$  vs post:  $4.9 \pm 0.1$   $\text{m}\cdot\text{s}^{-1}$ ;  $P = 0.698$ ). However, Lefferts *et al.* (22) did find alterations in myocardial work demands (rate-pressure product increased by 37%) and an indirect proxy of coronary perfusion (subendocardial viability ratio (SEVR) reduced by about 27%). After a short 18-min bout of live-fire activity, Horn *et al.* (18) found a larger increase in rate-pressure product (80%–95%) and similar reductions in SEVR (30%–35%). These results, although they must be interpreted cautiously given limitations with SEVR, suggest a potential mismatch between myocardial oxygen demand and supply, which may result in ischemia during strenuous work in the heat. This potential mismatch may be more pronounced after firefighting activities than exercise-induced heat stress.

Thus, firefighting activity and heat stress may result in vascular dysfunction and arterial-ventricular uncoupling as evidenced by increased central arterial stiffness, decreased vascular function, and a myocardial oxygen supply-demand mismatch. A potential linkage between vascular alterations and the risk of SCD may be related to firefighters' individual characteristics. We have found increased arterial stiffness in a group of obese ( $\geq 29.5$   $\text{kg}\cdot\text{m}^{-2}$ ) and overweight ( $25.9$ – $29.4$   $\text{kg}\cdot\text{m}^{-2}$ ) firefighters compared with lean ( $< 25.9$   $\text{kg}\cdot\text{m}^{-2}$ ) firefighters, where carotid artery  $\beta$  stiffness was greatest in the obese group compared with the overweight and lean groups ( $5.9 \pm 0.3$ ,  $5.1 \pm 0.3$ , and  $4.9 \pm 0.3$ , respectively) (7). Furthermore, we also have examined vascular changes in older firefighters (40–60 yr) before and after

firefighting activity and found that reactive hyperemia, a measure of microvascular blood flow, and pressure-controlled arterial stiffness (central pulse wave velocity/aMAP) increased significantly after firefighting (21). The cause of increased vascular stiffness after firefighting is not known. The increased central vascular stiffness observed after firefighting activities could be a compensatory mechanism to counteract the profound skin vasodilation in an attempt to facilitate blood flow to the heart and brain or it could reflect a detrimental response to the stressors encountered during firefighting. Additional studies are necessary to better understand the cause and consequences of arterial stiffness and to elucidate what populations of firefighters who, through underlying disease or CVD risk factors, may have a greater risk of experiencing acute vascular changes that may result in SCD.

Because changes in vascular function may be caused by reactive oxygen species or prostaglandin production, we had conducted studies that used antioxidant supplementation or aspirin. We have investigated the effect of vitamin C supplementation on vascular responses to firefighting in young healthy firefighters and found that 2 g of vitamin C did not affect measures of vascular stiffness or microvascular function (6). We also have investigated the effect of aspirin supplementation on vascular changes associated with firefighting in older subjects and found that 2 wk of aspirin supplementation did not affect microvascular (reactive hyperemia) or macrovascular (arterial stiffness/central blood pressure) responses to firefighting (21).

Collectively, research has shown that firefighting and exercise-induced heat stress lead to vascular alterations, specifically, reduced vascular reactivity/endothelial function (6) and increased central arterial stiffness (7,22), which may play roles in arterial-ventricular uncoupling in response to firefighting activity and heat stress (26,35). The uncoupling of the arterial-ventricular system may explain the oxygen supply-demand mismatch observed after firefighting and exercise-induced heat stress (22), leading to ischemia. Increased arterial stiffness after firefighting may be detrimental because of increased cardiac work (increased afterload) or impaired vascular function (compromised vasodilation), and this effect is likely more pronounced in individuals with underlying CVD. Furthermore, overweight/obese and older firefighters may be at increased risk for abnormal vascular responses associated with firefighting and heat stress because the vasculature of these persons is stiffer at rest without the external influence of occupational stressors (7).

### Hemostatic Responses

Firefighting leads to an increase in blood pressure and sweating. Accordingly, we have documented a decrease of approximately 15% in plasma volume after an 18-min bout of firefighting (30). In turn, this resultant hypovolemia decreases central venous pressure, causes hemoconcentration, and increases blood viscosity.

Firefighting likewise seems to disrupt hemostatic balance. We conducted a large study (N = 114) to examine the acute effects of firefighting on platelet number and function. Live-fire firefighting drills (~18 min) caused a modest change in  $T_{co}$  (0.7°C) and a peak HR of 167 beats  $\text{min}^{-1}$  and resulted in increased platelet number and decreased platelet closure time (increased aggregation) in young (29 ± 8 yr) apparently healthy firefighters (31). In a follow-up study, we evaluated the effects

of firefighting activities on platelets, coagulation, and fibrinolytic activity and documented the extent to which these variables recovered 2 h after completion of the firefighting activity in young (25 ± 5 yr) apparently healthy firefighters (27). Platelet number, platelet activity, and coagulatory potential increased immediately after firefighting, and many variables (platelet function, activated partial thromboplastin time (aPTT) and factor VII) continued to reflect a procoagulatory state even after 2 h of recovery. Fibrinolysis also was enhanced immediately after firefighting but returned to baseline values 2 h after firefighting. Research with athletes has similarly indicated that strenuous physical activity acutely increases platelet number and platelet activation (4) and leads to a hypercoagulable state that is normally offset by simultaneous increases in fibrinolysis (16). This hypercoagulable state persists longer into the postactivity recovery period than does the increase in fibrinolysis, potentially reflecting a “vulnerable period” after strenuous exercise (16). In situations of abnormal hemostatic balance, the exercise-induced procoagulatory state may result in increased incidence in cardiovascular events during and immediately after strenuous physical activity. These data support the hypothesis that firefighting leads to a hemostatic imbalance that is primarily prothrombotic during the recovery period from firefighting activities.

### INDIVIDUAL CHARACTERISTICS AND UNDERLYING CVD RISK

As we have summarized in a previous review (32), individual factors may mediate the magnitude of the cardiovascular strain of firefighting. Although firefighting results in significant cardiovascular strain, most firefighters recover from firefighting activities with no untoward event. However, the cardiovascular strain of firefighting interacts with an individual's health and fitness status to determine whether responses to the strain of firefighting are limited to transient physiologic disruptions or result in the activation of pathophysiologic pathways that may lead to sudden cardiac events (32). Underlying cardiovascular health status is determined largely by the prevalence of cardiovascular risk factors. As shown in the Table, such risk factors greatly increase the risk of cardiac death in the fire service, with smoking, hypertension, diabetes, and old age all associated with a greatly elevated risk. However, the greatest risk was associated with previous CHD diagnosis (32). In addition, low fitness also likely contributes to the increased risk of sudden cardiac events (2) because fit individuals can do more work at the same level of cardiovascular strain or they experience less strain at the same level of work. Unfortunately, there is substantial evidence that firefighters often lack high levels of fitness and a large percentage are overweight or obese (2,7,32).

A potential linkage between vascular alterations and the risk of SCD also may be related to individual factors, including obesity. Obesity (body mass index (BMI),  $\geq 30 \text{ kg} \cdot \text{m}^{-2}$ ) is a global epidemic affecting all members of society, including first responders. In the fire service, obesity has been found to increase the relative risk of an on-duty coronary heart disease fatality threefold (32). Obesity is a well-established risk factor for CVD and has been associated with reduced arterial function and increased aortic blood pressures (10). We examined the influence of body weight on vascular structure and function in a group of 110 firefighters (30 ± 8 yr). Firefighters were evenly

TABLE. Relative risk of cardiovascular outcome by risk factor in firefighters

	On-Duty CHD Fatalities, OR (95% CI) (20)	Non-CHD Cardiovascular Retirements, OR (95% CI) (16)	CHD Retirements, OR (95% CI) (16)
Current smoking	8.6 (4.2–17)	2.5 (1.2–5.1)	3.9 (2.5–6.2)
Hypertension	12 (5.8–25)	11 (6.1–20)	5.4 (3.7–7.9)
Obesity, BMI $\geq 30$ kg·m <sup>-2</sup>	3.1 (1.5–6.6)	3.6 (2.0–6.4)	1.4 (0.96–1.93)
Cholesterol $\geq 5.18$ mmol·L <sup>-1</sup> (200 mg·dL <sup>-1</sup> )	4.4 (1.5–13)	1.1 (0.51–2.24)	2.4 (1.6–3.6)
Diabetes mellitus	10.2 (3.7–28)	7.7 (2.9–20)	13 (6.1–28)
Prior diagnosis of CHD	35 (9.5–128)	NA	30 (9.1–96)
Age $\geq 45$ yr	18 (8.5–40)	26 (13–51)	63 (35–111)

BMI, body mass index; CHD, coronary heart disease; CI, confidence interval; diabetes mellitus, defined as random blood glucose level more than 8.3 mmol·L<sup>-1</sup> (150 mg·dL<sup>-1</sup>), previous diagnosis, or receiving insulin or hypoglycemic medications; hypertension, defined as resting blood pressure of 140/90 mm Hg or higher, previous diagnosis of hypertension, or receiving anti-hypertensive therapy; OR, odds ratio. (Reprinted from (32). Copyright © 2011 Wolters Kluwer Health. Used with permission.)

divided into tertiles according to BMI (<25.9, 25.9–29.4, and  $\geq 29.5$  kg·m<sup>-2</sup>). We found increased arterial stiffness in the obese ( $\geq 29.5$  kg·m<sup>-2</sup>) and overweight (25.9–29.4 kg·m<sup>-2</sup>) firefighters compared with that in lean (<25.9 kg·m<sup>-2</sup>) firefighters (7). Furthermore, carotid artery  $\beta$  stiffness was greatest in the obese group compared with the overweight and lean groups ( $5.9 \pm 0.3$ ,  $5.1 \pm 0.3$ , and  $4.9 \pm 0.3$ , respectively). However, measures of endothelial function did not differ by BMI classification (7).

We also have investigated the effect of obesity on coagulatory response to acute firefighting activity (28). An 18-min bout of live-fire training caused a significant increase in coagulatory and fibrinolytic markers, including an overall shift toward a procoagulatory state, as evidenced by a decrease in aPTT and an increase in platelet activity. We also found that obese firefighters exhibited lower baseline levels of fibrinolytic activity (lower tissue plasminogen activator and higher plasminogen activator inhibitor-1), which is consistent with previous literature. However, contrary to our hypothesis, we did not detect an increase in baseline coagulatory measures in obese firefighters nor did we find a greater coagulatory response among obese firefighters. Additional research is necessary to better understand how age, body composition, fitness, and cardiovascular risk factors affect vascular-hemostatic balance after firefighting because it is known that the vascular-hemostatic responses to exercise differ between healthy individuals and those with underlying CVD or CVD risk factors (34).

### TRIGGERING A CARDIOVASCULAR EVENT

Atherosclerosis and structural heart changes, such as left ventricular hypertrophy (LVH), generally develop during a period of many years — even decades. Although CVD may progress with or without symptoms for many years, a plaque rupture or arrhythmia can lead to the rapid onset of severe symptoms and even SCD. Understanding what precipitates, or triggers, such an event is of interest to researchers, clinicians, and those involved in health policy.

Classic studies have temporally linked heavy physical exertion/strenuous work (such as running or snow shoveling) to the onset of acute cardiovascular events, with the risk being concentrated among individuals who are unaccustomed to such levels of exertion (1,12). Sympathetic nervous activation caused by emotional stress, such as excitement and frustration/anger, also is associated with triggering cardiovascular events

in individuals with known CHD (32). In addition, environmental conditions such as elevated levels of air pollution have been shown to be associated with increased rates of sudden cardiac events among susceptible individuals (23).

Although a series of complex pathophysiological processes are involved in SCD, pump failure usually caused by terminal cardiac arrhythmias is ultimately the cause of death. Terminal arrhythmias may be caused by a primary electrical conduction problem (primary arrhythmia) or as complications of plaque rupture and thrombus formation that causes a myocardial infarction. SCD can be caused by many underlying conditions; however, a very large percentage of SCD is caused by CHD (*i.e.*, atherosclerosis) and/or cardiomegaly/LVH (13,36).

### Firefighting as a Trigger for Sudden Cardiac Events

The work of a firefighter is characterized by long periods of low-intensity work, such as inspection, chores, and public education, unpredictably punctuated by episodes of strenuous work. During these intense intervals, firefighting activity involves heavy muscular work and requires high levels of oxygen consumption. Thus, during firefighting, multiple stressors may function independently or more likely synergistically to precipitate acute CVD events among susceptible firefighters (32).

Multiple studies have provided compelling evidence that firefighting activities can trigger cardiovascular events in susceptible firefighters (19,20). These studies found highly elevated and remarkably consistent odds for SCD and other acute CVD events during emergency firefighting activities compared with nonemergency duties. The largest of these studies (19) investigated line-of-duty deaths ( $n = 449$ ) attributed to CHD between 1994 and 2004 and found that, although firefighting (*i.e.*, active fire suppression) represents between 1% and 5% of a firefighter's annual working time, firefighting accounted for more than 30% of line-of-duty CHD deaths. This resulted in a relative risk of SCD during fire suppression of roughly 10 to 100 times the risk encountered during nonemergency duties (19).

The aforementioned physiological disruption and cardiac strain associated with firefighting do not normally pose a significant risk in healthy individuals. However, in susceptible individuals, the stress of firefighting can serve as a trigger for SCD. Most sudden cardiac events are likely caused by myocardial infarctions in individuals with CHD or fatal arrhythmias in individuals with CHD or cardiomegaly/LVH.



## Coronary Heart Disease

Studies that have examined autopsy findings of firefighters who suffered SCD have found that roughly 90% of victims had evidence of coronary atherosclerosis (13,20). CHD is characterized by atherosclerotic plaque in the arterial wall, which is preceded by endothelial dysfunction as the onset of the atherosclerotic process. As the plaque progresses, it results in stenosis and can cause ischemia. Death from a myocardial infarction frequently involves the rupture of vulnerable plaque, exposing blood to underlying connective tissue that is highly thrombotic. Platelets begin to adhere to the vessel and aggregate to each other to form a plug. Ultimately, this may result in the formation of an occlusive thrombus that causes a myocardial infarction.

Firefighting leads to increased shear stress that may increase the risk of plaque rupture. Furthermore, firefighting increases platelet number and activity and leads to a procoagulatory condition that may make thrombus formation more likely. Thus, although most firefighters recover from the cardiovascular strain of firefighting without incident, an individual with underlying atherosclerotic plaque, especially vulnerable plaque, is at a greatly increased risk of plaque rupture and thrombus formation during firefighting activity.

## Cardiomegaly/LVH

Cardiomegaly (increased heart size and mass) and LVH (increased wall thickness and mass) are structural abnormalities that increase the risk of SCD caused by arrhythmia. LVH is a powerful predictor of cardiovascular morbidity and mortality in population-based studies (3), and there is a strong graded association between left ventricular mass and increased cardiovascular risk (14). LVH is frequently associated with fatal arrhythmias (33). Research has found that the increased risk associated with LVH is independent of other factors such as age, sex, smoking status, diabetes, and serum cholesterol. In a majority of cases, LVH is typically a result of hypertension with or without obesity and/or CHD. Obstructive sleep apnea, which also is commonly associated with hypertension and obesity, is another risk factor for LVH. In cases of firefighting SCD, CHD and LVH are frequently comorbid (13,20,36). Myocardial fibrosis is thought to be an important mediator of increased risk of SCD associated with LVH, although the precise mechanisms by which LVH causes cardiovascular morbidity and mortality are not fully understood. However, vascular changes, such as increased arterial stiffness, altered wave reflections and arterial-ventricular uncoupling may lead to the development of LVH.

A recent retrospective study found that cardiomegaly/LVH is a frequent cause of SCD in the general public and is highly associated with obesity and death at a younger age than CHD (33). There is mounting evidence that LVH/cardiomegaly is common among US firefighters and plays a major role in CVD events in the fire service. Kales *et al.* (20) conducted a case-controlled investigation of on-duty CHD fatalities and found evidence for LVH in 76% of the CHD deaths where the autopsy results were available. Subsequently, a larger follow-up case-fatality study was conducted to compare firefighters succumbing to on-duty CHD fatalities with firefighters suffering nonfatal CHD events leading to retirement. Among the fatalities, LVH/cardiomegaly was mentioned in summary reports of almost 60% of the available autopsies (13). In

addition, Yang *et al.* (36) studied younger (<45 yr) firefighters and found a greater than 100-g difference in heart weight among SCD cases compared with trauma fatality controls. Furthermore, approximately 66% of cardiac cases had evidence of cardiomegaly (heart weight, >450 g), and this conveyed a five-fold increase in relative risk of SCD. These studies provide convincing evidence that LVH/cardiomegaly plays a role in a large percentage of firefighter fatalities.

As illustrated in Figure 3, firefighting may lead to several cardiac and vascular changes that increase the risk of arrhythmia, particularly in individuals with underlying vascular dysfunction and/or structural heart abnormalities. Obviously, firefighting leads to increased cardiac work. Furthermore, our research suggests that firefighting also leads to increased arterial stiffening and decreased arterial compliance. The combination of increased cardiac work and decreased arterial compliance may lead to ischemia that could provoke an arrhythmia, particularly in individuals with underlying CHD and/or structural heart changes that include myocardial fibrosis, which likely increases susceptibility to electrical abnormalities.

