EVALUATING FATIGUE IN FIRE AND EMS WORKERS WORKING 24 HOURS OR MORE IN DURATION

Research Presented in Partial Fulfillment

of the Requirements for the

Executive Fire Officer Program

by

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Abstract

The problem identified for this capstone research paper is that the Pocatello Fire Department has not adequately addressed fatigue. The department provides fire services for a mid-sized city and emergency medical response to a county that includes a large rural area. The purpose of this research is to understand better how fire and EMS workers at the Pocatello Fire Department experience fatigue. To understand the issue, a generic qualitative inquiry was chosen as the research method. Three questions guided the research. The first addressed how employees working 24-hour or longer shifts describe their fatigue. The second focused on how employees perceive their organization's efforts to address fatigue. The third explored what strategies may be effective at mitigating fatigue. Twelve firefighters from two different agencies were included in a study using a semi-structured interview to gather data. Several themes emerged from the data that related to each of the research questions. The study concluded with recommendations for organizations to address fatigue. First, organizations should discuss fatigue with their employee groups. They should use short and long-term tactics to address fatigue. Second, organizations should evaluate their employee's shift design, as some schedules seem to have a less negative effect on fatigue than others. The data suggest that the 48/96 schedule may have a lesser impact on fatigue than other schedules that involve alternating work shifts and days off. Finally, individuals and organizations should develop a culture of good sleep hygiene to promote a healthy and resilient workforce.

Acknowledgements

This Capstone Research Paper is dedicated to my wife Michelle, my son Cade, and daughters Maeve and Bailee. They have supported me throughout my fire service career. Every day they inspire me to be the best version of myself. It is also dedicated to the men and women of the Pocatello Fire Department who serve their community with compassion and professionalism. My goal is to ensure my organization provides for the health and wellness of our personnel. I would also like to thank my classmates in the Executive Fire Officer Program. Their friendship and support have helped me through this incredible experience. They are a credit to their organizations and communities.

My affiliation with the Pocatello Fire Department is provided as biographical information. No official sponsorship or endorsement of this Capstone Research Paper by the Pocatello Fire Department was provided or should be inferred.

The views expressed in this Capstone Research Paper are the views of the author and participants alone and do not represent the official views of the U.S. Government or any fire department. Certain commercial entities, equipment, or materials may be identified to describe a concept or experimental procedure adequately. Use of company names or devices does not imply recommendation or endorsement by The Pocatello Fire Department or The Lewiston Fire Department, nor is it intended to imply that the entities, materials, or equipment are the best available for the purpose.

Contents

CHAPTER 1. INTRODUCTION

The Pocatello Fire Department was formed in 1886 as a bucket brigade for the Oregon Short-Line Railroad in a small railroad town. Today, the department is an all-hazards career organization with 92 employees. Seventy-eight personnel work in a three-platoon system. The department services the community's call volume using three engines, one ladder truck, one aircraft rescue firefighting apparatus, three ALS ambulances, and one battalion chief. The department has five fire stations. The department works the 48/96 schedule. The department serves as a municipal fire department for the city of Pocatello, a community of approximately 57,730 people in an area of 33 square miles (United States Census Bureau, 2023). The department also provides an advanced life support transport ambulance service for Bannock County. The county has a population of 89,517 with a land mass of 1,112 square miles (United States Census Bureau, 2023). The department has a long history of collective bargaining with the IAFF local that dates to the local's charter in 1919.

Background

In 2021 the City of Pocatello negotiated with the labor group representing the firefighters to switch from the old schedule to the 48/96 schedule. The old schedule consisted of an employee working alternating 24-hour shifts on and off for five days, followed by four consecutive 24-hour days off. This schedule is commonly referred to as the 'modified Detroit' schedule. It will also be referred to as the 3/4 schedule in this paper. Appendix A contains examples of the shift schedules mentioned in this paper. Figure 1, Appendix A contains an example of the 3/4 schedule. The new schedule has an employee work two consecutive 24-hour shifts, followed by four consecutive 24-hour days off. This shift is referred to as the '48/96'

schedule (see Appendix A, Figure 2). Because of the perceived concern of having employees work 48 hours in duration, the employer advocated for a method to measure fatigue.

To better evaluate fatigue in employees, labor and management agreed to implement a fatigue measurement tool that used a combination of the Karolinska Sleepiness Scale and Psychomotor Vigilance Testing. This measurement was facilitated using a third-party vendor with specific expertise in fatigue risk management. Shahid et al. (2012) describe The Karolinska Sleepiness Scale (KSS) as a subjective measurement of sleepiness. The KSS presents several statements to an employee that reflect the level of sleepiness experienced at the time of the test. A subject may choose from a range of 1, extremely alert, to 10, extremely sleepy, can't keep awake. A higher score correlates with increased sleepiness. The Psychomotor Vigilance Test (PVT) is a measure of reaction time in a candidate. It has become one of the most effective methods of evaluating attention deficit due to sleep deprivation (Lim & Dinges, 2008). A higher PVT score corresponds with a delayed reaction time and indicates some level of attention deficit.

During the old work schedule, employees were directed to take the test upon arriving at the beginning of a 24-hour shift. They were also directed to take the test before leaving the worksite after completing a 24-hour shift. Once the employees transitioned to the 48/96 schedule, they were directed to take the test when they arrived at work to begin their 48-hour shift, midway through their shift at the 24-hour mark, and before leaving the worksite after completing their shift. Though the study lacked the scientific design to qualify as a valid quantitative research project, the findings indicated a change in the KSS and PVT scores. The incidence of KSS scores greater than 6, which correlates with the statement "some signs of sleepiness," decreased from 16.2% on the old schedule, to 5.1% on the 48/96. The frequency of PVT scores above 8 decreased from 4.5% on the old schedule to 3.7% on the 48/96. While not

conclusive, these findings seem to suggest that fatigue is affected by the arrangement of work shifts and days off. Different arrangements can have a positive or negative effect on fatigue. A more scientific research design with strict adherence to institutional review board oversight may yield more definitive results.

Though the Pocatello Fire Department engaged in a process to evaluate fatigue in its members, it did not operationalize the findings or make any policy changes to address fatigue. The department determined the new schedule did not have a dramatic negative effect on employees. City management and labor agreed to discontinue the measurements. Consequently, fatigue remains a perceived issue in the department today.

Significance of the Study

In 2020, the Center for Public Safety Excellence and the International City/County Management Association published a white paper titled "21st Century Fire and Emergency Services" (2020). The paper incorporated feedback gathered from professionals in the fire and emergency services and local governments. In the white paper, several critical issues were identified. One critical issue addresses Health and Wellness, particularly the role sleep disruption has on fire and emergency services personnel. The authors underscore that this research is necessary to guide decision-making and policy development to protect fire and EMS personnel in the workplace.

One of the central elements of the Executive Fire Officer Program design focuses on an executive's organization. This research paper focuses on the component of the organization that seeks to elevate safety and employee health programs to create a more prepared and resilient organization (U.S. Fire Administration, 2023). Evaluating and measuring fatigue in employees addresses this goal.

Problem Statement

The problem is that fatigue has not been effectively addressed in the Pocatello Fire Department. This leads to the impression that employees feel burned out and that workload and fatigue are overlooked. There is much discussion in the fire service about cardiovascular disease and cancer, but little about fatigue in comparison. Peterson (2016) cites several studies that identify poor sleep patterns as precursors to other health problems such as cardiovascular disease, cancer, Alzheimer's Disease, and other metabolic syndromes. Because fatigue is a precursor to other health problems, a holistic approach to employee health and wellness must address fatigue as well as other health issues. Advancing the discussion of fatigue in the Pocatello Fire Department may yield corresponding benefits toward other health problems facing personnel. The goal of a healthy and resilient workforce corresponds with two of the seven critical issues identified at the U.S. Fire Administrator's Summit on Fire Prevention and Control. Those two issues are firefighter mental health and well-being, and firefighter cancer (U.S. Fire Administration, 2023). Though fatigue was not specifically mentioned, it seems to correlate with other health problems affecting the United States Fire Service as a whole.