## CONCLUSIONS

The proposed model suggests that the cardiovascular strain associated with firefighting may trigger a sudden cardiac event in a susceptible person through several biological pathways. Increases in shear stress may cause rupture of vulnerable plaque, resulting in thrombus formation and the occlusion of coronary arteries, which may be exacerbated by hypercoagulability that is known to increase the risk of thrombotic events. Alternately, acute risks encountered during firefighting activities may increase the risk of fatal arrhythmias. Ischemia (caused by an increase in myocardial oxygen demand that exceeds myocardial supply) may result in electrical, mechanical, and biochemical dysfunction of the cardiac muscle. Exposure to environmental conditions (such as gaseous and particulate toxicants in smoke) also may increase susceptibility to arrhythmias (23), particularly in those with LVH and other forms of cardiomegaly or in the context of ischemia.

Additional research is necessary to better understand how individual characteristics affect the cardiovascular responses to firefighting and the precise mechanisms by which firefighting leads to an increased risk of fatal arrhythmias and plaque rupture. Additional research also is needed to identify the types of physical fitness training programs that provide the greatest potential for reducing the risk of sudden cardiac events in the fire service. Firefighters accept great risks to protect their communities. Exercise professionals have a unique opportunity to help improve the health of this remarkable occupation, which is so important to our public safety.

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## References

1. Albert CM, Mittleman MA, Chae CU, Lee IM, Hennekens CH, Manson JE. Triggering of sudden death from cardiac causes by vigorous exertion. *N. Engl. J. Med.* 2000; 343:1355–61.

2. Baur DM, Christophi CA, Kales SN. Metabolic syndrome is inversely related to cardiorespiratory fitness in male career firefighters. *J. Strength Cond. Res.* 2012; 26:2331–7.
3. Bluemke DA, Kronmal RA, Lima JA, et al. The relationship of left ventricular mass and geometry to incident cardiovascular events: the MESA study. *J. Am. Coll. Cardiol.* 2008; 52:2148–55.
4. El-Sayed MS, Ali N, Ali ZE-S. Aggregation and activation of blood platelets in exercise and training. *Sports Med.* 2005; 35:11–22.
5. Fabian TZ, Borgerson JL, Gandhi PD. Characterization of firefighter smoke exposure. *Fire Technol.* 2014; 50:993–1019.
6. Fahs CA, Huimin Y, Ranadive S, et al. Acute effects of firefighting on arterial stiffness and blood flow. *Vasc. Med.* 2011; 16(2):113–8.
7. Fahs CA, Smith DL, Horn GP, et al. Impact of excess body weight on arterial structure, function, and blood pressure in firefighters. *Am. J. Cardiol.* 2009; 104:1441–5.
8. Fahy RF, LeBlanc PR, Molis JL. *Firefighter Fatalities in the United States — 2014*. Quincy (MA): National Fire Protection Association; 2015.
9. Fehling PC, Haller JM, Lefferts WK, et al. Effect of exercise, heat stress and dehydration on myocardial performance. *Occup. Med.* 2015; 65:317–23.
10. Fernhall B, Agiovlasitis S. Arterial function in youth: window into cardiovascular risk. *J. Appl. Physiol.* 2008; 105:325–33.
11. Fernhall B, Fahs CA, Horn G, Rowland T, Smith D. Acute effects of firefighting on cardiac performance. *Eur. J. Appl. Physiol.* 2012; 112:735–41.
12. Franklin BA, Bonzheim K, Gordon S, Timmis GC. Snow shoveling: a trigger for acute myocardial infarction and sudden coronary death. *Am. J. Cardiol.* 1996; 77:855–8.
13. Geibe JR, Holder J, Peebles L, Kinney AM, Burress JW, Kales SN. Predictors of on-duty coronary events in male firefighters in the United States. *Am. J. Cardiol.* 2008; 101:585–9.
14. Haider AW, Larson MG, Benjamin EJ, Levy D. Increased left ventricular mass and hypertrophy are associated with increased risk for sudden death. *J. Am. Coll. Cardiol.* 1998; 32:1454–9.
15. Haynes HJG, Molis JL. *US Firefighter Injuries — 2014*. Quincy (MA): National Fire Protection Association; 2015.
16. Hegde SS, Goldfarb AH, Hegde S. Clotting and fibrinolytic activity change during the 1 h after a submaximal run. *Med. Sci. Sports Exerc.* 2001; 33:887–92.
17. Horn GP, Blevins S, Fernhall B, Smith DL. Core temperature and heart rate response to repeated bouts of firefighting activities. *Ergonomics.* 2013; 56:1465–73.
18. Horn GP, Gutzmer S, Fahs CA, et al. Physiological recovery from firefighting activities in rehabilitation and beyond. *Prehosp. Emerg. Care.* 2011; 15:214–25.
19. Kales SN, Soteriades ES, Christophi CA, Christiani DC. Emergency duties and deaths from heart disease among firefighters in the United States. *N. Engl. J. Med.* 2007; 356:1207–15.
20. Kales SN, Soteriades ES, Christoudias SG, Christiani DC. Firefighters and on-duty deaths from coronary heart disease: a case control study. *Environ. Health.* 2003; 2:14.
21. Lane-Cordova AD, Ranadive SM, Yan H, et al. Effect of aspirin supplementation on hemodynamics in older firefighters. *Med. Sci. Sports Exerc.* 2015; 47:2653–59.
22. Lefferts WK, Heffernan KS, Hultquist EM, Fehling PC, Smith DL. Vascular and central hemodynamic changes following exercise-induced heat stress. *Vasc. Med.* 2015; 20:222–9.
23. Mittleman MA. Air pollution, exercise, and cardiovascular risk. *N. Engl. J. Med.* 2007; 357:1147–9.
24. NFPA 1582. *Standard on Comprehensive Occupational Medical Program for Fire Departments*. Quincy (MA): National Fire Protection Association; 2013.
25. Rakebrandt F, Palombo C, Swampillai J, et al. Arterial wave intensity and ventricular-arterial coupling by vascular ultrasound: rationale and methods for the automated analysis of forwards and backwards running waves. *Ultrasound Med. Biol.* 2009; 35:266–77.
26. Smith DL, DeBlois JP, Wharton M, Fehling PC, Ranadive SM. Effect of moderate exercise-induced heat stress on carotid wave intensity. *Eur. J. Appl. Physiol.* 2015; 115:2223–30.
27. Smith DL, Horn GP, Petruzzello SJ, Fahey G, Woods J, Fernhall BO. Clotting and fibrinolytic changes after firefighting activities. *Med. Sci. Sports Exerc.* 2014; 46:448–54.
28. Smith DL, Horn GP, Petruzzello SJ, et al. Effect of obesity on acute hemostatic responses to live-fire training drills. *Am. J. Cardiol.* 2014; 114:1768–71.
29. Smith DL, Manning TS, Petruzzello SJ. Effect of strenuous live-fire drills on cardiovascular and psychological responses of recruit firefighters. *Ergonomics.* 2001; 44:244–54.
30. Smith DL, Petruzzello SJ, Chludzinski MA, Reed JJ, Woods JA. Effects of strenuous live-fire fire fighting drills on hematological, blood chemistry and psychological measures. *J. Therm. Biol.* 2001; 26:375–9.
31. Smith DL, Petruzzello SJ, Goldstein E, et al. Effect of live-fire training drills on firefighters' platelet number and function. *Prehosp. Emerg. Care.* 2011; 15:233–9.
32. Soteriades ES, Smith DL, Tsismenakis AJ, Baur DM, Kales SN. Cardiovascular disease in US firefighters: a systematic review. *Cardiol. Rev.* 2011; 19:202–15.
33. Tavora F, Zhang Y, Zhang M, et al. Cardiomegaly is a common arrhythmogenic substrate in adult sudden cardiac deaths, and is associated with obesity. *Pathology.* 2012; 44:187–91.
34. Womack CJ, Rasmussen JM, Vickers DG, Paton CM, Osmond PJ, Davis GL. Changes in fibrinolysis following exercise above and below lactate threshold. *Thromb. Res.* 2006; 118:263–8.
35. Yan H, Fahs CA, Ranadive S, et al. Evaluation of carotid wave intensity in firefighters following firefighting. *Eur. J. Appl. Physiol.* 2012; 112:2385–91.
36. Yang J, Teehan D, Farioli A, Baur DM, Smith D, Kales SN. Sudden cardiac death among firefighters ≤45 years of age in the United States. *Am. J. Cardiol.* 2013; 112:1962–7.




REVIEW

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# Prostate cancer in firefighting and police work: a systematic review and meta-analysis of epidemiologic studies

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## Abstract

**Objectives:** We conducted a systematic review and meta-analysis to evaluate potential associations between firefighting and police occupations, and prostate cancer incidence and mortality.

**Methods:** Original epidemiological studies published from 1980 to 2017 were identified through PubMed and Web of Science. Studies were included if they contained specific job titles for ever/never firefighting and police work and associated prostate cancer risk estimates with 95% confidence intervals (CI). Study quality was assessed using a 20-point checklist. Prostate cancer meta-risk estimates (mRE) and corresponding 95% CIs were calculated for firefighting and police work separately and by various study characteristics using random effects models. Between-study heterogeneity was evaluated using the  $I^2$  score. Publication bias was assessed using Begg's and Egger's tests.

**Results:** A total of 26 firefighter and 12 police studies were included in the meta-analysis, with quality assessment scores ranging from 7 to 19 points. For firefighter studies, the prostate cancer incidence mRE was 1.17 (95% CI = 1.08–1.28,  $I^2 = 72%$ ) and the mortality mRE was 1.12 (95% CI = 0.92–1.36,  $I^2 = 50%$ ). The mRE for police incidence studies was 1.14 (95% CI = 1.02–1.28;  $I^2 = 33%$ ); for mortality studies, the mRE was 1.08 (95% CI = 0.80–1.45;  $I^2 = 0%$ ). By study design, mREs for both firefighter and police studies were similar to estimates of incidence and mortality.

**Conclusion:** Small excess risks of prostate cancer were observed from firefighter studies with moderate to substantial heterogeneity and a relatively small number of police studies, respectively. There is a need for further studies to examine police occupations and to assess unique and shared exposures in firefighting and police work.

**Keywords:** Firefighters, Police, Occupation, Prostate cancer risk, Incidence, Mortality, Meta-analysis, Systematic review, Epidemiology

## Background

Prostate cancer is one of the most commonly diagnosed cancers in men worldwide but its etiology remains poorly understood [1–5]. The only established risk factors for prostate cancer are older age, positive family history of prostate cancer, and African-American ethnicity [1, 2, 4, 5]. There is some evidence linking prostate cancer to differences in socioeconomic status, increased height, increased

obesity, reduced physical activity, and active smoking and alcohol use [3, 5–10]. There is growing evidence that occupation may be a risk factor, and previous studies have shown increased risks associated with employment in agriculture/farming, management and administration, rubber production, metal work, and transportation [11–13]. Some studies have also suggested associations between prostate cancer risk and employment in protective services occupations [11, 12, 15–17].

Protective services occupations include firefighting, police, military, and other groups (eg. security guards). Previous epidemiological studies have demonstrated consistent associations between firefighting and different

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types of cancer, with some evidence for prostate cancer [14]. In 2007, the International Agency for Research on Cancer (IARC) classified firefighting as “possibly” carcinogenic to humans (IARC Group 2B) [16]. IARC’s evaluation was based on evidence from 42 epidemiological studies, including two previous meta-analyses on firefighting and cancer [14, 18]. Based on studies published at the time, IARC evaluated multiple cancer sites and identified statistically significant increased risks of prostate cancer, testicular cancer, and non-Hodgkin lymphoma [16]. Since the IARC evaluation, 11 new studies have been published that included assessments of prostate cancer risk in firefighters. Relatively less is known about prostate cancer risk in police occupations, as this group is often understudied and findings have been inconsistent [11, 12, 15, 19, 20].

Only one meta-analysis, published over a decade ago, focused on firefighting and cancer risks that included prostate cancer [14]. This study found a significant association with prostate cancer incidence (summary risk estimate: 1.28, 95% CI: 1.15–1.43) based on evidence from 6 cohort studies [14]. Recently, a narrative review examined cancer risk in police work. Eight studies reported on prostate cancer risk in police work, with mixed findings [15]. The objective of the present systematic review and meta-analysis was to evaluate the quality of the epidemiological evidence on firefighting and police employment in association with prostate cancer incidence and mortality, and to conduct a quantitative synthesis. Based on the availability of epidemiologic literature, this meta-analysis focused on firefighting and police work, and not protective services as a whole.

## Material and methods

### Search strategy

A search was conducted on PubMed and Web of Science to identify epidemiological studies published between January 1980 and December 2017 in English or French about employment in firefighting and police occupations, and risk of prostate cancer. Various combinations of MeSH terms were used to search for studies that included firefighter and police occupations (firefighting OR firefighter OR fire fighter OR fire OR police OR police officer OR policeman OR policemen) and that reported on associations with prostate cancer risk (prostate OR prostate neoplasm OR neoplasm OR cancer). Cited references in individual papers and review papers that resulted from the search were used to identify any additional studies.

### Inclusion criteria

To be included in the meta-analysis, articles must have reported results for original case–control or cohort studies that contained specific job titles related to ever/never

firefighting and police work and that examined associated prostate cancer incidence and/or mortality using any type of relative risk estimator (hazard ratio (HR), odds ratio (OR), relative risk (RR), standardized mortality ratio (SMR), or standardized incidence ratio (SIR)) with corresponding 95% confidence intervals. Reviews, meta-analyses, editorials, and experimental studies were excluded. For any articles with overlapping study populations, only the most recently published study with prostate cancer incidence and/or mortality results was included. Furthermore, studies were excluded if reported risk estimates were only based on internal comparisons between different occupational groups rather than based on comparisons to the general population. Titles and abstracts were initially screened for eligibility, and for those eligible, full-text articles were reviewed.

### Data extraction

Information on author(s), date of publication, title, country of study, study design, number of cases/deaths and controls/non-cases, data collection method, effect sizes and 95% CIs for prostate cancer, and covariates was extracted from and tabulated for each study included in the meta-analysis. Effect sizes and 95% CIs recorded from included studies were for ever vs. never firefighter or police employment in models that were adjusted for the maximum number of potentially confounding variables.

### Quality assessment

The quality of each study included in the meta-analysis was independently assessed by two authors (JS and MP) using a modified quality assessment checklist by Downs and Black [21]. Checklist items that were irrelevant to observational studies were omitted, resulting in a maximum of 20 achievable points for reporting (9 points), external validity (2 points), internal validity (bias and confounding) (8 points), and power (1 point) [21]. Any disagreement of ratings was discussed and a consensus was arrived at mutually or by consulting a third author, if earlier consensus could not be reached.

### Statistical analysis

Reported ORs, HRs, RRs, SIRs, and SMRs were considered as RRs in meta-analyses and used in forest plots. A random effects model was used to calculate meta-risk estimates (mREs) in all meta-analyses due to potential variance in effect sizes between the included studies. mREs were calculated separately for firefighting and police occupations and prostate cancer risk. mREs were calculated for subgroups based on the following characteristics: incidence versus mortality, study design (i.e. cohort versus case–control, and administrative linkage-based studies,

defined as large studies that used multiple linked administrative databases, e.g. census data and tumour registries.

For each mRE, heterogeneity was evaluated using the  $I^2$  statistic. The  $I^2$  statistic is a percentage that describes the variation between studies that is not due to chance [22]. Two-sided  $p$ -values for the  $I^2$  statistic were reported. Ninety-five percent confidence intervals for the  $I^2$  statistic were calculated to address small numbers of included studies ( $N < 5$ ) in some subgroup meta-analyses. In addition, the Galbraith plot was used to visualize if individual studies fell within or outside of the 95% confidence region. Studies outside of the 95% confidence region can contribute to high heterogeneity. These studies were removed in sensitivity analyses to evaluate the impact of decreased heterogeneity on mREs [23].

Begg’s test and Egger’s test were used to assess publication bias. Begg’s test uses the correlation between ranks of effect sizes and variances, whereas Egger’s test uses a funnel plot to plot the effect estimates against sample size [24, 25]. All statistical analyses were performed using STATA version 14.2 (StataCorp LLC, College Station, USA).

**Results**

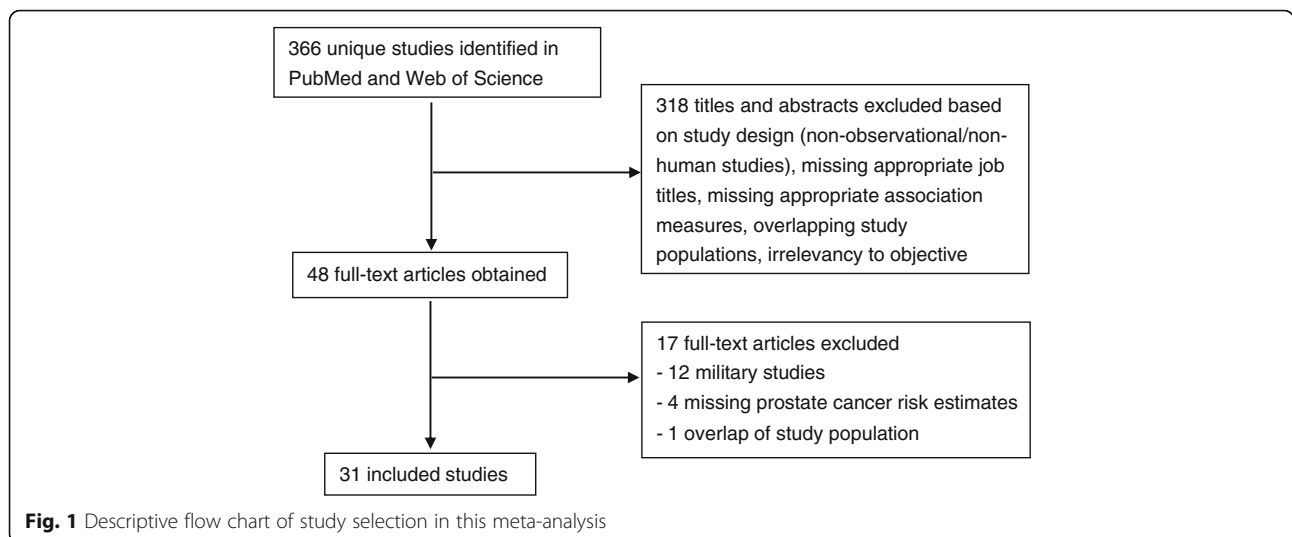
The literature search resulted in 366 unique studies published in English or French. Based on the screening of titles and abstracts, 318 (87%) were excluded due to non-observational/non-human studies, missing job titles, missing effect estimates for prostate cancer, duplicate studies, or irrelevancy to the objective of this meta-analysis. Of the remaining 48 studies that were obtained in full text, 17 were excluded because they did not include reports of relative risks for prostate cancer with 95% CIs, had overlapping study populations, or were studies of military workers. As a result, 31 unique studies were included (Fig. 1).

Of these, 24 were cohort and seven were case–control studies. Nineteen studies only included investigations of firefighters (Table 1) and five focused on police workers (Table 2); seven contained investigations of both firefighters and police workers (Table 3). In all studies that included firefighters ( $N = 26$ ), there were 5712 incident cases of prostate cancer and 428 deaths from prostate cancer. In all studies that included police workers ( $N = 12$ ), there were 1510 incident cases and 49 deaths. The characteristics of each included study are summarized in Tables 1 (firefighters), 2 (police workers), and 3 (both). Covariates included in the risk estimates selected from each of the seven case–control studies are shown in Additional file 1: Table S1.

Of all the firefighter studies, 2 pairs of studies (Ma et al., 2005 & Ma et al., 2006; Demers et al., 1992 & Demers et al., 1994) [26–29] examined the same respective populations but reported on different prostate cancer outcomes (incidence and mortality). In the meta-analyses of prostate cancer incidence and mortality in firefighters, respective results from both pairs of studies were retained and used. Two studies [30, 31] published results for both prostate cancer incidence and mortality, and each estimate was used [31, 32]. For the police studies, [28, 29] reported on the same populations with different outcomes of incidence and mortality, and each estimate was used. Each incidence and mortality outcome was used only in their respective categories and not included together for any meta-risk estimates.

**Quality assessment**

The overall quality assessment of all 31 included studies ranged from 5 to 19 points (Table 4). Scores were similar for firefighter, police, and firefighter and police studies across the different quality assessment categories. The mean score for reporting was 6 out of 9, based on clear



**Table 1** Characteristics of included studies on firefighting and prostate cancer risk ( $N = 19$ )

Author/Year	Location of Study	Study Design	Incidence or Mortality	Follow-up period	Number of Cases/Deaths	Cohort Size/Total Number of Cases <sup>a</sup>	Prostate Cancer Risk Estimates for Ever versus Never Employment <sup>b</sup>
Glass et al. 2016 [63]	Australia	Cohort	Incidence	1980–2011	478	30,057	SIR 1.31, 95% CI 1.19–1.43
Brice et al. 2015 [64]	France	Cohort	Mortality	1979–2008	17	10,829	SMR 0.54, 95% CI 0.31–0.86
Daniels et al. 2014 [32]	USA	Cohort	Incidence; Mortality	1950–2009	1261 cases 282 deaths	29,993 29,993	SIR 1.03, 95% CI 0.98–1.09; SMR 1.09, 95% CI 0.96–1.22
Pukkala et al. 2014 [17]	Denmark, Finland, Iceland, Norway and Sweden	Cohort (linkage)	Incidence	1961–2005	660	16,422	SIR 1.13, 95% CI 1.03–1.22
Ahn et al. 2012 [65]	Korea	Cohort	Incidence	1996–2007	9	33,416	SIR 1.32, 95% CI 0.60–2.51
Ma et al. 2006 [27]	USA	Cohort	Incidence	1981–1999	209	34,796	SIR 1.10, 95% CI 0.95–1.42
Ma et al. 2005 [26]	USA	Cohort	Mortality	1972–1999	21	34,796	SMR 1.08, 95% CI 0.67–1.65
Baris et al. 2001 [66]	USA, USA	Cohort	Mortality	1925–1986	31	7,789	SMR 0.96, 95% CI 0.68–1.37
Bates et al. 2001 [67]	New Zealand	Cohort	Incidence	1977–1995	11	4,221	SIR 1.08, 95% CI 0.50–1.90
Tornling et al. 1994 [31]	Sweden	Cohort	Incidence; Mortality	1951–1986	28 cases 14 deaths	1,116 1,091	SMR 114, 95% CI 76–165; SMR 121, 95% CI 66–202
Aronson et al. 1994 [68]	Canada	Cohort	Mortality	1950–1989	16	5,373	SMR 132, 95% CI 76–215
Giles et al. 1993 [69]	Australia	Cohort	Incidence	1980–1989	5	2,865	SIR 2.09, 95% CI 0.67–4.88
Guidotti 1993 [70]	Canada	Cohort	Mortality	1927–1987	8	3,328	SMR 146.1, 95% CI 63.1–287.9
Beaumont et al. 1991 [33]	USA	Cohort	Incidence	1940–1982	8	3,066	RR 0.38, 95% CI 0.16–0.75
Grimes et al. 1991 [71]	USA	Cohort	Mortality	1969–1988	4	205	PRR 2.6, 95% CI 1.4–5.0
Vena & Friedler 1987 [72]	USA	Cohort	Mortality	1950–1979	5	470	SMR 0.71, 95% CI 0.23–1.65
Tsai et al. 2015 [73]	USA	Case–control (linkage)	Incidence	1988–2007	1397	3,996	OR 1.45, 95% CI 1.25–1.69
Kang et al., 2008 [74]	USA	Case–control (linkage)	Incidence	1986–2003	577	285,964	SMOR 1.05, 95% CI 0.88–1.24
Krstevec et al. 1998 [75]	USA	Case–control	Incidence	1986–1989	12	981	OR 3.34, 95% CI 1.13–9.91

<sup>a</sup>cohort size represents the total sample size in only cohort studies, and the total number of cases is only applicable to case–control studies

<sup>b</sup>HR – hazard ratio, SIR – standardized incidence ratio, SMR – standardized mortality/morbidity ratio, RR – relative risk, PRR – proportionate risk ratio, OR – odds ratio, NR – not reported

and detailed reporting of aims/hypotheses, outcomes measures, participant information, confounder information, and loss to follow-up. Studies were generally found to be externally valid, and there was minimal bias.

Studies of firefighters had higher scores for confounding factors than studies of police workers. Only one study reported a power calculation making it difficult to evaluate this category.

**Table 2** Characteristics of included studies on police work and prostate cancer risk (N = 5)

Author/Year	Location of Study	Study Design	Incidence or Mortality	Follow-up Period	Number of Cases/Deaths	Cohort Size/Total Number of Cases <sup>a</sup>	Prostate Cancer Risk Estimates for Ever versus Never Employment <sup>b</sup>
Vena et al. 2014 [19]	USA	Cohort	Mortality	1980–2005	31	3, 424	SMR 1.18, 95% CI 0.80–1.67
Gu et al. 2011 [76]	USA	Cohort	Incidence	1976–2006	104	2, 234	SIR 0.88, 95% CI 0.72–1.07
Finkelstein 1998 [20]	Canada	Cohort	Incidence	1964–1995	85	22, 197	SIR 1.16, 95% CI 0.93–1.43
Forastiere et al. 1994 [77]	Italy	Cohort	Mortality	1973–1991	7	3, 868	SMR 0.77, 95% CI 0.31–1.50
Bouchardy et al. 2002 [78]	Switzerland	Case–control	Incidence	1980–1993	129	9, 126	OR 1.20, 95% CI 1.00–1.50

<sup>a</sup>cohort size represents the total sample size in only cohort studies, and the total number of cases is only applicable to case–control studies

<sup>b</sup>HR – hazard ratio, SIR – standardized incidence ratio, SMR – standardized mortality/morbidity ratio, RR – relative risk, OR – odds ratio

### Firefighter and prostate cancer meta-analyses

There were significantly elevated prostate cancer risks for firefighting occupations for incidence outcomes, cohort studies, and administrative linkage-based studies. For incidence studies, the mRE was 1.17 (95% CI: 1.08–1.28;  $I^2 = 72\%$ , 95% CI: 55–82%,  $p$ -value <0.001; 19 studies) (Fig. 2); for mortality studies, it was 1.12 (95% CI: 0.92–1.36;  $I^2 = 50\%$ , 95% CI: 0–76%,  $p$ -value = 0.04; 10 studies) (Fig. 3). In cohort studies, the prostate cancer mRE was 1.14 (95% CI: 1.03–1.26;  $I^2 = 67\%$ , 95% CI: 46–80%,  $p$ -value <0.001; 18 studies) (Additional file 2: Figure S1). The meta-analysis of case–control studies resulted in an mRE of 1.27 (95% CI: 0.95–1.69;  $I^2 = 78\%$ , 95% CI: 53–90%,  $p$ -value <0.001; 6 studies) (Additional file 3: Figure S2). The mRE for census or administrative linkage-based studies was 1.19 (95% CI: 1.06–1.34;  $I^2 = 61\%$ , 95% CI: 0–85%,  $p$ -value = 0.04; 5 studies) (Additional file 4: Figure S3).

### Police work and prostate cancer meta-analyses

There were significantly elevated prostate cancer risks for police occupations by incidence outcomes and in case–control studies. The mRE for prostate cancer incidence studies was 1.14 (95% CI: 1.02–1.28;  $I^2 = 33\%$ , 95% CI: 0–74%,  $p$ -value = 0.16; 9 studies) (Fig. 4) while the mRE for prostate cancer mortality studies was 1.08 (95% CI: 0.80–1.45;  $I^2 = 0\%$ , 95% CI: 0%–90%,  $p$ -value = 0.62; 3 studies) (Fig. 5). The mRE for case–control studies was higher compared to the mRE for cohort studies (case–control studies: mRE = 1.22, 95% CI: 1.03–1.44;  $I^2 = 0\%$  (95% CI 0%–85%,  $p$ -value = 0.42; 4 studies) (Additional file 5: Figure S4) versus cohort studies: mRE = 1.10, 95% CI: 0.96–1.26;  $I^2 = 37\%$ , 95% CI: 0–79%,  $p$ -value = 0.15; 7 studies) (Additional file 6: Figure S5). There were no administrative linkage-based studies of police workers and prostate cancer risk.

**Table 3** Characteristics of included studies on both firefighting and police work and prostate cancer risk (N = 7)

Author/Year	Location of Study	Study Design	Incidence or Mortality	Follow-up Period	Number of Cases/Deaths	Cohort Size/Total Number of Cases <sup>a</sup>	Prostate Cancer Risk Estimates for Ever versus Never Employment <sup>b</sup>
Sriitharan et al, 2017b*	Canada	Cohort (linkage)	Incidence	1991–2011	165 firefighters; 325 police	1,100,000 1,100,000	HR 1.17, 95% CI 1.01–1.36; HR 1.22, 95% CI 1.09–1.36
Zeegers et al. 2004 [11]	Netherlands	Cohort (linkage)	Incidence	1986–1993	709 firefighters; 693 police	58, 279 58, 279	RR 0.59, 95% CI 0.05–6.33; RR 1.62, 95% CI 0.62–4.27
Demers et al. 1994 [28]	USA	Cohort	Incidence	1974–1989	66 firefighters; 28 police	2, 447 1, 878	SIR 1.40, 95% CI 1.10–1.70; IDR 1.10, 95% CI 0.70–1.80
Demers et al. 1992 [29]	USA	Cohort	Mortality	1945–1989	30 firefighters; 11 police	4, 546 3, 676	SMR 1.34, 95% CI 0.90–1.91; SMR 1.02, 95% CI 0.51–1.82
Sriitharan et al. 2017a [79]	Canada	Case–control	Incidence	1995–1998	38 firefighters; 35 police	1, 737 1, 737	OR 1.67, 95% CI 0.94–2.95; OR 1.15, 95% CI 0.66–1.99
Sriitharan et al. 2016 [80]	Canada	Case–control	Incidence	1994–1997	53 firefighters; 12 police	760 760	OR 0.73, 95% CI 0.53–1.01; OR 0.82, 95% CI 0.41–1.63
Sauve et al. 2016 [12]	Canada	Case–control	Incidence	2005–2009	26 firefighters; 45 police	1, 937 1, 937	OR 1.72, 95% CI 0.88–3.37; OR 1.60, 95% CI 1.00–2.40

<sup>a</sup>cohort size represents the total sample size in only cohort studies, and the total number of cases is only applicable to case–control studies

<sup>b</sup>HR – hazard ratio, SIR – standardized incidence ratio, SMR – standardized mortality/morbidity ratio, RR – relative risk, IDR – incidence density ratio, OR – odds ratio

\*manuscript submitted and currently being revised for publication



**Table 4** Quality assessment of included firefighter and police studies

Quality Assessment Category	Maximum Attainable Score	Studies on firefighters (n = 19)		Studies on police workers (n = 5)		Studies on both firefighters and police workers (n = 7)		All studies (n = 31)
		Range	Mean	Range	Mean	Range	Mean	
Reporting	9	4–9	6.0	1–8	5.4	4–8	6.1	5.9
External Validity	2	1–2	1.8	0–2	1.6	1–2	1.6	1.7
Internal Validity: Bias	4	3–4	3.8	3–4	3.8	4	4	3.8
Internal Validity: Confounding	4	2–4	3.2	1–4	2.8	3–4	3.6	3.2
Power	1	0	0	0	0	0–1	0.1	0.0
Total	20	10–19	14.8	5–18	13.6	12–18	15.4	14.6

**Between-study heterogeneity**

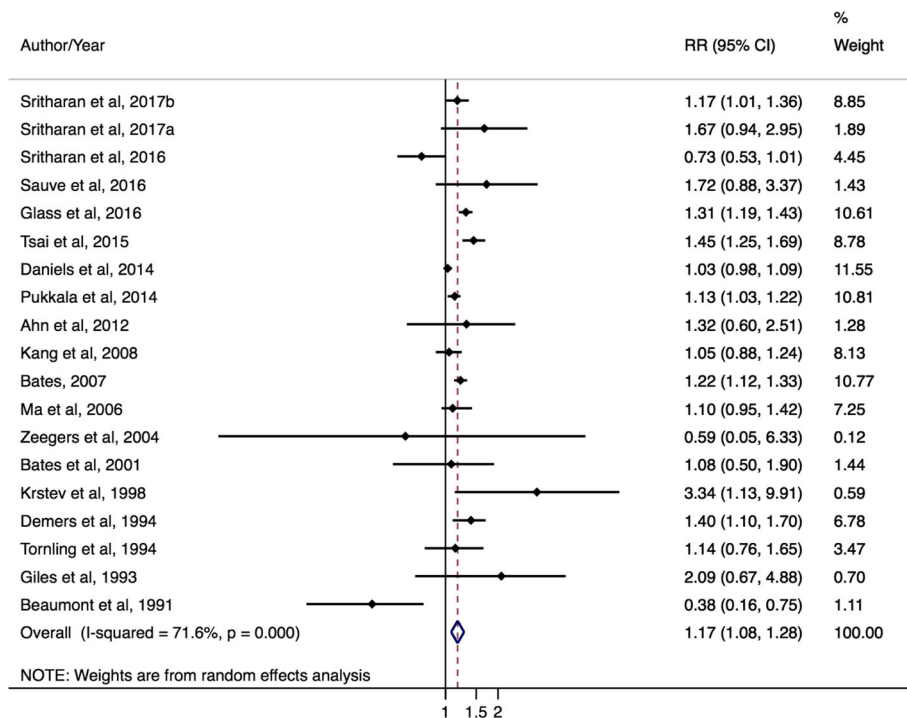
There was high heterogeneity (72%) for the meta-analysis of all 19 firefighter incidence studies. As a sensitivity analysis, the Galbraith plot was used and one study [33], appeared outside of the 95% confidence region. Removal of this study resulted in a minimal change in heterogeneity (72 versus 69%, respectively). For the meta-analysis of the 10 mortality studies, there was moderate heterogeneity (50%). High heterogeneity was observed for the six case-control studies (78%), 18 cohort studies (67%) and the five administrative linkage-based studies (61%). When plotting these subgroups using the Galbraith plot, no studies appeared outside of the 95% confidence region.