In addition to the deleterious medical effects, sleep disorders were associated with higher instances of motor vehicle crashes among firefighters (Barger, et al., 2015). Fatigue is not only a health and wellness problem but also a safety problem. The higher potential for motor vehicle crashes negatively affects the safety of employees as well as the safety of other motorists who share the road with responders. A higher potential for motor vehicle crashes has a monetary impact on an organization as well, either directly through claims or indirectly through increased worker's compensation and other insurance rates.

These findings underscore the impact fatigue has on fire service personnel. The authors of the "21st Century Fire and Emergency Services" paper (2020) acknowledge that research in this area may not be readily accepted in the industry. This was found to be the case when the Pocatello Fire Department explored a method to measure fatigue. Members were hesitant about the applicability of research in other worker populations and the validity with which they applied to firefighters working 24-hour shifts. This hesitancy toward measuring fatigue was ultimately a contributing factor to the decision to discontinue the evaluation of fatigue in employees. This was a decision agreed upon by both labor and management.

Purpose Statement

The purpose of this generic qualitative inquiry is to understand better how fire and EMS workers at the Pocatello Fire Department experience fatigue. To perform qualitative research, employees who work 24 hours or longer in duration will be interviewed about their experiences and views related to fatigue. This will enable a better understanding of fatigue from an employee's perspective. Once the department has a better understanding of fatigue and can quantify it through measurement, it can implement solutions to mitigate the negative effects. This will lead to a healthier and more resilient workforce. This is important for the health and safety of fire and EMS personnel. It benefits citizens who are the recipients of fire and emergency medical services. It will have positive effects on the organization, both to develop comprehensive health and wellness programs for employees and to address issues related to fatigue and risk management.

Research Questions

The questions this capstone research paper will address are:

1. How do employees working 48-hour shifts describe their fatigue?

2. How do employees perceive their employer's efforts to address fatigue?
3. What strategies may be effective at mitigating fatigue?

Summary

Chapter 1 provided an overview of the Pocatello Fire Department. It went on to provide the background related to a change in shift schedule that pointed to the need to understand and evaluate fatigue in its employees. The significance included research that underscores the impact fatigue has on employee health. It identified fatigue as a problem that needs to be adequately discussed and effectively evaluated and went on to provide a framework for a generic qualitative inquiry into the issue. Moving forward, Chapter 2 will provide an analysis of research about fatigue's effect on health and its measurement in individuals. Chapter 3 will provide the methodology to describe the research approach on this topic. Chapter 4 will outline the results of the qualitative research. Chapter 5 will conclude with recommendations supported by the data.

CHAPTER 2: LITERATURE REVIEW

Introduction

To gain insight into the connection between fatigue and firefighters, a survey of literature was conducted. Searches were performed primarily in EBSCO using search terms related to fatigue, sleep deprivation, health effects, cardiovascular, cancer, errors, measuring fatigue, mitigating fatigue, as well as others. Forty-three articles were obtained related to the search terms. The articles were predominantly peer-reviewed scholarly articles. The remaining few were trade publications. This literature review will focus only on those scholarly articles. The articles were categorized according to how closely the main thesis was related to the following subtopics: fatigue and physical health, fatigue and mental health, fatigue as it relates to accidents

and errors, shift duration and fatigue, measuring fatigue, and fatigue interventions. Despite the attempt to categorize the literature, many sources addressed multiple subtopics.

Existing Literature

Fatigue and Physical Health

Bender (2018) performed a quantitative study on firefighters to determine the effect of sleep deprivation. Her research focused on the problem of sleep deprivation and its relationship to cardiovascular disease, mental illness, and metabolic disease. After evaluating 255 firefighters she concluded that sleep deprivation over time is related to cardiovascular disease and obesity. Her research revealed that firefighters recognize a need to improve sleep. However, they are less interested in resources related to sleep hygiene than other more tangible resources, such as physical fitness programs. Because sleep does not carry the same negative stigma as mental health or substance abuse, she recommends advances in sleep hygiene to open the door to addressing those other health problems.

Holmer et al. (2021) explored the connection that endothelial function (EF) may have with cardiovascular disease. They identify that sleep deprivation is associated with cardiovascular disease (CVD). They conducted a review of peer-reviewed literature to evaluate the link between EF and CVD. The studies focused on participants who were subjected to some measure of sleep deprivation. Their review concludes that EF may be the reason that sleep deprivation is associated with CVD. To address this, they recommend adequate sleep as a tool to decrease the prevalence of cardiovascular disease over time.

Pasetes et al. (2023) identify that, in addition to being related to CVD, sleep loss is also related to other health problems including cancer, diabetes, and Alzheimer's. Their research investigated the effects of sleep deprivation over time. Their research divided participants into

two groups. One group participated in a 4-month study, the other in an 8-month study. Participants were given different opportunities to sleep. This established a baseline. During the study, they were subjected to periods of total sleep deprivation (TSD). Participants were also given opportunities to get recovery sleep (REC). Different tests measured cardiovascular markers during the study. Results showed that TSD influenced many of the cardiovascular markers. They also identified that participants had some recovery of the cardiovascular markers after two nights of REC. Their results confirm the need to get adequate sleep over time to ensure cardiovascular health. They recommend further studies to evaluate the relationship REC may have on cardiovascular markers secondary to TSD.

Gatari et al. (2023) used a person-centered approach to sleep. They argue that sleep dimensions are dynamic, varying from person to person. They also recognize that over time the same person may experience varying sleep dimensions. Their study involved 296 Indonesian employees. The participants answered questionnaires related to sleep dimensions such as duration and quality. Using the questionnaires, the participants were categorized according to their sleep profiles. The authors concluded that extrinsic factors such as workload did not correlate to a participant's inclusion in a particular sleep category. They also found evidence that contrasted previous findings that correlated sleep with a higher risk of adverse health effects. In conclusion, they advocate for a more nuanced person-centered approach to evaluating sleep and its effect on employees.

Fatigue and Mental Health

A review of cognitive performance focuses on the biological explanation and research on sleep deprivation's effect on multiple mental faculties (Khan & Al-Jahdali, 2023). Effects on memory, attention, decision-making, and other cognitive domains were analyzed. The authors

concluded that overall cognitive performance was diminished secondary to sleep deprivation. Their research provided proof that the body's systems will continue to decline when subjected to sustained sleep deprivation over time. This decline is independent of an individual's baseline health.

Kelly et al. (2021) focus their research on the effect of recovery sleep on stress, fatigue, and irritability in fire service workers. The study involved fire service workers completing a questionnaire during their on-shift and off-shift time throughout their 15-day cycle. The findings were analyzed to determine the effect of the worker's off-shift recovery period on stress, fatigue, and irritability. The results of the study determined that focusing on sleep quality and duration may be more beneficial than emotion regulation techniques in decreasing firefighter stress, fatigue, and irritability.

Choshen-Hillel et al. (2021) evaluated medical residents to determine the degree to which sleep deprivation affected cognitive and physiological measures. The study involved a combination of resident and attending physicians and evaluated their self-reported sleep quality using the Pittsburgh Sleep Quality Index (PSQI). The results suggest sleep deprivation is correlated with negative cognitive effects such as impaired decision-making and greater impulsiveness.

Fatigue and Errors or Accidents

Research in the *Journal of Clinical Sleep Medicine* evaluated the relationship between sleep disorders and the increased risk of motor vehicle crashes and adverse health outcomes in firefighters (Barger, et al., 2015). Researchers conducted screening of participants to evaluate the number of firefighters with sleep disorders. The screening included questions addressing the self-reported health status of participants. Nearly all participants worked ≥ 24 hours; twenty percent

of participants worked ≥ 48 hours. The results showed that firefighters who screened positive for a sleep disorder had a greater incidence of motor vehicle crashes. The results also showed that firefighters who screened positive had a greater prevalence of self-reported medical disorders such as CVD and diabetes.

Patterson et al. (2012) investigated the connection between fatigue and self-reported safety outcomes in emergency medical services (EMS) workers. The results of the study showed that most participants experienced fatigue at work and that those participants were at greater risk for a negative outcome related to safety. Interestingly, the authors determined that 24-hour shifts had no greater correlation with these negative outcomes than shorter 12-hour shifts. They speculate about other variables that may influence this lack of relationship.

Shift Duration and Fatigue

One study evaluated the impact of shift duration on emergency care workers by conducting psychomotor vigilance testing (PVT) on participants at the beginning and end of their shifts (Patterson, et al., 2018). The study compared workers during shifts of less than 24 hours to workers during shifts of 24 hours. The authors hypothesized that workers on 24-hour shifts would score worse than workers on shorter shifts. The authors failed to find a correlation in fatigue scores related to shift duration. They referenced three previous studies focused on the relationship between shift duration and performance. Among the three, one study found no correlation, another showed benefits from shorter shift duration, and the third showed benefits from longer shift duration. They recommend further study to contribute to the evidence.

Allison et al. (2022) conducted a review of research that spanned a cross-section of public safety workers and fatigue-related effects. Unique to firefighters, they found workers on a 48-hour shift reported a high amount of daytime sleepiness. Firefighters also experience

performance related effects after even minimal nighttime sleep loss due to workload. They report on the link between shiftwork and CVD, cancer, and other adverse health effects among firefighters. They advocate for further research to evaluate interventions to improve sleep among firefighters to reduce some of the negative effects of shift work.

Klinefelter et al. (2023) evaluated fatigue in emergency physicians (EPs). The research involved interviews with EPs to measure their perceptions about fatigue related issues. The results found fatigue related issues consistent with those experienced by other shift workers. The authors identified "learned helplessness" as a trait among EPs. This was characterized as the notion that fatigue is inevitable and perhaps unable to be mitigated among physicians; that it is a part of their identity as providers. The authors connected this to burnout in this population.

Measuring Fatigue

Patterson et al. (2018) performed a review of literature to identify a reliable tool to evaluate fatigue in EMS workers. Thirty-four studies were reviewed to determine the extent to which they identified a reliable and valid method for identifying fatigue in workers. The authors revealed limited evidence to support the use of a reliable tool to evaluate fatigue in EMS workers. Despite this, the authors remain optimistic that tools commonly used in other populations may prove effective for the assessment of fatigue and sleepiness in EMS workers. Examples of those tools are the Epworth Sleepiness Scale, Karolinska Sleepiness Scale, and Stanford Sleepiness Scale.

Methods to Mitigate Fatigue

Barger et al. (2018) performed a systematic literature review to evaluate the effectiveness of fatigue training on safety among shift employees. The findings revealed positive effects for increasing patient safety, improving provider health, and decreasing provider injuries. They

correlated fatigue training to decreased burnout among providers and improved sleep quality. The authors recommend further research to evaluate which methods of fatigue training yield the best results for providers.

The effect that caffeine has on attention and reaction time was evaluated by Quiquempoix et al. (2023). The researchers performed a double-blind study during which 37 participants received either caffeine or a placebo during total sleep deprivation (TSD). The results revealed that caffeine does have a positive effect on decreasing reaction time during PVT. The effect was more pronounced in participants who were low-caffeine users. Reaction times were higher, even with caffeine, in moderate to high caffeine users.

The question of whether napping during shifts reduces work-related fatigue in public safety shift workers was discussed in a commentary by Patterson et al. (2020). The authors discussed the pros and cons of intra-shift napping in public safety workers, particularly EMS workers. They identify that napping decreases fatigue and sleepiness and leads to an improvement in measurable health effects. Some of the evidence against napping includes negative public perception. One negative performance metric identified by the authors is related to sleep inertia. Sleep inertia is a period of decreased performance after waking from sleep. The authors cite the lack of research involving sleep inertia in EMS workers. They conclude that napping during shifts has positive effects on EMS workers and has further applicability to other public safety workers.

Stockelman et al. (2021) provide a framework for counteracting the negative effects of sleep deprivation on CVD. In a study involving 36 healthy adults, one group maintained normal sleep duration, while the other group had reduced sleep duration. They concluded that regular aerobic exercise has positive effects on endothelial function, which may reduce the risk for CVD.

Synthesis of the Existing Literature

There is a strong theme of negative health effects secondary to sleep deprivation and fatigue in workers. These effects predominantly involve cardiovascular disease, metabolic syndrome, and cancer. There is a consistent reference to the negative effects chronic fatigue and sleep deprivation have on mental health and other cognitive faculties. The "21st Century Fire and Emergency Services" (2020) paper identifies health and wellness as a critical issue. Sleep is mentioned specifically, along with mental health challenges, fitness and wellness concerns, and decontamination concerns. The literature shows that sleep is closely linked with the health issues facing fire and emergency services workers.

There was also a concurrent theme that sleep deprivation leads to decreased cognitive function. The literature showed that participants subjected to sleep deprivation were more prone to accidents and errors. The literature did not reflect an increased correlation between workers on a 12-hour shift vs a 24-hour shift.

The literature is somewhat unclear as to whether shorter or longer duration shifts are more beneficial to workers. Though shorter shifts may intuitively seem more beneficial for workers and organizations, it seems more research is needed to evaluate the link between shift duration and fatigue. Multiple studies addressed the concept of recovery sleep. An area where there appears to be a gap in the literature is in the arrangement of shift days to days off. One study established that most firefighters work 24 or 48-hour shifts (Barger, et al., 2015). Evaluating the relationship between shift days and days off to determine which combinations are most beneficial to emergency services workers seems to be an area in need of research. Most of the literature involved the effect of fatigue on health and the increase in accidents secondary to fatigue. There was less literature on measuring fatigue and efforts to mitigate fatigue in workers.

Summary

Chapter 2 surveyed the literature on fatigue and sleep deprivation and the negative effects it may have on workers. It evaluated the effects of fatigue on aspects of physical and mental health. It also evaluated the relationship between fatigue and accidents or errors. Several articles attempted to establish the link between shift duration and fatigue. The last two subtopics related to evaluating and mitigating fatigue in workers.

The literature review formed a good foundation for understanding the relationship between fatigue and negative effects on workers. Moving forward, it appears there is an opportunity for research into the arrangement of work shifts and days off in firefighters to account for adequate recovery sleep to counteract some of the negative effects of sleep deprivation.

CHAPTER 3: METHODOLOGY

This chapter provides a detailed description of the methodology used to conduct research to investigate the problem of fatigue in the fire service for employees working 24-hour or longer-duration shifts. The literature review narrowed the focus and pointed to a gap in the research that dealt with the arrangement of shifts worked to days off. This arrangement affects how well an employee recovers from any sleep deprivation experienced at work. This chapter will address the research design and outline the populations to be included. It will describe the instruments used in the research. It will also detail the process used to conduct qualitative research and to address ethical considerations.

Research Design

To investigate the problem, various qualitative and quantitative designs were considered, as outlined by Creswell & Creswell (2018). A common quantitative approach involves

investigating the causal relationship of a variable on a subject or population. A mixed-method design would involve the use of quantitative and qualitative research. This study is more focused on the experience subjects have with fatigue. Therefore, a qualitative design was used, as opposed to a quantitative or mixed-method approach. Narrative research, Phenomenological research, including grounded theory, ethnography, and case study were all considered. Generic Qualitative Inquiry was chosen as the design method for this capstone research project. Percy et al. (2015) identify generic qualitative research as an appropriate tool to investigate a participant's life experience. As the purpose of this capstone research paper is to evaluate how employees experience fatigue because of sleep deprivation due to extended shifts, a generic qualitative inquiry was determined to be appropriate. Semi-structured interviews were conducted to evaluate how participants described fatigue related to shift work.

Population and Sample Size

Two fire departments were chosen for inclusion in this study, the Lewiston Fire Department (LFD) and the Pocatello Fire Department (PFD). They were chosen because of their similar demographics. Both departments are of similar size, operating out of 4 and 5 stations respectively. The PFD has 78 line personnel working in a three-platoon system. This accounts for 26 personnel on each shift. The LFD has 56 full-time personnel working in a three-platoon system. This accounts for 18 people on each shift. The LFD does use some part-time personnel to supplement staffing levels. Both departments provide fire, EMS, technical rescue, hazardous materials, and other emergency response. Both departments have a call volume between 8,000 and 9,000 calls per year. Key to this research, both departments have shift schedules that involve 24-hour, or longer duration, work shifts. The LFD schedules fire and EMS responders for 24-hour shifts. Employees work an alternating schedule of 24 hours at a time, every other day for

nine days, followed by six consecutive 24-hour days off. See Appendix A, Figure 3. PFD responders work 48-hour shifts, followed by four consecutive 24-hour days off. The PFD has been on this shift schedule since January 2022.