For police studies, heterogeneity ranged from none to moderate. Moderate heterogeneity was observed for the nine incidence studies (33%) and seven cohort studies

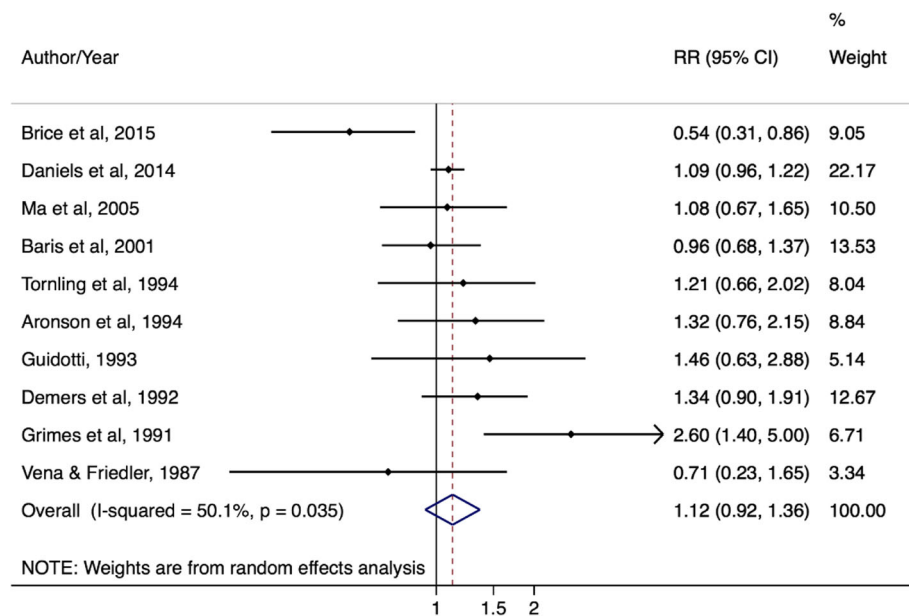
(37%), but no heterogeneity (0%, 95% CI: 0–90%) was observed for the mortality (three studies) and case-control (four studies) subgroups.  $I^2$  values of 0% are biased and imprecise, likely because of the small number of studies in these subgroups ( $n < 5$ ) [34]. Using the Galbraith plot, none of the police studies appeared outside of the 95% confidence region.

**Publication bias**

There was no evidence of publication bias according to Begg’s test ( $p = 0.86$ ) and Egger’s test ( $p = 0.11$ ) for the meta-analysis of all 19 firefighter incidence studies. No publication bias was evident for the 9 police incidence studies (Begg’s test:  $p = 0.60$ , Egger’s test:  $p = 0.68$ ). There were also no statistically significant findings for



**Fig. 2** Forest plot and mRE of all included prostate cancer incidence studies on firefighters



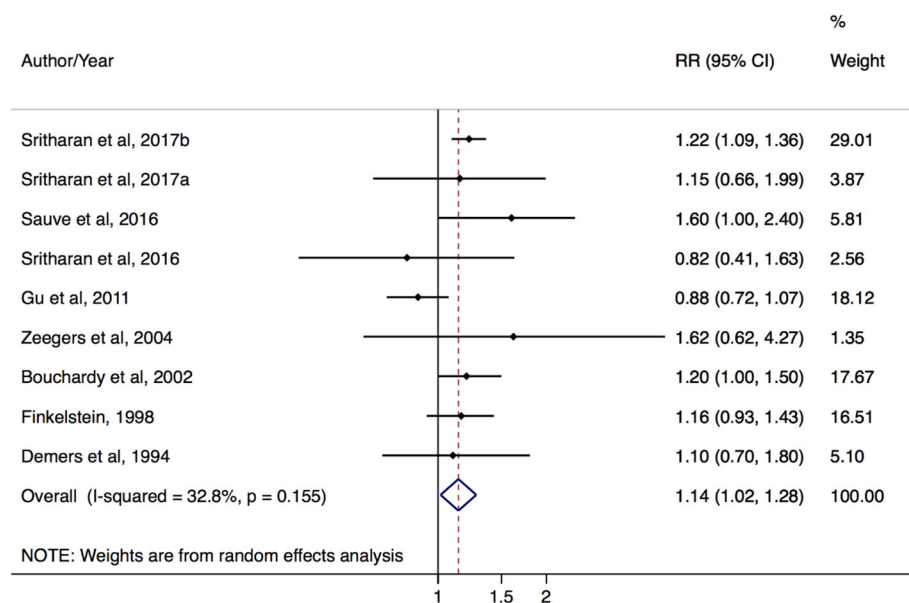
**Fig. 3** Forest plot and mRE of all included prostate cancer mortality studies on firefighters

publication bias for mortality studies, case-control, cohort, and administrative linkage-based studies.

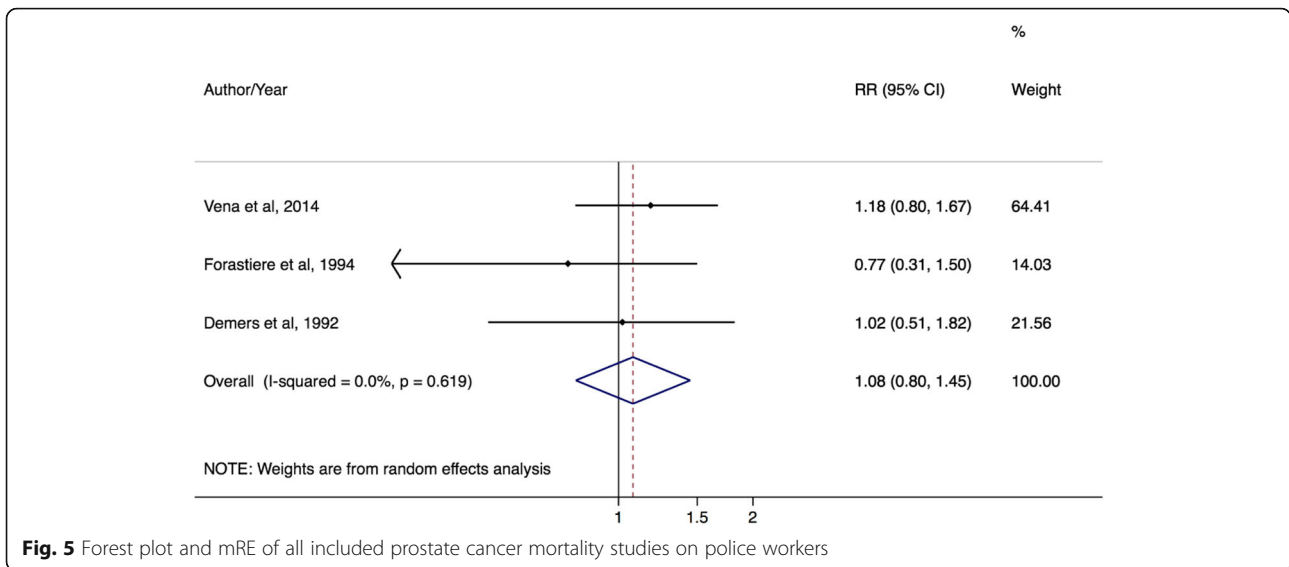
**Discussion**

In this meta-analysis of 31 epidemiological studies of protective services workers, nearly identical and small statistically significant excess risks of prostate cancer were found for ever working in firefighting and police work. Statistically significant and borderline prostate cancer mREs were found for firefighters in separate evaluations of incidence

studies, cohort studies, and administrative linkage studies, as well as in each meta-analysis of police worker incidence studies and case-control studies. Most studies were of average quality, with opportunities for improvement in reporting and study power assessment. As expected, case-control studies compared to cohort studies generally had more information on variables that can act as potential confounders of the firefighter/police work and prostate cancer associations. All case-control studies reported prostate cancer risk estimates that were adjusted for age;



**Fig. 4** Forest plot and mRE of all included prostate cancer incidence studies on police workers



**Fig. 5** Forest plot and mRE of all included prostate cancer mortality studies on police workers

most were also adjusted for ethnicity. Fewer case-control studies adjusted risk estimates for family history of prostate cancer and potentially confounding variables such as socioeconomic status, physical activity, height, obesity, active smoking, and alcohol consumption. Overall, findings from this meta-analysis support positive associations found between prostate cancer risk and firefighting in the epidemiological literature, and indicate a potential relationship with police work as well.

There are a few hypotheses that may explain why employment in protective services occupations could be associated with increased prostate cancer risk. Firefighting and police jobs are inherently dangerous occupations that involve stressful, and, at times, life-threatening, situations with exposure to multiple hazards [14–16]. Psychological stressors can influence biological processes and lead to decreased immune function, increased pro-inflammatory cytokine secretion, and cancer progression [15]. Shift work, which is common in protective services work, was significantly associated with increased prostate cancer risk in a recent meta-analysis of eight case-control and cohort studies [35]. Firefighters are also exposed to toxins released by fire and smoke including benzene, 1,3-butadiene, formaldehyde and at times can be exposed to other compounds such as radiation, diesel exhaust, asbestos, metals (arsenic and cadmium), and PAHs [14, 16, 27]. The chemical reactions during combustion and the age and type of building or material on fire can contribute to exposure to these compounds [16]. Police work involves fewer chemical exposures compared to firefighting, although exposure to ionizing radiation from radar devices is a concern for overall cancer risk [11, 12]. Firefighters and police workers may also be exposed to air pollution on the job, as ambient concentrations of ultrafine particles and NO<sub>2</sub> have been

previously linked to prostate cancer risk [36, 37]. Of the described chemical exposures, only x and gamma radiation, arsenic compounds, and cadmium compounds have been linked to prostate cancer by IARC based on limited evidence in non-occupational settings. However, IARC has classified benzene, ionizing radiation, diesel exhaust, asbestos, arsenic compounds, cadmium compounds, and air pollution as all Group 1 carcinogens, based on evidence for other cancer sites [38]. There is a need to further examine these chemical exposures in both firefighting and police work to understand if these exposures are involved in prostate cancer risk.

Evaluating potential associations between shift work and prostate cancer is an active area of ongoing research [39–41]. Shift work can disrupt the body's endogenous circadian rhythm (sleep-wake cycle) and contribute to increased susceptibility to acute and chronic diseases. However, the biological mechanisms that may be involved in prostate and other cancers have not been established [18, 42]. One hypothesis is that night shift work can lead to decreased melatonin, which can then lead to continuous testosterone production, influencing the growth and differentiation of prostate cancer cells [16]. In addition, decreased sunlight exposure in night shift workers reduces the production of vitamin D, thereby compromising the effects of vitamin D on suppressing the production of prostate cancer cells [16].

Psychological stress also has been linked to cancer progression, but there is limited evidence for how this impacts cancer promotion [43]. Firefighting and police work involve constant stressors that can potentially affect cancer progression, particularly prolonged stress over years of employment in these jobs [44]. A recent study on stress at work and cancer outcomes found that



the highest prevalence of stress at work was reported among firemen when compared to other types of occupations [45].

Another factor that may influence our meta-analysis results is prostate cancer screening. Although prostate specific antigen (PSA) testing varies across different countries and within countries, it is believed that protective services workers have frequent and better access to health resources compared to other workers, including access to cancer screening [32]. In North America, for example, firefighters are provided with health information and recommendations on what to consider when completing a health examination with their primary physician, including recommendations for prostate cancer screening [46]. However, it is up to each fire department to disseminate this information and ultimately up to each firefighter to request screening from their primary physician. In this meta-analysis we found slightly lower mortality mREs compared to incidence mREs for firefighters and police officers. As increased screening of prostate cancer leads to the identification of more early stage cases (increased incidence), this may be indicative of a screening effect. However, the mREs for both incidence and mortality were so similar that it was difficult to attribute these differences to screening. Also, prostate cancer screening may not be of high importance in firefighting compared to other cancers (ex. brain, bladder, and colon) and health conditions that have been consistently associated with firefighting. We evaluated study estimates based on different follow-up periods defined as pre-PSA period (prior to 1990 before the PSA test was introduced), during the introduction of PSA testing (early 1990s), and after the introduction of PSA testing (late 1990s and onwards). Although we included studies from different nations, most of the studies were North American so we loosely defined the time periods based on North America. We identified a number of pre-PSA period firefighter studies and observed a meta-risk estimate of 1.26 (95% CI 0.96–1.67) for these studies. For firefighter studies that had follow-up periods during and after the introduction of PSA testing, we observed a meta-risk estimate of 1.13 (95% CI 1.02–1.25). It was challenging to define firefighter study follow-up periods as post PSA testing (late 1990s onwards) since most of these studies had follow-up periods that overlapped the early 1990s when PSA testing began. We identified only a few firefighter studies that had later follow-up periods (late 1990s and early 2000s) and observed a meta-risk estimate of 1.58 (95% CI 1.09–2.29) for these studies. Overall, we observed an elevated risk for firefighter studies that were conducted before the introduction of PSA testing, and a statistically significant elevated risk for firefighter studies that took place during and after the introduction of PSA testing. These findings may be

representative of the increased screening that took place over this time period. We attempted to evaluate police studies as well but were limited as almost all included police studies had follow-up periods overlapping periods with and without PSA testing.

Our findings of a slight excess risk of prostate cancer in firefighting and police services should be cautiously interpreted. As expected, there was considerable heterogeneity between studies, particularly in subgroup meta-analyses of police workers and prostate cancer risk that involved small numbers of studies. This makes it challenging to interpret mRE values with precision [34]. Heterogeneity was likely due to differences in study design and populations studied, follow-up years, occupational exposure assessment and job coding, and adjustment of relative risk values for known or potential covariates. Specifically, there were differences in how the study populations were defined, in terms of paid or unpaid work, full time vs. part time, and eligible employment duration. Some heterogeneity may also be attributed to different follow-up periods in each study, especially those overlapping the pre and post PSA era. The variation in age distribution across included studies could also contribute to heterogeneity based on differences in how studies stratified by age. Some studies had relatively younger populations than other studies and we observed a similar elevated meta-risk estimate for these younger population studies as we did for the overall estimates. Publication bias was also considered, but was not recognized as a significant factor as a majority of the included studies were cohort designs. The cohort studies generally looked at multiple cancer sites as outcomes, so it is unlikely that publication bias would have been of concern based on solely prostate cancer results.

A major strength of this meta-analysis is that it was the first to assess prostate cancer risk in both firefighting and police work, replete with subgroup analyses and assessments of study quality, heterogeneity, and publication bias. This meta-analysis captured all previously and newly published studies since the IARC evaluation of firefighting in 2007, and also quantitatively evaluated prostate cancer risk in police studies which had not been done before. Firefighting and police work should be priority areas for investigation because these occupations frequently involve exposure to multiple chemical, biological, physical, and psycho-social hazards. Exposure to some hazards may be associated with increased risk of prostate cancer, although the strength and consistency of associations varies across studies and there are substantial research gaps. Altogether, this research can be used to help identify opportunities for further research on occupation and prostate cancer risk.

Other occupations of interest with respect to prostate cancer risk are military workers. While we initially sought to include military studies in this meta-analysis, they were ultimately not included because these studies were primarily based on specific historical events (ex. Gulf war) or internal comparisons between military groups [47–62]. This made it difficult to compare findings to other studies that did not focus on single events or that compared workers to the general population. Future assessments can separately consider military studies.

## Conclusions

Overall, the slight excess risks of prostate cancer in firefighting and police services found in this meta-analysis of 31 studies were generally robust to subgroup analyses by outcome (incidence and mortality) and study design. Our findings are important as they show the importance of prostate cancer incidence and mortality among protective services workers, and as this is the first meta-analysis to include both firefighting and police work and prostate cancer risk. The observed findings suggest that screening may not entirely explain our findings, but further investigation into actual screening rates and screening behaviours in firefighting and police work is warranted. Also, further investigations should be designed to assess specific exposures such as benzene, radiation, diesel exhaust, arsenic and cadmium compounds, PAHs, asbestos, and air pollution which are involved in firefighting. Little evidence on how they may relate to prostate cancer risk has been accrued. There is also a need for future studies to examine prostate cancer risk in police work given the small number of police workers published to date. By addressing these important issues in future studies, there will be better understanding on prostate cancer risk in firefighting and police work.

## Additional files

**Additional file 1: Table S1.** Covariates adjusted for in firefighter and police case-control studies (DOCX 12 kb)

**Additional file 2: Figure S1.** Forest plot and mRE of all included cohort studies on firefighters. (DOCX 285 kb)

**Additional file 3: Figure S2.** Forest plot and mRE of all included case-control studies on firefighters. (DOCX 137 kb)

**Additional file 4: Figure S3.** Forest plot and mRE of all included administrative linkage-based studies on firefighters. (DOCX 153 kb)

**Additional file 5: Figure S4.** Forest plot and mRE of all included cohort studies on police workers. (DOCX 175 kb)

**Additional file 6: Figure S5.** Forest plot and mRE of all included case-control studies on police workers. (DOCX 117 kb)

## Abbreviations

CI: Confidence Interval; HR: Hazard Ratio; IARC: International Agency for Research on Cancer; mRE: Meta-risk Estimate; OR: Odds Ratio; PSA: Prostate Specific Antigen; RR: Relative Risk; SIR: Standardized Incidence Ratio; SMR: Standardized Mortality Ratio

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## Data availability statements

All data generated or analyzed during this study are included in this published article.

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## Authors' contributions

The corresponding author, JS, is the main contributor in the design and conceptualization of the study, analysis and interpretation of the data, drafting the work and revising content critically, final approval of the work to be published. MP contributed to the design and conceptualization of the study, analysis and interpretation of the data, drafting and revising the work critically, and final approval of the version to be published. PD contributed to the conceptualizing and design of the study, acquisition and interpretation of the data, drafting the work and revising content critically, and final approval of the work to be published. SH and DC contributed to the design and interpretation of the work, drafting and revising content critically, and final approval of the version to be published. MEP contributed to the design and conceptualization of the study, interpretation of the data, drafting and revising the work critically, and final approval of the version to be published.