To evaluate how each shift schedule may contribute to fatigue, six responders from each agency participated in semi-structured interviews. To ensure an information-rich population for participation in this study, purposive sampling was used to determine the sample size (Palinkas, et al., 2015). Percy et al. (2015) describe traditional generic qualitative inquiry as an approach that uses a large sample size when measured against other qualitative approaches. The use of an information-rich sample size supports the smaller sample size in this study. The inclusion criteria for participation required them to have worked on shift for at least one year before participating in the interview. This was to ensure that participants were accustomed to shift work and that a new employee who had only been working shift work for a few weeks was not included in the study. Participants must also be full-time employees. Employees had to be working 24-hour or longer duration shifts as a firefighter or EMT.

Instruments

Interviews were conducted via Zoom to provide a consistent platform and methodology. The use of Zoom was chosen over in-person interviews due to the distance to one of the sites. The use of Zoom made it possible to record the interviews for archiving. Zoom has a built-in feature that was used to generate a transcript of the interview. The list of participants was randomized, and each participant was assigned a participant number. The transcript was cleansed to remove any names or overtly identifiable information. The assigned participant number was substituted for the screen name that appeared in the Zoom transcript. The transcript was processed using QDA Miner Lite, a data analysis software platform. Transcripts were uploaded

to QDA Miner Lite to facilitate coding. Forty-seven initial codes were used. The codes were later merged to develop thirteen themes that emerged in the interviews.

An introduction to provide a background of the research was emailed to the participants. A consent form, developed by the National Fire Academy was attached to the email. See Appendix B.

Before the interview, questions were developed in line with the research questions identified in Chapter 1. The questions were then field tested by two professors at Idaho State University. One professor was from the Psychology Department. The other was from the Political Science Department. Both professors are familiar with various research methods and provided valuable feedback. Feedback from the evaluators was gathered before finalizing the interview question set. The semi-structured interview set consisted of 11 questions, some including additional sub-questions, that were asked of each participant. See Appendix C.

Research Process

The research process began by contacting the respective administrators in the two departments. For the Lewiston Fire Department, Chief Gregory Rightmier, authorized research to be conducted at his worksite. As the Fire Chief for the Pocatello Fire Department is the researcher for this capstone research paper, the Mayor of Pocatello, Brian Blad, authorized research to be done. In each worksite, participants who met the inclusion criteria were solicited via email to volunteer for the study. Volunteers were asked to email the researcher directly. Once a list of volunteers was compiled by the researcher, participants were chosen using a random number generator to select the individuals to be included in the study.

The researcher contacted potential participants to inform them that they had been selected. An introductory email and consent form were sent to the participants. Once the

participants returned the consent form and elected to participate in the study, the researchers reached out to determine a time for the interview.

The participants were informed that their involvement in the study was purely voluntary. There was no compensation or other incentive for participation. They were informed that a decision not to be involved or to withdraw from the study would not result in any adverse consequences, either in their employment or otherwise. They were informed that their involvement in the study would be confidential and that their name and any other personally identifiable information would be masked. The participants would be given a numerical designator, and the only information that may be revealed about them would be the shift schedule that they work. The participants were also told they would receive a copy of the study when completed.

After the appropriate information was presented to participants, and consent was obtained, the interviews were conducted using Zoom. The interviews were recorded and later transcribed to allow for evaluation and coding of responses. The interviews and all records were maintained by the researcher and will be retained as required by federal statutes.

Transcripts from each interview were coded using a web-based qualitative data analysis software platform, QDA Miner Lite. The data was then organized and evaluated to determine themes to give insight into the research questions.

Ethical Considerations

The researcher took many steps to ensure each participant's rights and welfare were protected during the study. The American Psychological Association outlines considerations for ethical research (2020). Participants were well-informed during the study and provided informed consent before participation. Participants could choose to be included or excluded from the study

at any time with no consequences to them or their employment. Their employer was not informed about their involvement, or lack thereof, in the study. The researcher ensured that participants of the study were protected from any physical or psychological harm during the study. Care was taken to ensure no one not associated with the study had access to any personally identifiable information related to the study.

To ensure that confidentiality was maintained, the researcher used strategies to disguise the characteristics of the participants. Participants were chosen based on their schedules. In this manner, a participant's department could be inferred based on their schedule. Outside of that information, a participant's gender, age, rank, platoon, and any other personal demographics were masked after the interview. To track and report on data, participants were assigned a generic numerical identifier.

The researcher is the Fire Chief of one of the departments included in the study. As such they are a ranking officer over some of the participants. The researcher has long-standing personal and professional relationships with many of the participants. The researcher worked on shift for 18 years at one of the departments. Both factors could impart bias into the study. The researcher acknowledged their previous experience and relationship with the department and the participants to maintain objectivity in conducting research and reporting results.

To address the researcher's role in the organization, previous associations with participants, and previous experience, the researcher used the concept of reflexivity as identified by Creswell & Creswell (2018). Reflexivity recognizes that the researcher's experience, role, cultural history, gender, and other factors affect their interpretations during the research process. During the process, the researcher took steps to separate their experiences and interpretations

from the data obtained through participants. Only the data and results derived from participant interviews were reported.

To maintain data security and comply with retention requirements, the researcher maintains all raw data on a private Google Drive. The data will be stored for four years. The data is available by contacting the researcher directly. The only limitation on sharing would be if it in any way compromised the confidentiality of participants.

Summary

Chapter 3 outlined the research design developed to investigate the research questions. A generic qualitative inquiry was chosen as the design method of the study. The chapter identified the organizations chosen to participate in the study and the rationale for their inclusion. Population size and parameters were explained. Participants from each organization were interviewed using a semi-structured format. The instrument to conduct research was accounted for. Following the interviews, the results were transcribed and coded to analyze themes. A detailed description of the research process was described. To fully address any ethical considerations a description of steps taken to protect participants and minimize any bias was presented. The next chapters will present the study results and draw conclusions based on the data.

CHAPTER 4: STUDY RESULTS

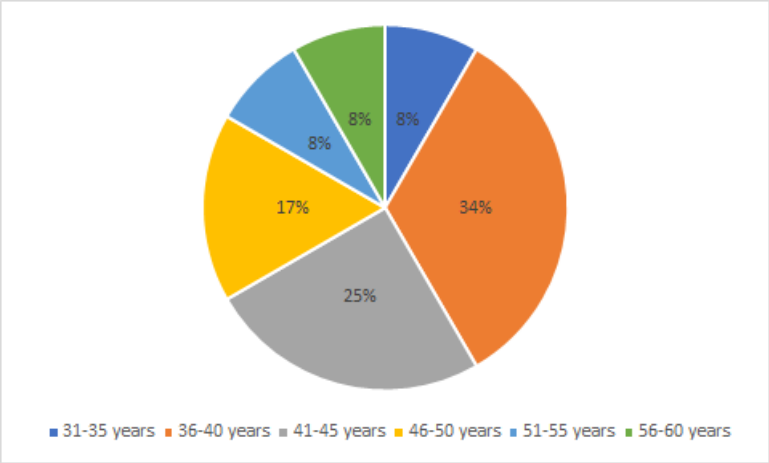
Introduction – Demographics of the Participants

This study involved interviews with 12 career firefighters in two different departments. Six members each from the Pocatello Fire Department and Lewiston Fire Department participated. The race and gender of all participants were recorded as White male. This is

reflective of the overall racial and gender makeup of the two departments. The age range of participants was from 30 to 60 years of age. Figure 1 shows the age distribution of participants.

Figure 1

Age distribution of participants



The interview consisted of a semi-structured interview conducted over Zoom. The interviews were recorded, and a transcription was obtained using the platform's built-in audio transcription feature. The transcripts were cleansed of any personal information and assigned a randomized participant number. The transcript was uploaded into QDA Miner Lite, a free qualitative data analysis software. The transcripts were all initially coded for content. Following initial coding, similar codes were merged. The codes were grouped to develop themes.

Thirteen themes emerged that addressed the research questions. The main themes will be addressed based on their alignment with the three research questions in this capstone research paper. The first research question explored how employees working 24 or 48-hour shifts describe their fatigue. The second research question investigated how employees perceive their employer's efforts to address fatigue. The third question addressed what strategies may be effective to mitigate fatigue. Though the themes are presented as they apply to the research

questions, many of the codes and themes have some overlap that may apply to different points of the research questions.

Research Results

The first research question focused on how employees describe their experience with fatigue. Multiple themes emerged that focus on the effects of fatigue. The dominant effect described by participants dealt with the mental health and behavioral effects of fatigue. The other effects described by participants focused on job assignment and workload factors.

The dominant theme related to the first research question was the effect fatigue has on mental health and other behavioral effects. Eleven of the twelve participants had responses that were coded under this theme. One of the codes related to mental health and behavior changes was ‘short temper’. Seventy-five percent of the participants used phrases such as “getting short”, or irritable, with co-workers and patients. Participant 1 reported. “You got your kids that are doing this or that you know. Sometimes you get a little more short [*sic*] with them”. Participant 9 reported this about irritability. “It in the past has definitely affected my marriage.”

Similar descriptions about having a short temper developed as participants described the effect fatigue has on their patient care. Participant 8 reported having a “short fuse” with patients. Participant 1 remarked that when you’re fatigued, “you’re a little more short [*sic*] with patients.” Participant 1 went further to describe how fatigue can affect more than just being short with patients. Participant 1 continued by saying, that when they are fatigued, they are “a little more quick [*sic*] to just get him [the patient] to the hospital. Maybe not do as thorough of an assessment.”

Many participants made the connection between symptoms such as a short temper to the greater impact that fatigue has on mental health in general. Participant 12 commented on the

reality of the effect fatigue has had on him. “I wasn’t the exception, because I feel like a lot of firemen always think they’re the exception.” They concluded by saying “And then when you kinda [*sic*] figure it out. You’re like, Oh, I’m not different”. A similar sentiment about mental health was a common thread among the participants. When asked about the effects of fatigue, Participant 2 responded “I think fatigue is a huge contributor to my mental health, my emotional health. If I’m not getting a lot of sleep, I feel like it affects my decision-making.” There were no codes that indicated a participant didn’t feel fatigue negatively affected their mental health.

A second theme emerged which related to research question one that dealt with job assignment and workload factors. One of the codes that was grouped in this theme dealt with overtime, or extra hours of work. Many of the participants described circumstances where they were forced to work overtime due to a staffing shortage. In other words, they were not allowed to go home on their day off to rest. Instead, they had to remain at work due to staffing shortages. Participant 3 reported “There’s a lot of overtime. So anytime people are on extended shifts for beyond 24 hours, we definitely try to give them some space, some time to get away and try to decompress and rest best [*sic*] they can.” This participant shared the sentiment of others that the requirement to work extra hours, or even the constant requests to work extra hours, negatively impacted their days off. Participant 7 commented on this by saying “I think that if we didn’t have the overtime issue, your twenty-four hours in between would be good rest to get going.” Some of the participants reported being resistant to taking overtime. Participant 12 said, “I don’t like to come in for overtime. I feel like there’s a very big wall that I’ve put up because of the different strategies to just keep me still liking work”. Almost half of the participants tied overtime to an increase in fatigue.

When asked whether 24-hour shifts, or even longer, were the best option for fire and EMS scheduling, almost all participants replied that they were. Participants used phrases such as "it's the ideal," and "I think a 48-hour shift [is best]." However, not all were as resolute. Some questioned whether shorter shifts may be better. Those participants speculated that "12-hour shifts would probably be better," and "I think 24-hour [shifts] are detrimental to our health." Some who questioned whether shifts shorter than 24 may be more beneficial also pointed out that 24-hour shifts are part of the attraction of the job. Participant 3 commented. "Part of the reason I got into it is also because I like my days off." Participant 10 shared that sentiment, proclaiming "That's why we do the 24-hour shift. We can get the days off." Both participants identified that working shorter shifts would mean more days when an employee would have a work shift. Those commenting on shifts shorter than 24 hours concluded they didn't have enough information to definitively say what may be best, as only one participant had worked in a system with shorter shifts. The participants all seemed to conclude that 24-hour, or longer, shifts were appropriate given their current call volume.

Most participants mentioned call volume or apparatus assignment as a factor in their experience of fatigue. Participant 8 commented, "Our run volume at night is pretty significant for all stations." A common theme emerged among participants that call volume and apparatus assignment affect fatigue. Participant 6 identified this difference. "I understand it's probably very different for our medics who are working full-time on an ambulance versus someone who's driving the engine." Several participants commented on the increased call volume related to being a 'medic' or being assigned to an ambulance. Participant 11 relayed a story about a coworker's response to call volume. "They get a call and it's just instantaneous. . .. It's almost like they're overwhelmed. They're like, Oh! here we go again. . .. You just get wore [*sic*] out."

The comment referred to the response of a coworker assigned to the ambulance when they were alerted for a response.

This stress in coworkers can manifest in different ways. This concept was coded as crew dynamics and is related to the theme of job assignment and workload factors. Participant 12 provided two perspectives that demonstrated positive and negative experiences with crew dynamics. “I didn’t realize how much emotional energy it took, and that was [*sic*] my burnout was having to just keep him in line.” They went on to contrast that example with one about a positive experience related to coworkers and call volume.

> We got burned out and fatigued because our call volume is high. . .. But the right partner, we’re laughing. We’re having fun doing it. . .. You’re a little sleep-deprived, but that’s no big deal. But, I’m not expending all this energy of managing a partner or managing a toxic crew. . .. It takes so much energy, so much energy [*sic*] with the wrong crew and the wrong partner.

The themes related to the research question led many to comment on how organizations recognized or addressed fatigue.

Four themes emerged during the interviews that relate to the second research question of how employees perceive their organization’s efforts to address fatigue. The first theme describes the employee’s impression of how important it is to address fatigue. The second theme addresses how often fatigue is discussed or recognized by labor and management. The third theme deals with the organization’s efforts to address fatigue. The fourth theme focuses on shift design, how days worked to days off are arranged, and how that may relate to fatigue.

The first theme did not contain multiple codes. It was intended to gauge how important efforts to address fatigue are to the participant. The interviewer asked the participant to compare

the importance of addressing fatigue to the fire service's efforts to address other issues such as cancer, mental health, and cardiovascular health. Nine participants responded that fatigue should be addressed with as much importance as the other topics. Participant 9 responded by saying "I would argue that there's a direct correlation to cancer rates and cardiac issues in the fire service because of fatigue." Eight other participants shared similar sentiments about fatigue being included in the discussion of important health topics in the fire service. However, not all participants shared the same perspective. Participant 1 disagreed when asked the same question.

> You know I [*sic*] maybe not as much. I think fatigue can lead to those. I think that's something that affects it a lot is, if you know your fatigue, those things, I think start to become more of a major concern for individuals. . .. I would say it's worth having discussions about, maybe not to the extent of like the mental health of PTS [post-traumatic stress].

Two other participants did not address the question. The question was not asked of one participant. Another participant did not address the question directly.

The participants were asked about the extent to which fatigue is discussed formally by management or labor as an issue. There was a mixed response to this question. Some participants reported that there was a lack of formal discussions about fatigue. Participant 1 responded. "I don't think there's [*sic*] a lot of conversations." Participant 10 reported. "So there's no [*sic*] nothing in writing and nothing official." The participant expanded their answer:

> It's really not. . .. He [the chief] didn't really follow through with anything to change fatigue. . .. So, there's zero follow-through. If it's been brought up, it's just brought up because [*sic*] to talk about it. But there's no follow-through to change any firefighter fatigue.

Other participants felt that fatigue is discussed more formally and recognized in their organization. Participant 3 reported “Absolutely, they definitely recognize it. Mostly because we’re working a lot of extra overtime now . . .. We’re just trying to come up with all kinds of different options to change what we currently do.” Several participants reported their organization had enacted a policy that prevents workers from working more than 72 hours in duration. They reported this was done as an attempt to minimize fatigue in workers.

A common theme emerged in responses about organizational efforts to address fatigue. Most participants felt that it was being addressed at the line level, by mid-level supervisors such as captains. Participant 11 described it this way.

> The option has been kind of given to the captains to recognize, you know, when something is start [*sic*] is standing out that they can tell their guys, hey go take a quick nap. Or, if they need to, you know, maybe rotate them out to [a] . . . slower station.