## Ethics approval and consent to participate

Not Applicable.

## Consent for publication

Not Applicable.

## Competing interests

The authors declare that they have no competing interests.

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## References

- International Agency for Research on Cancer. GLOBOCAN 2012: estimated cancer incidence, mortality and prevalence worldwide in 2012. Lyon IARC. 2016. [http://globocan.iarc.fr/Pages/fact\\_sheets\\_cancer.aspx](http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx). Accessed 5 May 2017.
- Canadian Cancer Society. Prostate cancer statistics. 2015. <http://www.cancer.ca/en/cancer-information/cancer-type/prostate/statistics/?region=on>. Accessed 5 May 2017.
- Dy GW, Gore JL, Forouzanfar MH, Naghavi M, Fitzmaurice C. Global burden of urologic cancers, 1990–2013. *Eur Urol*. 2017;71:437–336.
- Plato BA, Concepcion MT. Prostate cancer epidemiology. *Arch Esp Urol*. 2014;67(5):373–82.
- Bashir MN. Epidemiology of prostate cancer. *Asian Pac J Cancer Prev*. 2015; 16:5137–41.

6. Singh GK, Jemal A. Socioeconomic and racial/ethnic disparities in cancer mortality, incidence, and survival in the United States, 1950–2014: over six decades of changing patterns and widening inequalities. *J Environ Public Health*. 2017;2819372:1–19.
7. Zuccolo L, Harris R, Gunnell D, Oliver S, Lane JA, Davis M, Donovan J, Neal D, Hamdy F, Beynon R, Savovic J, Martin RM. Height and prostate cancer risk. *Cancer Epidemiol Biomark Prev*. 2008;17(9):2325–36.
8. Zhao J, Stockwell T, Roemer A, Chikritzhis T. Is alcohol consumption a risk factor for prostate cancer? A systematic review and meta-analysis. *BMC Cancer*. 2016;16:845.
9. Parikesit D, Mochtar CA, Umbas R, Hamid ARAH. The impact of obesity towards prostate diseases. *Prostate Int*. 2016;4(1):1–6.
10. Freedland SJ, Aronson WJ. Examining the relationship between obesity and prostate cancer. *Rev Urol*. 2004;6(2):73–81.
11. Zeegers MPA, Friesema IHM, Goldbohm RA, van den Brandt PA. A prospective study of occupation and prostate cancer risk. *J Occup Environ Med*. 2004;46(3):271–9.
12. Sauve JF, Lavoue J, Parent ME. Occupation, industry and the risk of prostate cancer: a case–control in Montreal, Canada. *Environ Health*. 2016;15:100.
13. Parent M-É, Siemiatycki J. Occupation and prostate cancer. *Epidemiol Rev*. 2001;23(1):138–43.
14. LeMasters GK, Genaidy AM, Succop P, Deddens J, Sobieih T, Barriera-Viruet H, et al. Cancer risk among firefighters: a review and meta-analysis of 32 studies. *J Occup Environ Med*. 2006;48(11):1189–201.
15. Wirth M, Vena JE, Smith EK, Bauer SE, Violanti J, Burch J. The epidemiology of cancer among police officers. *Am J Ind Med*. 2013;56(4):439–53.
16. The International Agency for Research on Cancer. Painting, firefighting, and shiftwork. Lyon; IARC. 2010. <http://monographs.iarc.fr/ENG/Monographs/vol98/mono98.pdf>. Accessed 13 Apr 2017.
17. Pukkala E, Martinsen JI, Weiderpass E, Kjaerheim K, Lyng E, Tryggvadottir L, Sørensen P, Demers PA. Cancer incidence among firefighters: 45 years of follow-up in five Nordic countries. *Occup Environ Med*. 2014;71:398–404.
18. Howe GR, Burch JD. Fire fighters and risk of cancer: an assessment and overview of the epidemiologic evidence. *Am J Epidemiol*. 1990;132:1039–50.
19. Vena JE, Charles LE, Gu JK, Burchfiel CM, Andrew ME, Fekedulegn D, Violanti JM. Mortality of a police cohort: 1950–2005. *J Law Enforc Leadersh Ethics*. 2014;1(1):7–20.
20. Finkelstein MM. Cancer incidence among Ontario police officers. *Am J Ind Med*. 1998;34:157–62.
21. Downs, Black. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health*. 1998; 52:377–284.
22. Higgins JPT, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Stat Med*. 2002;21:1539–58.
23. Bax L, Ikeda N, Fukui N, Yaju Y, Tsuruta H, Moons KGM. More than numbers: the power of graphs in meta-analysis. *Am J Epidemiol*. 2009;169(2):249–55.
24. Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. *Biometrics*. 1994;50(4):1088–101.
25. Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *BMJ*. 1997;315:629–34.
26. Ma F, Fleming LE, Lee DJ, Trapido E, Gerace TA, Lai H, Lai S. Mortality in Florida professional firefighters, 1972–1999. *Am J Ind Med*. 2005;47:509–17.
27. Ma F, Fleming LE, Lee DJ, Trapido E, Gerace TA. Cancer incidence in Florida professional firefighters, 1981 to 1999. *J Occup Environ Med*. 2006;48(9): 883–8.
28. Demers PA, Checkoway H, Vaughan TL, Weiss NS, Heyer NJ, Rosenstock L. Cancer incidence among firefighters in Seattle and Tacoma, Washington (United States). *Cancer Causes Control*. 1994;5:129–35.
29. Demers PA, Heyer NJ, Rosenstock L. Mortality among firefighters from three northwestern United States cities. *Br J Ind Med*. 1992;49:664–70.
30. Daniels RD, Bertke S, Dahm MM, Yiin JH, Kubale TL, Hales TR, Baris D, Zahm SH, Beaumont JJ, Waters KM, Pinkerton LE. Exposure-response relationships for select cancer and non-cancer health outcomes in a cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009). *Occup Environ Med*. 2015;72(10):699–706.
31. Tornling G, Gustavsson P, Hogstedt C. Mortality and cancer incidence in Stockholm fire fighters. *Am J Ind Med*. 1994;25:219–28.
32. Daniels RD, Kubale TL, Yiin JH, Dahm MM, Hales TR, Baris D, Zahm SH, Beaumont JJ, Waters KM, Pinkerton LE. Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009). *Occup Environ Med*. 2014;71(6):388–97.
33. Beaumont JJ, Chu GST, Jones JR, Schenker MB, Singleton JA, Plantanida LG, Reiterman M. An epidemiologic study of cancer and other causes of mortality in San Francisco firefighters. *Am J Ind Med*. 1991;19:357–72.
34. von Hippel PT. The heterogeneity statistic  $I^2$  can be biased in small meta-analyses. *BMC Med Res Methodol*. 2015;15:35.
35. Rao D, Yu H, Bai Y, Zheng X, Xie L. Does night-shift work increase the risk of prostate cancer? A systematic review and meta-analysis. *Oncol Targets Ther*. 2015;8:2817–26.
36. Weichenthal S, Lavigne E, Valois MF, Hatzopoulou M, Van Ryswyk K, Shekarrizfard M, Villeneuve P, Goldberg M, Parent M-É. Spatial variations in ambient ultrafine particle concentrations and the risk of incident prostate cancer: a case–control study. *Environ Res*. 2017;156:374–80.
37. Parent M-É, Goldberg MS, Crouse DL, Ross NA, Chen H, Valois MF, Liautaud A. Traffic-related air pollution and prostate cancer risk in Montreal Canada. *Occup Environ Med*. 2013;70:511–8.
38. International Agency for Research on Cancer. List of classifications by cancer site with sufficient or limited evidence in humans, volumes 1 to 119. Lyon: IARC. 2017. [http://monographs.iarc.fr/ENG/Classification/ Table4.pdf](http://monographs.iarc.fr/ENG/Classification/Table4.pdf). Accessed 5 July 2017.
39. Flynn-Evans EE, Mucci L, Stevens RG, Lockley SW. Shiftwork and prostate-specific antigen in the National Health and nutrition examination survey. *J Natl Cancer Inst*. 2013;105(17):1292–7.
40. Parent ME, El-Zein M, Rousseau MC, Pintos J, Siemiatycki J. Night work and the risk of cancer among men. *Am J Epidemiol*. 2012;176(9):751–9.
41. Papanitoniou K, Castano-Vinyals G, Espinosa A, Aragones N, Perez-Gomez B, Burgos J, Gomez-Acebo I, Llorca J, Peiro R, Jimenez-Moleon JJ, Arredondo F, Tardon A, Pollan M, Kogevinas M. Night shift work, chronotype and prostate cancer risk in the MCC-Spain case–control study. *Int J Cancer*. 2015;137(5):1147–57.
42. Fekedulegn D, Burchfiel CM, Hartley TA, Andrew ME, Charles LE, Tinney-Zara CA, Violanti JM. Shiftwork and sickness absence among police officers: the BCOPS study. *Chronobiol Int*. 2013;30(7):930–41.
43. Moreno-Smith M, Lutgendorf SK, Sood AK. Impact of stress on cancer metastasis. *Future Oncol*. 2010;6(12):1863–81.
44. Violanti JM, Vena JE, Petralia S. Mortality of a police cohort: 1950–1990. *Am J Ind Med*. 1998;33:366–73.
45. Blanc-Lapierre A, Rousseau MC, Weiss D, El-Zein M, Siemiatycki J, Parent ME. Lifetime report of perceived stress at work and cancer among men: a case–control study in Montreal Canada. *Prev Med*. 2016;96:28–35.
46. International Association of Firefighters. Annual cancer screening and medical evaluations for firefighters. Ottawa: IAFF. 2017. [http://www.iaff1782.org/index.cfm?zone=/unionactive/view\\_article.cfm&HomeID=68377&page=Health20and20Safety](http://www.iaff1782.org/index.cfm?zone=/unionactive/view_article.cfm&HomeID=68377&page=Health20and20Safety). Accessed 11 July 2017.
47. Strand LA, Martinsen JI, Borud EK. Cancer incidence and all-cause mortality in a cohort of 21 582 Norwegian military peacekeepers deployed to Lebanon during 1978–1998. *Cancer Epidemiol*. 2017;39:571–7.
48. Yi SW. Cancer incidence in Korean Vietnam veterans during 1992–2003: the Korean veterans health study. *J Prev Med Public Health*. 2013;46:309–18.
49. Armed Forces Health Surveillance Center. Incidence diagnoses of cancers and cancer-related deaths, active component, U.S. armed forces, 2000–2011. *Med Surveill Mon Rep*. 2012;19(6):18–22.
50. Strand LA, Martinsen JI, Koefoed VF, Sommerfelt-Pettersen J, Grimsrud TK. Cause-specific mortality and cancer incidence among 28 300 royal Norwegian navy servicemen followed for more than 50 years. *Scand J Work Environ Health*. 2011;37(4):307–15.
51. Rogers D, Boyd DD, Fox EE, Cooper S, Goldhagen M, Shen Y, del Junco DJ. Prostate cancer incidence in air force aviators compared with non-aviators. *Aviat Space Environ Med*. 2011;82(11):1067–70.
52. Cypel Y, Kang H. Mortality patterns of army chemical corps veterans who were occupationally exposed to herbicides in Vietnam. *Ann Epidemiol*. 2010;20(5):339–46.
53. Young HA, Maillard JD, Levine PH, Simmens SJ, Mahan CL, Kang HK. Investigating the risk of cancer in 1990–1991 US gulf war veterans with the use of state cancer registry data. *Ann Epidemiol*. 2010;20(4):265–72.
54. Storm HH, Jorgensen HO, Kejs AMT, Engholm G. Depleted uranium and cancer in Danish Balkan veterans deployed 1992–2001. *Eur J Cancer*. 2006; 42:2355–8.
55. Yamane GK. Cancer incidence in the U.S. air force: 1989–2002. *Aviat Space Environ Med*. 2006;77:7789–94.

56. Akhtar FZ, Garabrant DH, Ketchum NS, Michalek JE. Cancer in the US air force veterans of the Vietnam war. *J Occup Environ Med*. 2004;46(2):123–36.
57. Silva M, Santana VS, Loomis D. Cancer mortality among service men in the Brazilian navy. *Rev Saude Publica*. 2000;34(4):373–9.
58. Watanabe KK, Kang HK. Mortality patterns among Vietnam veterans. *J Occup Environ Med*. 1996;38(3):272–8.
59. Darby SC, Muirhead CR, Doll R, Kendall GM, Thakrar B. Mortality among United Kingdom servicemen who served abroad in the 1950s and 1960s. *Br J Ind Med*. 1990;47:793–804.
60. Leavy J, Gini A, Lin F. Vietnam military service history and prostate cancer. *BMC Public Health*. 2006;6:75.
61. Sanderson M, Coker AL, Logan P, Zheng W, Fadden MK. Lifestyle and prostate cancer among older African-American and Caucasian men in South Carolina. *Cancer Causes Control*. 2004;15:647–55.
62. Giri VN, Cassidy AE, Beebe-Dimmer J, Smith DC, Bock CH, Cooney KA. Association between agent orange and prostate cancer: a pilot case–control study. *Urology*. 2004;63:757–61.
63. Glass DC, Pircher S, Del Monaco A, Vander Hoorn S, Sim MR. Mortality and cancer incidence in a cohort of male paid Australian firefighters. *Occup Environ Med*. 2016;73:761–71.
64. Brice A, Jean-Luc M, Frederic M, Stephane D, Gaelle C, Simone MP, Christian L, Ellen I, Patrick B. French firefighter mortality: analysis over a 30-year period. *Am J Ind Med*. 2015;58:437–43.
65. Ahn YS, Jeong KS, Kim KS. Cancer morbidity of professional emergency responders in Korea. *Am J Ind Med*. 2012;55:768–78.
66. Baris D, Garrity TJ, Telles JL, Heineman EF, Olshan A, Zahm SH. Cohort mortality study of Philadelphia firefighters. *Am J Ind Med*. 2001;39:463–76.
67. Bates MN, Fawcett J, Garrett N, Arnold R, Pearce N, Woodward A. Is testicular cancer an occupational disease of fire fighters? *Am J Ind Med*. 2001;40:263–70.
68. Aronson KJ, Tomlinson GA, Smith L. Mortality among fire fighters in metropolitan Toronto. *Am J Ind Med*. 1994;26:89–101.
69. Giles G, Staples M, Berry J. Cancer incidence in Melbourne metropolitan fire brigade members, 1980–1989. *Health Rep Stat Can*. 1993;5(1):1–38.
70. Guidotti TL. Mortality of urban firefighters in Alberta, 1927–1987. *Am J Ind Med*. 1993;23:921–40.
71. Grimes G, Hirsch D, Borgeson D. Risk of death among Honolulu fire fighters. *Hawaii Med J*. 1991;50(3):82–5.
72. Vena JE, Fiedler RC. Mortality of a municipal-worker cohort: IV. Fire fighters. *Am J Ind Med*. 1987;11:671–84.
73. Tsai RJ, Luckhaupt SE, Schumacher P, Cress RD, Deapen DM, Calvert GM. Risk of cancer among firefighters in California, 1988–2007. *Am J Ind Med*. 2015;58(7):715–29.
74. Kang D, Davis LK, Hunt P, Kreibel D. Cancer incidence among male Massachusetts firefighters, 1987–2003. *Am J Ind Med*. 2008;51:329–35.
75. Krstev S, Baris D, Stewart P, Dosemeci M, Swanson GM, Greenberg RS, Schoenberg JB, Schwartz AG, Liff JM, Hayes RB. Occupational risk factors and prostate cancer in U.S. blacks and whites. *Am J Ind Med*. 1998;34:421–30.
76. Gu JK, Charles LE, Burchfiel CM, Andrew ME, Violanti JM. Cancer incidence among police officers in a U.S. northeast region: 1976–2006. *Int J Emerg Mental Health*. 2011;13(4):279–89.
77. Forastiere F, Perucci CA, Di Pietro A, Miceli M, Rapiti E, Bargagli A, Borgia P. Mortality among urban policemen in Rome. *Am J Ind Med*. 1994;26:785–98.
78. Boucharly C, Schuler G, Minder C, Hotz P, Bousquet A, Levi F, Fisch T, Torhorst J, Raymond L. Cancer risk by occupation and socioeconomic group among men – a study by the association of swiss cancer registries. *Scand J Work Environ Health*. 2002;28 suppl(1):1–88.
79. Sriitharan J, Demers PA, Harris SA, Cole DC, Peters CE, the Canadian Cancer Registries Epidemiology Research Group, Villeneuve PJ. Occupation and risk of prostate cancer in Canadian men: a case–control study across eight Canadian provinces. *Cancer Epidemiol*. 2017a;48:96–103.
80. Sriitharan J, Demers PA, Harris SA, Cole DC, Kreiger N, Sass-Korstak A, Lightfoot N. Natural resource-based industries and prostate cancer risk in northeastern Ontario: a case–control study. *Occup Environ Med*. 2016;73:506–11.

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## Risk of Cancer Among Firefighters in California, 1988–2007

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### Abstract

**Background**—Most studies of firefighter cancer risks were conducted prior to 1990 and do not reflect risk from advances in building materials.

**Methods**—A case–control study using California Cancer Registry data (1988–2007) was conducted to evaluate the risk of cancer among firefighters, stratified by race.