This sentiment was shared by many participants. The responses revealed that many didn’t think there needed to be a formal effort to address fatigue provided mid-level supervisors are empowered to make decisions to address fatigue in their people.

When asked if fatigue is effectively assessed in fire and EMS workers, most participants agreed it is not. Participant 11 reported the assessment of fatigue that is happening as “peer recognition”. Other participants all agreed that it is not effectively assessed. Participant 1 remarked, “I don’t think so, and I think part of the problem with it is it’s a very difficult thing to measure.” Participant 4 described an effort their organization had made to measure fatigue in this way.

> I don’t think that my fatigue has ever been assessed in a way that I found meaningful. I think somewhere along [the] line, someone should come up with a good way of like [*sic*]

> assessing fatigue. . .. I feel like if someone came up with a well-intentioned set of measurements and tests to monitor and study and keep track of you know, fatigue in first responders, that would be a good thing. I think where you might run into problems is if you make it in any way, I mean obviously it wouldn't have [*sic*] it couldn't be punitive. And, ideally, it could be set up in a way that could be voluntary.

This leads to a theme that emerged from the interviews that focused on organizational efforts to address fatigue. One of the codes addressed napping. All participants were asked how their organization addresses napping during the day as a method to mitigate fatigue. None of the participants reported that napping was forbidden or even discouraged in their organizations. Participant 6 reported, "Well if it's not encouraged, it's certainly allowed [by management]." Participant 5 said, "I don't think that is such a negative thing anymore." Participant 8 reported, "They encourage it, sadly there is not a quiet space in any of the stations [to get good rest]."

Other codes that emerged dealt with the organization's effort to address fatigue. They included a workload decrease or staffing options. This is manifested by moving an employee from a busier apparatus or station to a slower one. Participant 10 described it this way.

> I think it'd be great if people move[d] from, you know, less busy apparatuses to more busy apparatuses. I mean we all get paid the same, and we're all doing the same job. We're all qualified to do the same thing. And, if people kind of help share the workload, I think it would be less stress [*sic*] on certain people for sure.

Many of the responses addressed the workload of 'medics' or paramedics and their assignment on the ambulance. Participant 11 said.

> We've sent some of our 'medics' out to, you know, our slower station . . . for just a chance to be off the ambulance. . .. That call volume is definitely decreased. And, from

> what I've seen, when they come back to the ambulance, . . . they've had the opportunity to get their batteries recharged a little bit.

One the main themes that addressed research question two is the impression that participants had of their shift design. The participants were all asked about the relationship between their days worked and days off and the effect it had on their fatigue. Two codes addressed the participants' impressions of the 48/96 schedule and what will be referred to as the 5/6 schedule. On the 48/96, an employee is at work for 48 hours straight and then has 96 hours off. On the 5/6 schedule, an employee works every other day for nine days and then has six consecutive days off. Though none of the participants currently work a 3/4 schedule, it was referred to by some. On the 3/4 schedule, an employee works every other day for five days and then has four consecutive days off. The 3/4 schedule is also referred to as the Modified Detroit schedule.

All participants who reported working the 48/96 preferred it to their previous schedule of the 3/4. Participants were quoted as saying, "Only having worked these 2 [the 48/96 and the 3/4], you know, like I would say the 48 [is the best]." Participant 12 reported, "The 48/96, as a medic, is so much better." The participant went on to say this when asked about shift design and its effect on fatigue. "Oh, definitely Modified Detroit was horrific for me. Yeah, I struggled a lot with it. I'd say I used a lot more sick time back in those days." Participant 11 shared a story about their son that related to being short-tempered, but it also connected to the theme of shift design. They commented, "My son, who at the time was pretty young, came up and sat next to me and asked me, he's like, when are you gonna [*sic*] start working the other schedule again because you're mean." Participant 4 elaborated on their experience between the 48/96 and the 3/4.

> On the previous schedule [3/4] . . . I did not find those 24-hour periods between the days we worked to be much to me [*sic*] for recovery. It just felt like a five-day work shift. And I was not ready to go back to work on the second and third days of those sets at all.

Some participants working on the 5/6 were uncertain or hesitant about the 48/96 schedule. Participant 7 reported "I know that there's been a big push. . .. To go into [*sic*] the 48/96. I don't feel 96 hours is enough after a 48-hour [shift]." They also said "I've worked the 3/4. I've worked the 5/6. I like both of those schedules. I like the 5/6 better." Other participants working the 5/6 schedule described the period of alternating workdays and days off as having an impact on their fatigue. Participant 3 commented "I do know that the prolonged 5/6 definitely takes a wear [*sic*] on you. Yeah, that extended nine [to] 10-day period, it definitely takes a toll." Participant 5 said this about alternating days.

> The first couple of shifts it doesn't seem to be all that noticeable. But I'll tell you by that fifth shift, especially when I was on an ambulance, you know the busy and younger I was. I was dragging at the you know [*sic*] fourth and fifth day of work. And it just didn't seem like anything I did was [*sic*] I was feeling recovered enough. And then it seemed like it took about two to three days into my Kelly days [days off] where I actually started feeling recovered. And that's if I focus on the recovery and not just you know working overtime or getting mandatory [extra required shifts].

During the discussion about shift design, seven participants mentioned a four-platoon system. Many of the participants were curious about the four-platoon system. Participant 9 said, "I think a fourth platoon would be awesome to get to that kind of a schedule." They continued: "I was just in Spokane the other day and they run a four platoon, and they run a 24/72 [shift schedule]. That [sic] and I believe I read somewhere. [sic] But I think that is probably the best

for us health-wise." In a four-platoon system, an employee works one out of every four days. This equates to a 42-hour work week. An example of the four-platoon schedule is shown in Figure 4 in Appendix A. In a three-platoon system, an employee works one out of every three days. A three-platoon system equates to a 56-hour work week. All participants were working in a three-platoon system at the time of the interviews.

The participants' impressions of their fatigue as it related to their work shifts and days off led to the topic of sleep quality. These questions produced themes related to the third research question; what strategies may be effective at mitigating fatigue?

The main theme that addressed the third research question is sleep quality. Participants were asked questions about the quality of their sleep while at work. There was a span of different responses. Participant 1 reported, "I would say its adequate." They went on to say, "For the most part, if I choose to go to bed, I'm able to kind of [*sic*] relax and recover." On the other end of the scale, Participant 8 responded "Completely inadequate," when asked about the quality of their sleep at work. Participant 3 elaborated on that notion, "You're always sleeping on edge anyways. I mean you never really get a good night's sleep" Several participants referenced this notion of being 'on edge' when trying to sleep, either in themselves or their coworkers. One participant called this 'pre-call anxiety'. There was a spectrum of responses between adequate sleep and terrible sleep at work.

Participants were also asked about the quality of recovery sleep on their days off. Most participants reported they were able to get good sleep. Participant 2 described their off-duty sleep as "excellent." Participant 7 said "I go to bed on my days off. It's you know usually pretty early. [I] get good sleep. Get up. I feel rejuvenated in the morning." They went on to say "Of course you're gonna [*sic*] have those days where you just don't. That's normal."

Most participants reported getting good sleep at home. However, a few reported mixed quality of recovery sleep. Participant 3 shared this experience.

> I used to be pretty good at sleeping throughout [*sic*] the night previous [*sic*] to doing this profession. So I definitely think that its definitely [*sic*] been affected in the negative. . .. I just don't think you can every really catch up. I definitely think I always feel behind.

Participant 8 also reported some difficulty with recovery sleep. They said "I feel the days that [*sic*] the tweener [days in between work shifts] you do not get as good of rest typically." There was a sense by multiple participants that the quality of recovery sleep on the nights in between work shifts was not as good as on the four or six days stretches of days off.

Several participants reported using medications on their days off to help them get recovery sleep. They reported they did not use these medications when at work. Several participants had answers that were coded as 'sleep hygiene'. A few participants also reported that drinking alcohol before bed negatively affected their sleep quality. Participant 5 said "I've also just focused on a good sleep regimen. Making sure that, you know, no alcohol before I go to bed and using my days [off] for actual recovery." Multiple participants referenced a sleep regimen or sleep hygiene, which are habits they have adopted to help them get a better quality of sleep at home and work. Participant 2 described their sleep hygiene.

> Shutting off my computers and phones, all that stuff at 8 o'clock. And then trying to be in bed going to sleep by 10 o'clock. And so, I think just having those habits has helped me get good sleep even when we get woken up [*sic*] I can come back and go right back to sleep.

Participant 2 said they used this sleep hygiene routine at work and at home to improve sleep quality. One of the tactics participants reported as a part of their sleep hygiene included tracking their sleep with a smartwatch.

A final theme related to mitigation of fatigue deals with the physical environment in stations. Four participants discussed the toning system that alerts responders of an emergency. Participant 5 reported that their organization had open dispatch for many years. Responders would have to listen to radio traffic even if it didn't involve their station. Participant 7 identified this issue. "I'm on an engine company right now, but every time the tones drop for the medic boys, you still wake up."

Summary

A generic qualitative inquiry was performed using 12 participants from two different fire departments. The interviews with participants provided a good understanding of their experience with fatigue. Two main themes emerged that addressed the research question of that experience. They were mental health and behavioral effects and job performance factors. Multiple themes were connected to the second research question of the participant's impression of the organization's efforts to address fatigue. Those themes were the importance of addressing fatigue, discussion about fatigue, efforts to address fatigue, and shift design or workload factors. The final themes addressed the third research question of methods that may be effective at mitigating fatigue. Though there were commonalities in the themes, there were also many differences. The responses did not result in a homogenous experience of fatigue or an agreement on the factors affecting it. Chapter 5 will conclude by interpreting some of the results. It will provide recommendations that may be helpful as organizations and employees look to address fatigue in fire and EMS workers working 24-hour, or longer, shifts.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

Summary of the Results

The research problem that guided the interview questions is that fatigue has not been effectively addressed in the Pocatello Fire Department. The three research questions are listed below. Several themes emerged from the interview results. They are listed below the research question that they address:

1. How do employees working 24 or 48-hour shifts describe their fatigue?
    a. How fatigue affects mental health and behavior.
    b. What job assignment and workload factors affect fatigue?
2. How do employees perceive their organization's efforts to address fatigue?
    a. How important is it to address fatigue?
    b. How often is fatigue discussed formally by labor and management?
    c. What efforts do organizations make to address fatigue?
    d. What experiences do participants have because of shift design?
3. What strategies may be effective at mitigating fatigue?
    a. How do participants describe their sleep quality?
    b. How may the physical environment affect fatigue?

The results provided a good understanding of how employees experience fatigue. Participants shared insights about how they are affected by fatigue and what things contribute to their experience. This chapter will focus on those insights. It will interpret the themes to make recommendations for management and employees to begin addressing fatigue in their organizations. This will result in a healthier employee group that is more resilient and capable of serving their community.

Conclusions Based Upon Your Results

The interviews began by asking participants about their experience with fatigue. The overwhelming majority responded that fatigue has had negative effects on their mental health and behavior. These findings reflect those Kelly et al. (2021) identified in the literature review. The majority of answers related to being short-tempered or irritable with patients, family members, or coworkers. This type of irritability affects relationships and negatively impacts patient care. The effect on mental health can also be more serious than just being irritable. Several participants connected fatigue to post-traumatic stress disorder or injury (PTSD or PTSI). Fatigue may contribute to or reduce resilience related to PTSI. Fatigue also negatively impacts organizational culture. In this way, one member's fatigue could negatively affect other individuals.

Workload, apparatus assignment, and call volume all emerged as factors that influence fatigue. Mandatory overtime increases an employee's fatigue due to the additional hours of work. Depending on an employee's fatigue level when they are required to work mandatory overtime, the effect may be compounded. Often employees are required to stay at work because of personnel shortages. This indicates that an employee is likely in a fatigued state when required to remain at work to cover the staffing shortage.

Most participants also commented on being assigned to the ambulance. EMS is a large component of both departments' services. The ambulances seem to have a much larger workload and call volume than fire apparatus. This additional workload may cause greater fatigue in paramedics and those assigned to the ambulance than those assigned to fire apparatus. Rotating personnel to a slower apparatus or station relieves some of that workload and was reported to have a positive effect on fatigue.

Efforts to address fatigue should be prioritized at the same level as efforts to address cancer, mental health, and cardiovascular health in fire and EMS agencies. The responses by participants reflect the initiatives outlined in the 21st Century White Paper (2020) to address the critical issue of health and wellness. Participants felt organizations fell short of formally addressing fatigue through discussions or policies. Fatigue is predominantly being addressed by mid-level managers. This component is important for organizations. Mid-level managers, or captains, are in the best position to recognize fatigue in individuals and address it most directly.

All participants reported that napping was allowed or encouraged in organizations. This was facilitated mostly at the mid-level management level. In the literature review, Patterson et al. (2020) reported that one of the reasons that napping may be prohibited in work environments is due to the potential negative public perception surrounding it. Napping did not seem to carry any of the negative connotations according to the participants. Most reported napping while at work or home. Participants felt it was an effective method to mitigate fatigue.

One theme of significance for organizations is the arrangement of their shift schedule. The 48/96 schedule seems to have reduced fatigue in the participants who switched to it. It is reported to allow for better recovery on days off. Alternating shifts seem to negatively impact fatigue by not allowing for recovery sleep before returning to work. The cumulative effect of fatigue without recovery prolongs the time that an employee is fatigued. Though some participants were hesitant about the 48/96, it appears to have some benefits regarding fatigue.

The four-platoon system was an unintended subject that emerged from the interviews. Many employees mentioned this and thought their organizations should evaluate this as an option. A four-platoon system would require more employees than a three-platoon system if the

number of units and 24/7 response model remain unchanged. Reducing the hours worked in a week may have a corresponding positive effect on employee fatigue.

Investigating a participant's sleep quality was the focus of two of the interview questions. The ability to get quality sleep is lacking for most participants while on shift. Many participants mentioned sleep hygiene specifically. Sleep hygiene may include things such as reducing exposure to blue light and going to bed at a particular time. Good sleep hygiene leads to better sleep whether an employee is at work or home. Sleep hygiene is something the individual or the organization can adopt or promote. The physical environment in stations affects the sleep quality of employees at work.

Limitations

The sample size from each department was six participants. A total of 12 participants were interviewed. This sample size reflects just under 10% of one department and just slightly over 10% of the other. The results showed a correlation between fatigue and shift design. A more stringent study, which controls for independent variables, may provide a better causal link between fatigue and shift design. Several participants mentioned the four-platoon system as a possible way of mitigating fatigue. None of the participants have any experience working in such a system. Though the four-platoon system may reduce fatigue, this study was not able to evaluate that effect.

The study was limited to two departments in the Intermountain West. The demographics of the sample population reflected that of both agencies. However, the results cannot be generalized to Idaho or the United States Fire Service as a whole because of the limited number of departments and the small sample size involved. A qualitative study involving a broader sampling of departments from around the country, with a more diverse population of

participants, may yield more potential for sample-to-population generalization as described by Shkedi (2005).

The researcher is the fire chief of one of the agencies. There were instances during the interviews when the researcher was referred to as chief by some of the participants. This occurred during interviews with participants from his organization and with participants outside his organization. This demonstrates that, despite efforts to downplay rank structure, some of the participants recognized rank. This may have influenced participants' responses. Interviews conducted by someone outside the organization may have reduced the potential for bias related to rank.

Implications and Recommendations to the Field

Based on the results of this study there are several recommendations to address fatigue. As a first step, organizations should openly recognize the reality of fatigue in employees and some of the difficulties with managing it. Management should make fatigue a topic of discussion with labor groups and employee representatives. The "21st Century Fire and Emergency Services" paper could be a starting point. Both should collaborate on strategies to address fatigue in organizations. One method is to demonstrate leadership by empowering mid-level managers to address fatigue. Another tactic involves rotating employees from busier apparatus and stations to slower ones. In addition to relieving some fatigue, it may have additional benefits related to training or response. In the long term, agencies should address staffing levels to reduce mandatory overtime to the extent possible.