**Results**—This study identified 3,996 male firefighters with cancer. Firefighters were found to have a significantly elevated risk for melanoma (odds ratio [OR]=1.8; 95% confidence interval [CI] 1.4–2.1), multiple myeloma (OR 1.4; 95%CI 1.0–1.8), acute myeloid leukemia (OR 1.4; 95% CI 1.0–2.0), and cancers of the esophagus (OR 1.6;95%CI 1.2–2.1), prostate (OR 1.5; 95%CI 1.3–1.7), brain (OR 1.5; 95%CI 1.2–2.0), and kidney (OR 1.3; 95%CI 1.0–1.6).

**Conclusions**—In addition to observing cancer findings consistent with previous research, this study generated novel findings for firefighters with race/ethnicity other than white. It provides additional evidence to support the association between firefighting and several specific cancers.

### Keywords

cancer; firefighters; occupation; registry; risk

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## INTRODUCTION

Firefighting is considered one of the most hazardous occupations [Guidotti, 1993]. In 2013, there were about 354,600 (31%) career firefighters and 786,150 (69%) volunteer firefighters in the United States [National Fire Protection Association, 2014]. Firefighters are expected to perform under stressful conditions and are at risk for physical, biological, and chemical-related injuries and illnesses, including cancer [Melius, 2001].

Firefighters are often exposed to known carcinogens in their line of work [Stefanidou et al., 2008]. Additionally, the introduction of newer building materials beginning approximately 40 years ago (e.g., engineered thermoplastics such as polyvinylidene fluoride, and laminated veneer lumber), may expose firefighters to potentially new carcinogenic combustion products [Beaumont et al., 1991; Grundahl, 1992]. The burning of plastics found in home appliances, furniture, and electronics may also introduce firefighters to new carcinogens [Korst, 2012]. While the use of a self-contained breathing apparatus (SCBA) can eliminate or significantly decrease respiratory exposure to toxic particles during firefighting [Bates, 2007], SCBAs are not always worn, especially during overhaul. Overhaul is a late-stage in fire suppression when the burned area is inspected for flammable sources that can rekindle a fire. During overhaul, firefighters can be exposed to combustion products through disassembling walls or removing furniture [Bates, 2007]. Furthermore, even when SCBAs are worn, firefighters can absorb combustion products through the unprotected skin on their neck [Fent et al., 2014]. Several combustion products are classified by the International Agency for Research on Cancer (IARC) as carcinogenic to humans (Group 1), probably carcinogenic to humans (Group 2A) or possibly carcinogenic to humans (Group 2B). These combustion products include benzene (Group 1), benzo[a]pyrene (Group 1), vinyl chloride (Group 1), formaldehyde (Group 1), 1, 3-butadiene (Group 1), and polychlorinated biphenyls (PCBs) (Group 1) [Melius, 2001; Stefanidou et al., 2008; International Agency for Research on Cancer, 2015]. Firefighters may also be exposed to asbestos (Group 1) and lead (Group 2A) when present in burning buildings [International Agency for Research on Cancer, 2015]. Non-fire-related exposures may also increase cancer risk, as firefighters can be exposed to diesel exhaust from fire trucks, and diesel exhaust was found to be associated with increased cancer risks [International Agency for Research on Cancer, 2015].

Studies have found that firefighting is significantly associated with an increased risk for developing the following cancers: colorectal [Vena and Fiedler, 1987; Burnett et al., 1994; Baris et al., 2001; Daniels et al., 2014], lung [Pukkala et al., 2014; Daniels et al., 2015], melanoma [Howe and Burch, 1990; Sama et al., 1990], prostate [Grimes et al., 1991; Demers et al., 1994; LeMasters et al., 2006], testis [LeMasters et al., 2006; Ma et al., 2006], urinary bladder [Vena and Fiedler, 1987; Sama et al., 1990; Ma et al., 2006], kidney [Burnett et al., 1994; Delahunt et al., 1995; Daniels et al., 2014], brain [Grimes et al., 1991; Demers et al., 1992; Aronson et al., 1994; Ma et al., 2006], myeloma [LeMasters et al., 2006], non-Hodgkin lymphoma [Burnett et al., 1994; Figgs et al., 1995; Golden et al., 1995], and leukemia [Morton and Marjanovic, 1984; Golden et al., 1995; Baris et al., 2001; Daniels et al., 2015]. In recognition of these cancer risks, as of 2015, a total of 33 states cover firefighters for one or more cancers under workers' compensation as a result of presumption legislation [International Association of Fire Fighters, 2015]. In 20 of these states, the

language in the presumption legislation contains broad or nonspecific language that can be interpreted to cover any cancer experienced by a firefighter. In the other 13 states, only certain specific cancers are covered, most commonly leukemia (12 states), brain cancer (10 states), bladder cancer (9 states), non-Hodgkin lymphoma (9 states), and gastrointestinal cancer (8 states).

Ongoing assessment of cancer risks among firefighters is needed because of inconsistent findings across previous studies [International Agency for Research on Cancer, 2010], and because most studies were conducted prior to 1990 which may limit their ability to detect new risks arising from advances in building materials. In addition, few studies have examined the cancer risks among firefighters of other race/ethnicity. This study aims to update and expand a previous study by Bates [Bates, 2007], assessing cancer risks among firefighters using data from the California Cancer Registry (CCR). In addition, this is one of the first studies to include an examination of firefighter risk for subtypes of leukemia, esophageal cancer and lung cancer, and cancer risks among firefighters of other race/ethnicity (e.g., blacks and Hispanics).

## MATERIALS AND METHODS

### California Cancer Registry (CCR)

CCR is a population-based cancer surveillance system that collects data on all cancers (excluding non-melanoma skin cancers and in-situ cervical carcinoma) among California residents. It is estimated that at least 95% of cancer cases are ascertained by CCR [North American Association of Central Cancer Registries, 2015]. Cancer reporting has been mandated by California law since 1985 and CCR has collected statewide cancer data from doctors, hospitals, and other medical facilities since January 1, 1988. Data collected by CCR include demographics, cancer characteristics, and cancer treatments. Information on the industry and occupation (I&O) of the job held longest by each case are also collected in narrative form. CCR provided the National Institute for Occupational Safety and Health (NIOSH) with de-identified cancer data collected from 1988 to 2007. Because this is a public health surveillance study with analyses conducted on anonymous data without links to personal identifiers, it was exempted from review by the NIOSH Institutional Review Board.

### Firefighter Definition

To identify all cancer cases among firefighters, the I&O narrative fields were extensively searched for key words consistent with firefighting. The identified I&Os were coded using 1990 Bureau of Census (BOC) codes. Occupation codes used to indicate a career in firefighting are 413, 416, and 417. All firefighters with these codes were selected regardless of industry. The BOC manual states that the 417 code includes firefighters, fire chief's aides, smoke jumpers, forest-fire fighters, and crash-crew men [U.S. Department of Commerce, 2000]. Their main duties are to control and extinguish fires that threaten life, property or environment, fire prevention, emergency medical service, hazardous material response, search and rescue, and disaster management [U.S. Department of Commerce, 2000]. A total

of 29 search terms (e.g., firefighter, fire crew worker) were used to identify and code individuals as BOC code 417.

Individuals who work at a fire department but do not usually carry out firefighting duties have a BOC occupation code of 413 or 416. BOC code 413 indicates positions that supervise and coordinate the firefighter's activities, as well as participate in fire prevention and control [U.S. Department of Commerce, 2000]. A total of 11 search terms (e.g., fire captain, fire chief, and fire marshal) were used to identify and code individuals as BOC code 413. BOC code 416 refers to positions that inspect buildings and firefighting equipment for fire hazards, enforce state and local fire-related ordinances, determine cause of fires or explosions, and recommend fire prevention measures [U.S. Department of Commerce, 2000]. A total of 23 search terms (e.g., fire inspector, arson investigator, forest fire control officers, fire ranger, fire warden, and fire lookout) were used to identify and code individuals as BOC 416. Many of these individuals (i.e., those with BOC codes 413 or 416) likely started their career as firefighters (BOC code 417) and were labeled as firefighters in this study. Because our findings were very similar whether firefighters were defined as BOC code 417 only versus combining 413, 416, and 417, to maximize sample size we report only the findings for the combined definition.

Cancer cases can have multiple cancer records at CCR if they were diagnosed with the same primary cancer multiple times or diagnosed with two or more primary cancers at different times. A separate cancer record is created for each cancer diagnosis or recurrence. The I&O assigned to these cases with multiple cancer records were the I&O present at the initial diagnosis because I&O information from the earliest record is thought to provide the best indication for longest-held job. In addition, some individuals were found to have more than one primary cancer at initial diagnosis. CCR assigned the cancer with the worse prognosis as the "first" primary.

### Exclusion Criteria

This study included only adult male subjects (18–97 years of age) who had I&O information available. Excluded were females, homemakers, those with insufficient I&O narratives (e.g., narratives that mentioned only unemployed, disabled, or retired, or were blank), those who never worked, and those in the military.

### Selection of Cases and Control Cancers

In situ and benign tumors were excluded. Cancers that spread into surrounding tissues (malignant/invasive), and were identified as the first "malignant" primary were included in this study. The cancer risk among firefighters was assessed for all cancers that included at least 10 firefighters. Control cancers were selected after reviewing the literature for cancers that appeared to have little or no association with firefighting and its related exposures. These control cancers were cancers of the pharynx, stomach, liver, and pancreas. Cancers and histological subtypes were defined using Surveillance, Epidemiology, and End Results Program (SEER) recodes.



## Data Analysis

SAS<sup>®</sup> 9.3 (Research Triangle Institute, Research Triangle Park, NC) was used. For each type of cancer analyzed, the proportion of cases who were firefighters was compared to the proportion of control cancer cases who were firefighters. Unconditional logistic regression was used to calculate odds ratios (OR) and ORs were adjusted for age at diagnosis (5-year intervals), year of diagnosis (5-year intervals), and race. The Wald test was used to test the level of statistical significance and was defined by a  $P < 0.05$ .

The risk of cancer among firefighters was examined in three ways: (i) all firefighters combined, (ii) firefighters of other race/ethnicity (i.e., blacks, Hispanics, Asians/Pacific islanders, Indian/Alaskan natives, other/unknown) and, (iii) white firefighters. Analyses of case and control groups were restricted by race category. That is, when other races/ethnicities were assessed, only other races/ethnicities were included in the case and control groups. The analyses involving only whites were handled similarly. All cancers examined and reported in the “all firefighters combined” group, were also examined and reported in the race-stratified groups.

## RESULTS

A total of 2,470,496 cancer reports did not meet the eligibility requirements and were excluded from analysis (Table I). The study sample was selected from 678,132 cancer subjects diagnosed in California who met all eligibility requirements. A total of 48,725 of those in the study sample had a control cancer. Among the control cancers, 31% were diagnosed with pancreatic cancer, 29% with stomach cancer, 23% with liver cancer, and 18% with pharyngeal cancer.

The study sample included 3,996 firefighters. Compared to non-firefighters, firefighters in the study sample were slightly but significantly older (aged 63.3 years vs. 62.6 years) and more likely to be white (90.2% vs. 74%).

Among the 32 examined cancers, three were significantly elevated among all firefighters combined and among firefighters in both race groups (Tables II–IV). These three cancers were melanoma, prostate cancer, and brain cancer.

Three cancers were significantly elevated among all firefighters combined and among white firefighters: adenocarcinoma of the esophagus; non-specific, non-small cell lung cancer; and, acute myeloid leukemia (AML). Three cancers were significantly elevated among all firefighters combined and firefighters of other race/ethnicity: kidney cancer, multiple myeloma, and overall leukemia.

There were six cancers that were significantly elevated among firefighters of other race/ethnicity only: tongue cancer, testicular cancer, bladder cancer, non-Hodgkin lymphoma, chronic lymphocytic leukemia (CLL), and chronic myeloid leukemia (CML). Neither of the two other groups (i.e., all firefighters combined and white firefighters) had a significantly elevated cancer risk that was unique (i.e., that was not observed in at least one of the other two groups).

There were 18 cancers for which a significantly elevated risk was not found among any firefighter group. These were: cancer of the lip; cancer of the salivary gland; gum and other mouth cancer; pharyngeal cancer; esophageal squamous carcinoma; stomach cancer; colorectal cancer; liver cancer; pancreatic cancer; laryngeal cancer; four lung cancer subtypes (i.e., adenocarcinoma, squamous cell carcinoma, small cell carcinoma, and large cell carcinoma); soft tissue sarcoma; mesothelioma; thyroid cancer; and Hodgkin lymphoma.

## DISCUSSION

To our knowledge, this study included more firefighters with cancer than any previous study. This allowed us to assess the association between firefighters and the development of 32 cancers in all firefighters combined, white firefighters, and firefighters of other race/ethnicity. Of the 32 cancers assessed in this analysis of CCR data from 1988 to 2007, the risk for 14 cancers was significantly elevated in one or more firefighter groups. Firefighters of other race/ethnicity had significantly increased risk for more cancers than white firefighters. These findings warrant the need for further investigation of cancer risks among firefighters of other race/ethnicity.

### Comparison With a Pooled Cohort of Firefighters from San Francisco, Chicago, and Philadelphia

Daniels et al. [2014] reported mortality and cancer registry findings for firefighters who were employed for at least one day between 1950 and 2009 in fire departments that served San Francisco, Chicago, or Philadelphia. Their findings were similar to ours. Both Daniels et al. [2014] and our study found elevated risks for esophageal and kidney cancer among all firefighters combined and prostate cancer among firefighters of other race/ethnicity. In addition, Daniels et al. [2014] also found significantly elevated risks for melanoma and brain cancer incidence among San Francisco firefighters only, which were also elevated in our study of firefighters in the entire state of California. However, differences were identified when we compared the Daniels et al. [2014] overall findings (all three cities combined) with our study results. Daniels et al. [2014], unlike our study, found a significantly increased risk for mesothelioma and cancers of the pharyngeal/buccal cavity (including lip, tongue, other buccal, and pharynx), colon, larynx, and lung. Our study, unlike Daniels et al. [2014], found an increased risk for non-Hodgkin lymphoma and overall leukemia among all firefighters combined, and an increased risk for testicular cancer, bladder cancer, and multiple myeloma among firefighters of other race/ethnicity. Study design dissimilarities that may explain some of the differences in findings include: (i) the types of firefighters included (structural firefighters in Daniels et al. [2014] vs. all firefighters in ours); (ii) location of fire departments (Daniels et al. [2014] studied three major US cities, whereas we studied California); (iii) Daniels et al. [2014] used a retrospective cohort study design whereas we used a case–control study approach involving cancer registry data only; (iv) Daniels et al. [2014] had a smaller sample size of firefighters of other race/ethnicity with cancer; (v) inclusion of study participants for Daniels et al. [2014] was based on year employed (i.e., between 1950 and 2009), whereas ours was based on year of cancer diagnosis (i.e., between

1988 and 2007); and (vi) inclusion of female firefighters in Daniels et al. [2014] but not in our study.

### **Comparison With Another Large Firefighter Study and a Meta-Analysis**

Two other reports are notable for including large numbers of firefighters: Pukkala et al. [2014] and a meta analysis by LeMasters et al. [2006]. Like our study, Pukkala et al. [2014] and LeMasters et al. [2006] found firefighters to be at significantly increased risk for melanoma and prostate cancer. In addition, our study and LeMasters et al. [2014] found a significantly increased risk for brain cancer and non-Hodgkin lymphoma. Additionally, our study (i.e., only in firefighters of other race/ethnicity) and LeMasters et al. [2006] found an increased risk for multiple myeloma and testicular cancer. Unlike our study, neither Pukkala et al. [2014] or LeMasters et al. [2006] found increased risks for leukemia, or cancers of the esophagus, bladder, or kidney. Differences in findings between Pukkala et al. [2014] and our study may be attributed to sample size (2,536 firefighters with cancer in Pukkala et al. [2014] vs. 3,996 in ours), and differences in geographic region studied (Nordic countries in Pukkala et al. [2014] vs. the state of California).

### **Commonly Observed Increased Cancer Risks Among Firefighters**

The only two cancers consistently found significantly elevated in three large studies [Daniels et al., 2014, Pukkala et al., 2014, and ours] and a meta-analysis [LeMasters et al., 2006] were melanoma and prostate cancer. Significant elevations in two of the studies/meta-analysis, were observed for non-Hodgkin lymphoma, multiple myeloma, and cancers of the tongue, esophagus, colon, testis, kidney, and brain. Significantly increased risks identified in at least one large study/meta-analysis but not ours included: larynx [Daniels et al., 2014]; lung and bronchus [Daniels et al., 2014; Pukkala et al., 2014]; mesothelioma [Daniels et al., 2014]; colon cancer [LeMasters et al., 2006; Daniels et al., 2014] and stomach cancer [LeMasters et al., 2006].

### **Comparison With Bates [2007]**

A previous study by Bates also assessed cancer risks among firefighters using CCR data; however, Bates did not conduct analyses by race and did not examine as many cancers [Bates, 2007]. Both Bates and our study found a significantly increased risk for esophageal, melanoma, prostate, and brain cancers among all firefighters combined. Cancers significantly elevated in one or more of the firefighter groups in our study, but not in Bates were bladder cancer, kidney cancer, non-Hodgkin lymphoma, multiple myeloma, and leukemia. No cancers were significantly elevated in Bates and not in our study.