A second recommendation for organizations is to evaluate their shift schedule. The 48/96 schedule appears to yield positive effects for the employees who switched to it from the 3/4 or modified Detroit, schedule. Combining days off into a long stretch of four days seems to provide

for better recovery from fatigue. Days off in between work shifts do not seem to adequately allow for recovery from fatigue. Several participants conveyed the perception that the 48/96 schedule is detrimental to employee fatigue. The results indicate otherwise. Organizations must take call volume and other factors into consideration. Shift design is likely not a one-size-fits-all solution. Organizations may also investigate a four-platoon system as an option, though the benefits of that system were not evaluated in this study.

A final recommendation for organizations and individuals is to promote a culture of good sleep hygiene at work and home. The Centers for Disease Control and Prevention (CDC n.d.) recommends adopting a consistent time to go to bed and wake up each day. They also recommend a quiet dark bedroom and limiting exposure to electronic devices before bed. Individuals should avoid stimulants or alcohol before attempting sleep. Organizations should consider some of the components of good sleep hygiene in station design. There are options for station alerting that only alarm in the rooms of the employees that are assigned to an apparatus being called out. This may help facilitate better sleep for employees not being alerted to a call.

Recommendations for Future Research

The literature review identified a gap in academic literature. The gap relates to the study of shift design and the relationship between workdays and days off and their effect on fatigue. This study showed a correlation between shift design and fatigue. This study took a more general approach to fatigue in fire and EMS workers. A study that is more focused on the research question of shift design and its effect on fatigue would provide more conclusive evidence.

During this study, several participants mentioned a four-platoon shift schedule. This schedule reduces the number of hours worked by an employee from 56 to 42 hours per week. A

study comparing the three-platoon and four-platoon schedules is recommended. The study could evaluate many metrics. One of the metrics should be fatigue in employees.

Conclusion

This capstone research paper involved a thorough literature review on the topic of fatigue and its impacts. It included a study that involved members from two career fire and EMS departments to uncover their experiences with fatigue. It determined that fatigue is a problem experienced by fire and EMS workers. If unaddressed, fatigue may lead to other problems as outlined in the literature review.

Organizations wishing to take a holistic approach to employee health and wellness were provided guidance on recognizing and addressing fatigue in their agencies. Several recommendations were made to address fatigue. The recommendations include working with employee groups to address fatigue using low-cost short-term tactics. The recommendations also included more long-term tactics that involve staffing changes and shift design. It is hoped that this capstone research paper will generate an awareness about fatigue in fire and EMS workers. Organizations that address fatigue more effectively will have a healthier, more resilient workforce. This workforce will be able to respond to the needs of the communities more effectively.

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Appendix A

Shift Schedules

Figure A1

Modified Detroit or 3/4 schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
A Shift	B Shift	A Shift	B Shift	C Shift	B Shift	C Shift
A Shift	C Shift	A Shift	B Shift	A Shift	B Shift	C Shift
B Shift	C Shift	A Shift	C Shift	A Shift	B Shift	A Shift
B Shift	C Shift	B Shift	C Shift	A Shift	C Shift	A Shift
B Shift	A Shift	B Shift	C Shift	B Shift	C Shift	A Shift

Figure A2

48/96 schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
A Shift	A Shift	B Shift	B Shift	C Shift	C Shift	A Shift
A Shift	B Shift	B Shift	C Shift	C Shift	A Shift	A Shift
B Shift	B Shift	C Shift	C Shift	A Shift	A Shift	B Shift
B Shift	C Shift	C Shift	A Shift	A Shift	B Shift	B Shift
C Shift	C Shift	A Shift	A Shift	B Shift	B Shift	C Shift

Figure A3

5/6 schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
A Shift	B Shift	A Shift	B Shift	A Shift	C Shift	A Shift
C Shift	A Shift	C Shift	B Shift	C Shift	B Shift	C Shift
B Shift	A Shift	B Shift	A Shift	B Shift	A Shift	C Shift
A Shift	C Shift	A Shift	C Shift	B Shift	C Shift	B Shift
C Shift	B Shift	A Shift	B Shift	A Shift	B Shift	A Shift

Figure E1

Four-platoon schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
A Shift	C Shift	B Shift	D Shift	C Shift	A Shift	D Shift
B Shift	A Shift	C Shift	B Shift	D Shift	C Shift	A Shift
D Shift	B Shift	A Shift	C Shift	B Shift	D Shift	C Shift
A Shift	D Shift	B Shift	A Shift	C Shift	B Shift	D Shift
C Shift	A Shift	D Shift	B Shift	A Shift	C Shift	B Shift

Appendix B

Interview Consent Form

Identification of Investigators & Purpose of Study

You are being asked to participate in a research study conducted by John R. O'Hearn from the National Fire Academy (NFA) and Columbia Southern University. The purpose of this study is to develop a better understanding of a critical issue in the fire and emergency services. This study will contribute to the researcher's completion of their final project for the Executive Fire Officer program.

Research Procedures

Should you decide to participate in this research study, you will be asked to sign this consent form once all of your questions about the study have been answered to your satisfaction. The study consists of an interview that will be administered to individual participants. You will be asked to provide answers to a series of questions related to your experience within a particular community. **A video recording of the interview will be taken for transcription purposes. The audio file will be deleted at the conclusion of the study and will not be shared with anyone other than the researcher.** You may turn off your camera if you do not wish to be filmed.

Time Required

Participation in this study will require approximately 60 minutes of your time.

Risks

The investigator does not perceive more than minimal risks from your involvement in this study (that is, no risks beyond the risks associated with everyday life).

The NFA, Columbia Southern University, and its contractors take no responsibility for the actions or outcomes of the research study.

Benefits

There are no direct benefits to the participant; however, information from this study may benefit your, and other communities, in the future.

Incentives

There are no incentives (financial or otherwise) associated with participation in this study.

Confidentiality

The results of this research will be presented to NFA and Columbia Southern University program faculty and students. The results of this project will be coded in such a way that the respondent's identity will not be attached to the final form of this study. The researcher retains the right to use and publish non-identifiable data. While individual responses are confidential, aggregate data will be presented representing averages or generalizations about the responses as a whole. All data will be stored in a secure location accessible only to the researcher. Upon completion of the study, all information that matches up individual respondents with their answers (including audio and/or video recordings) will be destroyed. Final aggregate results will be made available to participants upon request.

Participation & Withdrawal

Your participation is entirely voluntary. You are free to choose not to participate. Should you choose to participate, you can withdraw at any time without consequences of any kind.

Questions about the Study

If you have questions or concerns during the time of your participation in this study, or after its completion, or you would like to receive a copy of the final aggregate results of this study, please contact:

John R. O'Hearn
Student
National Fire Academy
ohearn72@gmail.com

Dr. Justin Heim
Course Manager
Columbia Southern University
Justin.Heim@columbiasouthern.edu

Giving of Consent

I have read this consent form, and I understand what is being requested of me as a participant in this study. I freely consent to participate. I have received satisfactory answers to my questions. The investigator provided me with a copy of this form. I certify that I am at least 18-years of age.

☐ I give consent to be filmed and audio recorded during my interview. _____ (interviewee initials)
☐ I give consent to be audio recorded during my interview. _____ (interviewee initials)

Interviewer Signature		**Date**:	

Interviewee Signature		**Date:**	

Appendix C

Interview Questions

1. How is the issue of fatigue addressed in your organization?
    a. To what extent is it discussed formally by management or labor as an issue?
    b. What efforts to mitigate fatigue does your organization make?
    c. How does your organization address workers napping during the day as a method to mitigate fatigue?
2. Does management recognize fatigue in your organization? Please explain your answer.
3. How would you describe the sleep you get while on shift? Is it adequate?
4. How does your schedule of workdays and days off affect your level of fatigue?
5. What is the quality of your recovery sleep on your days off?
6. Do you feel fatigue affects you? How does it affect you, both on and off the job?
7. Do you feel 24-hour shifts, or longer, are the best option for fire and EMS scheduling? Why or why not?
    a. What ideal schedule do you think best addresses fatigue for fire and EMS workers?
    b. Do you feel the arrangement of your workdays to your days off has an impact on fatigue? For example, do certain schedules have a greater impact on fatigue than others?
8. Do you think that fatigue is effectively assessed in fire and EMS workers?
9. What policies would you like to enact or change to address fatigue at your worksite?
10. There has been an increase in discussion of cancer, mental health, and cardiovascular health in the fire service. Does fatigue deserve that same level of attention?
11. Is there anything else that you would like to address regarding fatigue and your organization?