In addition to conducting analyses by race, there were other differences in study design that likely explain at least some of the differences observed between Bates and our study. These include: (i) Our study used a more exhaustive keyword search for firefighters; (ii) Our study used four more years of data, as our study collected data from 1988 to 2007, while Bates only included data from 1988 to 2003; (iii) Differences in the cancers selected to serve as controls. For each examined cancer, Bates used all other cancers as the controls. In contrast, our study used cancers not thought to be associated with firefighting (i.e., cancers of the pharynx, stomach, liver, and pancreas); (iv) Our study examined more cancers. Only one

cancer examined in our study but not by Bates had a significantly elevated risk: cancer of the tongue.

### Firefighters of Other Race/Ethnicity

Firefighters of other race/ethnicity had significantly elevated risks for 12 cancers (tongue, melanoma, prostate, testicular, bladder, kidney, brain, non-Hodgkin, multiple myeloma, leukemia [overall], CLL, and CML). In contrast, only six cancers were significantly elevated among white firefighters.

Most of the 365 firefighters of other race/ethnicity in our study were Hispanic (62.2%) or black (27.7%). Since Hispanics and blacks generally have higher incidence rates for cancers than Asians [United States Cancer Statistics Working Group, 2014] and less than 10% of firefighters of other race/ethnicity were Asians, cancer risks observed among firefighters of other race/ethnicity were most likely driven by the Hispanic and black firefighters.

The reasons for the race/ethnicity-associated differences in our findings are unclear. Race/ethnicity is related to general constraints that can lead to differential access to opportunities in society [Jones, 2001]. In addition, those of other race/ethnicity have historically been subjected to prejudice and discrimination [Jones, 2001], including those seeking employment or promotion in fire departments [Ricucci and Saldivar, 2014]. Furthermore, those of other race/ethnicity may have selectively been assigned to busier fire stations. This is supported by studies of other industries that demonstrated that workers of other race/ethnicity may be more frequently exposed to occupational hazards than white workers [Birdsey et al., 2007]. These societally imposed conditions, as experienced by firefighters of other race/ethnicity, may lead to differential exposure to carcinogens or may heighten susceptibility to the effects of carcinogenic exposures.

To our knowledge, only two other studies reported cancer risks among firefighters of other race/ethnicity: Daniels et al. [2014] and Ma et al. [1998]. Ma et al. [1998] looked only at black firefighters, whereas Daniels et al. [2014] did not report the race/ethnicity distribution of firefighters of other race/ethnicity. Our study included more firefighters of other race/ethnicity with cancer (n=365) than Daniels et al. [2014] or Ma et al. [1998] (n=240 and n=66, respectively). Daniels et al. [2014] found only prostate cancer at significantly increased risk among firefighters of other race/ethnicity. Ma et al. [1998] found significantly increased risks for cancers of the prostate and brain among firefighters of other race/ethnicity, as in our study; they also found significant increases in nasopharyngeal and colon cancers, unlike our study. Differences between Ma et al. [1998] and our study may be due to our inclusion of nonwhite race/ethnicity other than blacks in our study, and different study periods. In addition, our larger study population of other race/ethnicity may have allowed us to detect more differences. Moreover, the evolving mix of carcinogenic exposures among firefighters may have also affected the types of cancer that were observed.

### Prostate Cancer

The prostate is a hormone-regulated gland (i.e., testosterone). Chemicals, such as pesticides, cadmium, Bisphenol A (BPA), or PCB, have been shown to be endocrine disruptors [Diamanti-Kandarakis et al., 2009] that interfere with androgen metabolism. This disruption

elevates the bioavailability of androgen which can initiate prostate cancer. The increased prostate cancer risk could also be due to an increased frequency of prostate cancer screening among firefighters as compared to the general population. Such a screening effect is supported by a recent study showing a lack of a positive dose-response relationship between fire-fighting exposure and prostate cancer incidence and mortality [Daniels et al., 2015].

### Melanoma

Although exposure to ultraviolet radiation (i.e., sunlight, tanning beds) is commonly associated with melanoma, melanoma has also been found on the unexposed skin of petrochemical refinery workers [Mehlman, 2006]. Researchers have found a significant positive association between melanoma and exposure to benzene, PAH, PCB, aromatic hydrocarbons, and heavy oil [Mehlman, 2006].

### Esophageal Cancer

The inhalation of smoke and dust during fire suppression activities and overhaul may have contributed to an increased risk of esophageal cancer. It is possible that mucociliary clearance of combustion products in the trachea led to esophageal irritation and inflammation. The inflammatory response, such as the infiltration of reactive oxygen species and inflammatory mediators, may further damage esophageal tissue [Kavanagh et al., 2014]. A study following a group of firefighters who responded to the 9/11 attack found an increased prevalence of gastroesophageal reflux disease (GERD) symptoms (5.8% prevalence pre-9/11 to a prevalence of 40% 4 years post 9/11) [Webber et al., 2009]. GERD is a strong predictor for esophageal adenocarcinoma, the most common type of esophageal cancer today [Lagergren and Lagergren, 2013]. Our study found that 68% of esophageal cancer in firefighters was adenocarcinoma, and that only esophageal adenocarcinoma, and not squamous carcinoma, was significantly elevated among firefighters.

### Limitations

This study has several limitations. First, using other cancer cases as controls may bias our findings towards the null if the selected control cancers are related to firefighting exposures. To minimize this bias, we did a comprehensive literature review of cancers found to be elevated among firefighters. Cancers that consistently showed very weak or no association with firefighters were selected as control cancers. Second, I&O data were missing for approximately 50% of cancer cases in CCR. Individuals in the CCR dataset who had unknown I&O were more likely to be older and of Hispanic descent compared to the CCR cases meeting study eligibility. Ascertainment bias would be present if the proportion of firefighters who were ascertained by the CCR varied across the different cancers. However, the California cancer presumption law enacted in 1982 and amended periodically can award compensation and benefits to any firefighter diagnosed with any cancer within 10 years of their last day worked [William Dallas Jones Cancer Presumption Act, 2010]. It should be noted that the employer can challenge the firefighter's compensation filing on the basis of an insufficient latency period (i.e., 10 years or less), or if the employer can prove that the association between the cancer and firefighting has been examined scientifically and shown not to exist [Heald, 2005]. Since firefighters can presume that any cancer was caused by work, it is unlikely that ascertainment bias was introduced. Third, because I&O recording is

not standardized, I&O data obtained may not be the longest-held job, but rather the current job. It is reassuring that findings based on large representative samples of U.S. workers found moderate to high correlation between current and longest-held job [Gomez-Marín et al., 2005; Luckhaupt et al., 2013], indicating that current job may be an acceptable surrogate for longest-held job. Fourth, those who worked as volunteer firefighters may have been classified as non-firefighters in our analyses because it is unlikely that volunteer firefighting was captured as the longest-held job. Conversely, some individuals with the designation of firefighter in this study may not have been involved in firefighting. The former misclassification of fire-fighting exposure may have biased the estimates towards the null, and it's not clear how the latter misclassification would bias our findings. Fifth, CCR does not have information on smoking, alcohol consumption, obesity, workplace exposures, length of employment, and actual job duties. Although many cancers of interest are influenced by lifestyle factors, this study was not able to adjust for these potential confounders. Recent studies found that firefighters working in the central region of the United States were less likely to smoke [Haddock et al., 2011], but have high rates of heavy and binge drinking on their off-duty days [Haddock et al., 2012]. Any differences in lifestyle factors could have biased our estimates in either direction. Sixth, due to small sample sizes, we were unable to examine blacks, Hispanics, and Asians separately. Finally, this study did not adjust for multiple comparisons and some findings may have arisen due to chance. Nevertheless, it is reassuring that many of the findings from this study are similar to those of previous studies.

### Strengths

CCR is one of the most comprehensive and complete cancer registries with a case ascertainment rate of at least 95% [North American Association of Central Cancer Registries, 2008,2015]. In addition, our study is among the largest cancer studies of firefighters. It is also one of the few studies that reported firefighter risk for cancer subtypes, including for leukemia, esophageal cancer, and lung cancer. Finally, ours is one of the few studies that reported findings for firefighters of other race/ethnicity.

### CONCLUSION

This study found that firefighters had a significantly elevated risk for melanoma, multiple myeloma, leukemia (i.e., AML), and cancers of the esophagus, prostate, kidney, and brain. Moreover, firefighters of other race/ethnicity, in addition to being at significantly increased risk for the same cancers identified for all firefighters combined, were found to have a significantly increased risk for non-Hodgkin lymphoma, leukemia (i.e., CLL, CML) and cancers of the tongue, testis, and bladder. The consistency of many of these findings with prior large studies (i.e., melanoma, non-Hodgkin lymphoma, multiple myeloma, and cancers of the prostate, esophagus, testis, bladder, kidney, and brain) strengthens the evidence supporting the association between firefighting exposures and these cancers.

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## References

- Aronson KJ, Tomlinson GA, Smith L. Mortality among fire fighters in metropolitan Toronto. *Am J Ind Med.* 1994; 26:89–101. [PubMed: 8074127]
- Baris D, Garrity TJ, Telles JL, Heineman EF, Olshan A, Zahm SH. Cohort mortality study of Philadelphia firefighters. *Am J Ind Med.* 2001; 39:463–476. [PubMed: 11333408]
- Bates MN. Registry-based case-control study of cancer in California firefighters. *Am J Ind Med.* 2007; 50:339–344. [PubMed: 17427202]
- Beaumont JJ, Chu GS, Jones JR, Schenker MB, Singleton JA, Piantanida LG, Reiterman M. An epidemiologic study of cancer and other causes of mortality in San Francisco firefighters. *Am J Ind Med.* 1991; 19:357–372. [PubMed: 2008922]
- Birdsey J, Alterman T, Petersen MR. Race, occupation, and lung cancer: Detecting disparities with death certificate data. *J Occup Environ Med.* 2007; 49:1257–1263. [PubMed: 17993930]
- Burnett CA, Halperin WE, Lalich NR, Sestito JP. Mortality among fire fighters: A 27 state survey. *Am J Ind Med.* 1994; 26:831–833. [PubMed: 7892834]
- Daniels RD, Bertke S, Dahm MM, Yiin JH, Kubale TL, Hales TR, Baris D, Zahm SH, Beaumont JJ, Waters KM, Pinkerton LE. Exposure response relationships for select cancer and non-cancer health outcomes in a cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009). *Occup Environ Med.* 2015 Epub ahead of print. 10.1136/oemed-2014-102671
- Daniels RD, Kubale TL, Yiin JH, Dahm MM, Hales TR, Baris D, Zahm SH, Beaumont JJ, Waters KM, Pinkerton LE. Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009). *Occup Environ Med.* 2014; 71:388–397. [PubMed: 24142974]
- Delahunt B, Bethwaite PB, Nacey JN. Occupational risk for renal cell carcinoma. A case-control study based on the New Zealand Cancer Registry. *Br J Urol.* 1995; 75:578–582. [PubMed: 7613791]
- Demers PA, Checkoway H, Vaughan TL, Weiss NS, Heyer NJ, Rosenstock L. Cancer incidence among firefighters in Seattle and Tacoma, Washington (United States). *Cancer Causes Control.* 1994; 5:129–135. [PubMed: 8167259]
- Demers PA, Heyer NJ, Rosenstock L. Mortality among firefighters from three northwestern United States cities. *Br J Ind Med.* 1992; 49:664–670. [PubMed: 1390274]
- Diamanti-Kandarakis E, Bourguignon JP, Giudice LC, Hauser R, Prins GS, Soto AM, Zoeller RT, Gore AC. Endocrine-disrupting chemicals: An Endocrine Society scientific statement. *Endocr Rev.* 2009; 30:293–342. [PubMed: 19502515]
- Fent KW, Eisenberg J, Snawder J, Sammons D, Pleil JD, Stiegel MA, Mueller C, Horn GP, Dalton J. Systemic exposure to PAHs and benzene in firefighters suppressing controlled structure fires. *Ann Occup Hyg.* 2014; 58:830–845. [PubMed: 24906357]
- Figs LW, Dosemeci M, Blair A. United States non-Hodgkin's lymphoma surveillance by occupation 1984–1989: A twenty-four state death certificate study. *Am J Ind Med.* 1995; 27:817–835. [PubMed: 7645576]
- Golden AL, Markowitz SB, Landrigan PJ. The risk of cancer in firefighters. *Occup Med.* 1995; 10:803–820. [PubMed: 8903750]

- Gomez-Marin O, Fleming LE, Caban A, Leblanc WG, Lee DJ, Pitman T. Longest held job in U.S. occupational groups: The National Health Interview Survey. *J Occup Environ Med.* 2005; 47:79–90. [PubMed: 15643162]
- Grimes G, Hirsch D, Borgeson D. Risk of death among Honolulu fire fighters. *Hawaii Med J.* 1991; 50:82–85. [PubMed: 2061032]
- Grundahl, K. National engineered lightweight construction fire research project. 1992. [http://www.carbeck.org/pdfs/NFPRF\\_Report\\_WTCA\\_version.pdf](http://www.carbeck.org/pdfs/NFPRF_Report_WTCA_version.pdf)
- Guidotti TL. Mortality of urban firefighters in Alberta, 1927–1987. *Am J Ind Med.* 1993; 23:921–940. [PubMed: 8328477]
- Haddock CK, Jahnke SA, Poston WS, Jitnarin N, Kaipust CM, Tuley B, Hyder ML. Alcohol use among firefighters in the Central United States. *Occup Med (Lond).* 2012; 62:661–664. [PubMed: 23064207]
- Haddock CK, Jitnarin N, Poston WS, Tuley B, Jahnke SA. Tobacco use among firefighters in the central United States. *Am J Ind Med.* 2011; 54:697–706. [PubMed: 21656838]
- Heald, K. Firefighters and the workers' compensation cancer presumption. 2005. <http://www.sffdlocal798.org/Vol33no8/Cancer.html>
- Howe GR, Burch JD. Fire fighters and risk of cancer: An assessment and overview of the epidemiologic evidence. *Am J Epidemiol.* 1990; 132:1039–1050. [PubMed: 2260535]
- International Agency for Research on Cancer. IARC monographs on the evaluation of carcinogenic risks to humans. Painting, firefighting, and shiftwork. 2010; 98 <http://monographs.iarc.fr/ENG/Monographs/vol98/mono98.pdf>.
- International Agency for Research on Cancer. Agents classified by the IARC monographs. 2015; 1–109 <http://monographs.iarc.fr/ENG/Classification/ClassificationsGroupOrder.pdf>.
- International Association of Fire Fighters. Presumptive law coverage for cancer. 2015. <http://www.iaff.org/hs/phi/disease/cancer.asp>
- Jones CP. Invited commentary: “race,” racism, and the practice of epidemiology. *Am J Epidemiol.* 2001; 154:299–304. discussion 305–296. [PubMed: 11495851]
- Kavanagh ME, O'Sullivan KE, O'Hanlon C, O'Sullivan JN, Lysaght J, Reynolds JV. The esophagitis to adenocarcinoma sequence; The role of inflammation. *Cancer Lett.* 2014; 345:182–189. [PubMed: 23994342]
- Korst, M. The high toll of cancer on the fire service: A proactive approach to preventing cancer. 2012. <http://ceas.uc.edu/content/dam/aero/docs/fire/Papers/FF%20Cancer.pdf>
- Lagergren J, Lagergren P. Recent developments in esophageal adenocarcinoma. *CA Cancer J Clin.* 2013; 63:232–248. [PubMed: 23818335]
- LeMasters GK, Genaidy AM, Succop P, Deddens J, Sobeih T, Barriera-Viruet H, Dunning K, Lockey J. Cancer risk among firefighters: A review and meta-analysis of 32 studies. *J Occup Environ Med.* 2006; 48:1189–1202. [PubMed: 17099456]
- Luckhaupt SE, Cohen MA, Calvert GM. Concordance between current job and usual job in occupational and industry groupings: Assessment of the 2010 National Health Interview Survey. *J Occup Environ Med.* 2013; 55:1074–1090. [PubMed: 23969506]
- Ma F, Fleming LE, Lee DJ, Trapido E, Gerace TA. Cancer incidence in Florida professional firefighters, 1981 to 1999. *J Occup Environ Med.* 2006; 48:883–888. [PubMed: 16966954]
- Ma F, Lee DJ, Fleming LE, Dosemeci M. Race-specific cancer mortality in US firefighters: 1984–1993. *J Occup Environ Med.* 1998; 40:1134–1138. [PubMed: 9871891]
- Mehlman MA. Causal relationship from exposure to chemicals in oil refining and chemical industries and malignant melanoma. *Ann N Y Acad Sci.* 2006; 1076:822–828. [PubMed: 17119259]
- Melius J. Occupational health for firefighters. *Occup Med.* 2001; 16:101–108. [PubMed: 11107227]
- Morton W, Marjanovic D. Leukemia incidence by occupation in the Portland-Vancouver metropolitan area. *Am J Ind Med.* 1984; 6:185–205. [PubMed: 6475965]
- National Fire Protection Association. US fire department profile 2013. 2014. <http://www.nfpa.org/~media/Files/Research/NFPA%20reports/Fire%20service%20statistics/osfdprofile.pdf>
- North American Association of Central Cancer Registries. Standards for cancer registries volume III: Standards for completeness, quality, analysis, management, security and confidentiality of data.



2008. <http://www.naaccr.org/LinkClick.aspx?fileticket=hfVzJKUcRM8%3d&tabid=134&mid=474>

North American Association of Central Cancer Registries. Certification: Who is Certified?. 2015. <http://www.naaccr.org/Certification/WhoisCertified.aspx>

Pukkala E, Martinsen JI, Weiderpass E, Kjaerheim K, Lyng E, Tryggvadottir L, Sparen P, Demers PA. Cancer incidence among firefighters: 45 years of follow-up in five Nordic countries. *Occup Environ Med*. 2014; 71:398–404. [PubMed: 24510539]

Ricucci N, Saldivar K. The status of employment discrimination suits in police and fire departments across the United States. *Review of Public Personnel Admini*. 2014; 34:263–288.

Sama SR, Martin TR, Davis LK, Kriebel D. Cancer incidence among Massachusetts firefighters, 1982–1986. *Am J Ind Med*. 1990; 18:47–54. [PubMed: 2378369]

Stefanidou M, Athanaselis S, Spiliopoulou C. Health impacts of fire smoke inhalation. *Inhal Toxicol*. 2008; 20:761–766. [PubMed: 18569098]

U.S. Department of Commerce. Standard occupational classification manual. White Plains, MD: National Technical Information Service and Bernan Associates; 2000.

United States Cancer Statistics Working Group. United States Cancer Statistics: 1999–2011 Incidence and Mortality Web-based Report. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute; 2014. <http://apps.nccd.cdc.gov/uscs/>

Vena JE, Fiedler RC. Mortality of a municipal-worker cohort: IV. Fire fighters. *Am J Ind Med*. 1987; 11:671–684. [PubMed: 3605104]

Webber MP, Gustave J, Lee R, Niles JK, Kelly K, Cohen HW, Prezant DJ. Trends in respiratory symptoms of firefighters exposed to the world trade center disaster: 2001–2005. *Environ Health Perspect*. 2009; 117:975–980. [PubMed: 19590693]

William Dallas Jones Cancer Presumption Act. 2010. Labor code §32121.

TABLE I

Number of Individuals Eligible for Study Inclusion, and Number Excluded From Study by Reason

	n	Total n
Total number of cancer records in CCR		3,148,628
Excluded: in-situ, benign, borderline cancers	346,379	
Excluded: multiple records <sup>a</sup>	251,501	
Excluded: non-first primary	168,696	
Excluded gender: Females, other, unknown gender	1,159,007	
Subtotal <sup>b</sup>		1,223,045
Industry and occupation (I&O) exclusions		
Unemployed, or unknown I&O	308,753	
Never worked	29,400	
Homemaker	366	
Retired	193,276	
Military	10,475	
Subtotal after I&O exclusions		680,775
Age exclusions		
Age <18, or >97 years	2,644	
Total eligible for study		678,132

<sup>a</sup>Individuals with more than one cancer diagnosis may have more than one cancer record. The first primary malignant cancer diagnosis recorded in CCR was retained in this study.

<sup>b</sup>Subtotal after benign/in-situ tumors, non-first primary cancer, multiple record, and gender exclusions.

Odds Ratios for Various Cancers Among Firefighters—All Races Combined, California, 1988–2007

TABLE II

Cancer	SEER code	Number of firefighters		
		N	% <sup>a</sup>	OR <sup>b</sup> 95%CI
Head and neck				
Lip	20010	19	0.96	1.44 0.89–2.33
Tongue	20020	35	0.65	1.18 0.82–1.70
Salivary gland	20030	14	0.70	1.30 0.75–2.25
Gum and other mouth	20050	14	0.56	1.07 0.62–1.85
Pharyngeal	20060–20100	43	0.50	1.06 0.75–1.50
Digestive				
Esophagus	21010	68	0.82	<b>1.59 1.20–2.09</b>
Esophagus-adenocarcinoma		46	1.04	<b>1.85 1.34–2.55</b>
Esophagus-squamous carcinoma		12	0.43	0.96 0.53–1.73
Stomach	21020	52	0.37	0.81 0.59–1.11
Colorectal	21041–21252	347	0.55	1.10 0.93–1.31
Liver	21071	39	0.35	1.07 0.75–1.53
Pancreas	21100	79	0.53	1.10 0.83–1.46
Respiratory				
Larynx	22020	25	0.32	<b>0.59 0.39–0.89</b>
Lung and bronchus	22030	533	0.58	1.08 0.92–1.28
Lung-adenocarcinoma <sup>c</sup>		173	0.58	1.10 0.89–1.35
Lung-squamous cell <sup>c</sup>		95	0.48	0.89 0.69–1.14
Lung-small cell <sup>c</sup>		82	0.69	1.24 0.95–1.61
Lung-large cell <sup>c</sup>		25	0.48	0.84 0.55–1.28
Lung-non-specific non-small cell cancer <sup>c</sup>		42	0.87	<b>2.01 1.38–2.93</b>
Connective tissue/skin				
Soft tissue, including heart	24000	26	0.54	1.16 0.76–1.77
Melanoma	25010	265	1.06	<b>1.75 1.44–2.13</b>
Mesothelioma <sup>d</sup>		21	0.75	1.40 0.89–2.21

Cancer	SEER code	Number of firefighters			
		N	% <sup>a</sup>	OR <sup>b</sup>	95%CI
Urinary/reproductive					
Prostate	28010	1397	0.72	<b>1.45</b>	<b>1.25–1.69</b>
Testis	28020	85	0.67	1.10	0.73–1.66
Urinary bladder	29010	106	0.56	0.99	0.78–1.26
Kidney	29020	115	0.62	<b>1.27</b>	<b>1.01–1.59</b>
Cranial/endocrine					
Brain	31010	87	0.75	<b>1.54</b>	<b>1.19–2.00</b>
Thyroid	32010	41	0.64	1.27	0.88–1.84
Blood					
Hodgkin lymphoma	33011–33012	29	0.52	1.15	0.72–1.83
Non-Hodgkin lymphoma	33041–33042	183	0.60	1.22	1.00–1.50
Multiple myeloma	34000	55	0.64	<b>1.35</b>	<b>1.00–1.82</b>
Leukemia	35011–35043	122	0.64	<b>1.32</b>	<b>1.05–1.66</b>
CLL	35012	43	0.74	1.34	0.96–1.87
AML	35021, 35031	42	0.69	<b>1.44</b>	<b>1.02–2.02</b>
CML	35022	21	0.73	1.51	0.95–2.40

SEER code = recode based on ICD-O-3 (<http://seer.cancer.gov/siterecode/>). A total of 187 firefighters had rare cancers (i.e., cancers with fewer than 10 firefighter cases) and these rare cancers are not included in this table. The race was not stated for 2,719 individuals. Bolded values indicate a statistically significantly elevated (or decreased) OR at  $P < 0.05$ .

OR, odds ratio; CI, confidence interval; ALL, acute lymphocytic leukemia; CLL, chronic lymphocytic leukemia; Other LL, other lymphocytic leukemia; AML, acute myeloid leukemia; CML, chronic myeloid leukemia.

<sup>a</sup>Controls consist of cancers of the pharynx, stomach, liver, and pancreas; 0.44% of individuals with control cancers were firefighters. This 0.44% applies to the comparison group for all case cancer examined except for pharyngeal, stomach, liver, and pancreatic cancers (which were also control cancers), where 0.42%, 0.46%, and 0.40% of individuals with control cancers were firefighters respectively (i.e., these represent the proportion of firefighters when the case cancer was removed from the control group).

<sup>b</sup>Adjusted for age of diagnosis, race, and year of diagnosis.

<sup>c</sup>Historical subtype of lung cancer. International Classification of Diseases for Oncology (ICD-O3 codes) for Adenocarcinoma = 8050, 8051, 8140, 8141, 8143, 8147, 8200, 8201, 8250–8255, 8260, 8310, 8320, 8323, 8430, 8480, 8481, 8490, 8550, 8551, 8560, 8562, 8570–8576; Squamous Cell = 8052, 8070–8076, 8078; Small Cell = 8002, 8041–8045; Large Cell = 8012–8014; Non-Small Cell Cancer, unspecified = 8046.

<sup>d</sup>Historical subtype of mesothelioma: ICD-O3 code = 9050–9055.

**TABLE III**  
Odds Ratios for Various Cancers Among Firefighters\* of Other Race/Ethnicity—California, 1988–2007

Cancer	SEER code	Number of firefighters		
		N	% <sup>a</sup>	OR <sup>b</sup> 95%CI
Head and neck				
Lip	20010	1	0.67	6.56 0.87–49.58
Tongue	20020	4	0.41	<b>3.57 1.23–10.35</b>
Salivary gland	20030	2	0.45	3.60 0.83–15.59
Gum and other mouth	20050	1	0.16	1.50 0.20–11.15
Pharyngeal	20062–20100	4	0.15	1.35 0.45–4.05
Digestive				
Esophagus	21010	5	0.26	2.14 0.81–5.65
Esophagus-adenocarcinoma		2	0.37	2.79 0.66–11.87
Esophagus-squamous carcinoma		2	0.18	1.44 0.34–6.14
Stomach	21020	10	0.17	1.61 0.71–3.65
Colorectal	21041–21052	30	0.18	1.41 0.82–2.41
Liver	21071	5	0.08	0.51 0.19–1.39
Pancreas	21100	5	0.12	0.90 0.33–2.45
Respiratory				
Larynx	22020	0		
Lung and bronchus	22030	26	0.13	1.01 0.57–1.78
Lung-adenocarcinoma <sup>c</sup>		8	0.11	0.89 0.40–2.00
Lung-squamous cell <sup>c</sup>		5	0.12	0.78 0.29–2.11
Lung-small cell <sup>c</sup>		1	0.05	0.36 0.05–2.71
Lung-large cell <sup>c</sup>		0		
Lung-non-specific non-small cell cancer <sup>c,d</sup>		5	0.37	2.42 0.86–6.80
Connective tissue/skin				
Soft tissue, including heart	24000	2	0.13	1.39 0.32–5.98
Melanoma	25010	7	0.61	<b>4.51 1.85–10.97</b>
Mesothelioma <sup>e</sup>		2	0.38	2.86 0.67–12.28

Cancer	SEER code	Number of firefighters		
		N	% <sup>a</sup>	OR <sup>b</sup> 95%CI
Urinary/reproductive				
Prostate	28010	125	0.27	<b>2.42</b> 1.53–3.84
Testis	28020	15	0.43	<b>3.73</b> 1.26–11.02
Urinary bladder	29010	8	0.29	<b>2.37</b> 1.05–5.33
Kidney	29020	18	0.33	<b>2.59</b> 1.40–4.80
Cranial/endocrine				
Brain	31010	10	0.38	<b>3.58</b> 1.65–7.74
Thyroid	32010	5	0.25	1.92 0.66–5.60
Blood				
Hodgkin lymphoma	33011–33012	4	0.25	2.50 0.76–8.28
Non-Hodgkin lymphoma	33041–33042	24	0.30	<b>2.17</b> 1.20–3.92
Multiple myeloma	34000	13	0.47	<b>3.77</b> 1.91–7.44
Leukemia	35011–35043	20	0.41	<b>3.64</b> 1.96–6.74
CLL	35012	7	0.86	<b>7.04</b> 2.99–16.56
AML	35021, 35031	2	0.11	1.12 0.26–4.76
CML	35022	6	0.61	<b>4.91</b> 1.84–13.12

SEER code =recode based on ICD-O-3 (<http://seer.cancer.gov/siterecode/>). Bolded values indicate a statistically significantly elevated (or decreased) OR at  $P < 0.05$ .

OR, odds ratio; CI, confidence interval; ALL, acute lymphocytic leukemia; CLL, chronic lymphocytic leukemia; AML, acute myeloid leukemia; CML, chronic myeloid leukemia.

\* Other race/ethnicity consists of individuals who were Black, Hispanic, Asian/Pacific Islander, Indian/Alaskan Native, and Other/unknown race.

<sup>a</sup> Controls consist of cancers of the pharynx, stomach, liver, and pancreas; 0.13% of individuals with control cancers were firefighters. This 0.13% applies to the comparison group for all case cancer examined except for pharyngeal, stomach, and liver cancers (which were also control cancers), where 0.12%, 0.11%, and 0.15% of individuals with control cancers were firefighters respectively (i.e., these represent the proportion of firefighters when the case cancer was removed from the control group).

<sup>b</sup> Adjusted for age of diagnosis and year of diagnosis.

<sup>c</sup> Histological subtype of lung cancer. International Classification of Diseases for Oncology (ICD-O3 codes) for Adenocarcinoma = 8050, 8051, 8140, 8141, 8143, 8147, 8200, 8201, 8250–8255, 8260, 8310, 8320, 8323, 8430, 8480, 8481, 8490, 8550, 8551, 8560, 8562, 8570–8576; Squamous Cell = 8052, 8070–8076, 8078; Small Cell = 8002, 8041–8045; Large Cell = 8012–8014; Non-Small Cell Cancer, unspecified = 8046.

<sup>d</sup> Firth bias-correction applied.

<sup>e</sup> Histological subtype of mesothelioma: ICD-O3 code = 9050–9055.

**TABLE IV**  
Odds Ratios for Various Cancers Among White Firefighters—California, 1988–2007

Cancer	SEER code	Number of firefighters		
		N	% <sup>a</sup>	OR <sup>b</sup> 95%CI
Head and neck				
Lip	20010	17	0.95	1.36 0.82–2.25
Tongue	20020	31	0.70	1.10 0.75–1.61
Salivary gland	20030	12	0.77	1.19 0.66–2.15
Gum and other mouth	20050	13	0.70	1.06 0.60–1.87
Pharyngeal	20062–20100	38	0.66	1.03 0.71–1.48
Digestive				
Esophagus	21010	63	0.99	<b>1.59 1.19–2.12</b>
Esophagus-adenocarcinoma		44	1.14	<b>1.84 1.32–2.56</b>
Esophagus-squamous carcinoma		10	0.61	0.94 0.49–1.78
Stomach	21020	42	0.51	0.73 0.52–1.03
Colorectal	21041–21052	317	0.69	1.08 0.90–1.30
Liver	21071	34	0.70	1.21 0.83–1.76
Pancreas	21100	74	0.67	1.14 0.85–1.54
Respiratory				
Larynx	22020	25	0.41	<b>0.64 0.42–0.97</b>
Lung and bronchus	22030	506	0.71	1.10 0.92–1.30
Lung-adenocarcinoma <sup>c</sup>		164	0.73	1.11 0.90–1.38
Lung-squamous cell <sup>c</sup>		90	0.58	0.90 0.70–1.17
Lung-small cell <sup>c</sup>		81	0.84	1.30 1.00–1.70
Non-large cell <sup>c</sup>		25	0.62	0.89 0.58–1.36
Non-specific, non-small cell cancer <sup>c</sup>		37	1.07	<b>2.02 1.34–3.04</b>
Connective tissue/skin				
Soft tissue, including heart	24000	24	0.73	1.16 0.75–1.82
Melanoma	25010	254	1.09	<b>1.71 1.40–2.09</b>
Mesothelioma <sup>d</sup>		19	0.85	1.34 0.83–2.16

Cancer	SEER code	Number of firefighters		
		N	% <sup>a</sup>	OR <sup>b</sup> 95%CI
Urinary/reproductive				
Prostate	28010	1256	0.87	<b>1.40</b> <b>1.19–1.64</b>
Testis	28020	70	0.78	0.91 0.58–1.44
Urinary bladder	29010	98	0.61	0.94 0.73–1.21
Kidney	29020	96	0.74	1.16 0.91–1.49
Cranial/endocrine				
Brain	31010	76	0.85	<b>1.41</b> <b>1.07–1.87</b>
Thyroid	32010	36	0.82	1.21 0.81–1.80
Blood				
Hodgkin lymphoma	33011–33012	25	0.64	1.07 0.63–1.80
Non-Hodgkin lymphoma	33041–33042	159	0.71	1.16 0.94–1.45
Multiple myeloma	34000	42	0.73	1.17 0.84–1.64
Leukemia	35011–35043	101	0.73	1.17 0.91–1.49
CLL	35012	36	0.73	1.17 0.82–1.67
AML	35021, 35031	40	0.93	<b>1.46</b> <b>1.03–2.08</b>
CML	35022	14	0.74	1.14 0.66–1.99

EER code = recode based on ICD-O-3 (<http://seer.cancer.gov/siterecode/>). Bolded values indicate a statistically significantly elevated (or decreased) OR at  $P < 0.05$ .

OR, odds ratio; CI, confidence interval; ALL, acute lymphocytic leukemia; CLL, chronic lymphocytic leukemia; AML, acute myeloid leukemia; CML, chronic myeloid leukemia.

<sup>a</sup> Controls consists of cancers of the pharynx, stomach, liver, and pancreas; 0.63% of individuals with control cancers were firefighters. This 0.63% applies to the comparison group for all case cancer examined except for pharyngeal, stomach, liver and pancreatic cancers (which were also control cancers), where 0.62%, 0.67%, and 0.61% of individuals with control cancers were firefighters respectively (i.e., these represent the proportion of firefighters when the case cancer was removed from the control group).

<sup>b</sup> Adjusted for age of diagnosis and year of diagnosis.

<sup>c</sup> Histological subtype of lung cancer. International Classification of Diseases for Oncology (ICD-O3 codes) for Adenocarcinoma = 8050, 8051, 8140, 8141, 8143, 8147, 8200, 8201, 8250–8255, 8260, 8310, 8320, 8323, 8430, 8480, 8481, 8490, 8550, 8551, 8560, 8562, 8570–8576; Squamous Cell = 8052, 8070–8076, 8078; Small Cell = 8002, 8041–8045; Large Cell = 8012–8014; Non-Small Cell Cancer, unspecified = 8046.

<sup>d</sup> Histological subtype of pleural mesothelioma<sup>d</sup> (ICD-O3 code = 9050–9055).