AKENTEN APPIAH- MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT

OCCUPATIONAL HEALTH, SAFETY, AND INJURIES AMONG FIREFIGHTERS IN THE WESTERN REGION OF GHANA

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OCCUPATIONAL HEALTH, SAFETY, AND INJURIES AMONG FIREFIGHTERS IN THE WESTERN REGION OF GHANA

BY

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JULY, 2024

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Jonas Acquah

Signature: …… Date: ……

Supervisors' Declaration

We hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development.

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ABSTRACT

The Ghana National Fire Service (GNFS) was established in 1963 by Act 219 primarily engages in firefighting, extinguishment, and humanitarian services. This study assessed occupational health, safety, and injuries among firefighters in the Western Region of Ghana, drawing from a sample of 270 respondents. The research employed a descriptive cross-sectional design to assess the prevalence of occupational injuries and associated risk factors, and the effect of first-aid training programmemes on occupational health and safety. The key findings revealed that 28.5% of firefighters reported experiencing work-related injuries, with activities such as fighting fires (34.1%) and handling tools and equipment (18.3%). Despite the prevalence of injuries, 45.1% of firefighters took no days off due to their injuries, underscoring potential challenges in injury management and rehabilitation. Work-related health issues are also prevalent among firefighters, with 31.9% experiencing post-traumatic stress disorders and 26.3% reporting sleep troubles. While health and safety policies exist within the GNFS, disparities in implementation and adherence are apparent. Notably, while 52.6% of firefighters reported the presence of a documented health and safety policy, only 13.0% indicated having enough personal protective equipment (PPE) for all workers. First aid training emerges as a crucial aspect, with 84.8% of firefighters believing it is essential to learn first aid, and 83.3% agreeing that first aid should be given quick attention in the workplace. However, exposure to biological and chemical hazards underscores the need for continuous training and stringent safety protocols. In conclusion, this study provides valuable insights into the occupational health and safety challenges faced by firefighters in Ghana's Western region. The findings underscore the importance of targeted interventions to enhance

workplace safety, injury prevention, and emergency response strategies within the firefighting profession. Policymakers and fire service authorities can utilize these findings to implement measures aimed at ensuring the well-being of firefighters and the efficacy of firefighting operations. Further research is warranted to delve deeper into specific aspects of firefighter safety and health, facilitating continuous improvement in occupational safety practices and operational effectiveness.

KEYWORDS: Occupational Health, Safety and Injuries, Firefighters, First aid, and Occupational Hazards.

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DEDICATION

I dedicate this work to the creator and sustainer of the universe, our Lord and Saviour, Jesus Christ. Again, I dedicate this work to my lovely wife (Mrs. Mavis Obeng Asamoah) and my children (Kezia Nhyiraba Acquah, Jason Nyametiase Acquah, Caleb Aseda Acquah, and Alan Adom Acquah).

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LIST OF ACRONYMS

Abriviation	Meaning
AED	Automated External Defibrillator
APA	American Psychological Association
BLS	Basic Life Support
BOS	Base of Support
CNS	Central Nervous System
COM	Center of Mass
COP	Center of Pressure
CPR	Cardiopulmonary Resuscitation
CRP	C-Reactive Protein
CVD	Cardiovascular Disease
DSM	Diagnostic and Statistical Manual
EMS	Emergency Medical Service
GNFS	Ghana National Fire Service
IARC	International Agency for Research on Cancer
ILO	International Labour Organization
MSK	Musculoskeletal
NFPA	National Fire Protection Association
NOCCA	Nordic Occupational Cancer
OSH	Occupational Health and Safety
PPE	Personal Protection Equipment
PSP	Public Safety personnel
PTSD	Post-Traumatic Stress Disorder

PV	Personal Vaporizer
RCOF	Required Coefficient of Friction
SCBA	Self-Contained Breathing Apparatus
SLT	Smokeless Tobacco
SOT	Sensory Organization Test
TPC	Thermal Protective Clothing
USFA	United States Fire Administration
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Annually, approximately 360,000 lives are claimed by occupational injuries and diseases worldwide (Kim et al., 2019). The issue of workplace accidents remains unresolved in both developing and developed countries (Mekkodathil et al., 2016). ILO (2020) states that any personal injury, illness, or fatality resulting from a work-related accident should be categorized as an occupational injury. Firefighters are faced with a range of dynamic responsibilities that extend beyond firefighting, including water rescue, trench rescue, sea rescue, aircraft rescue, motor vehicle accidents, train derailments, car extrication, hazardous materials (hazmat) situations, and confined space/elevation rescue (Rachman, 2018).

Firefighters regularly encounter explosive materials, extreme weather conditions, physically demanding tasks such as awkward postures or heavy lifting, work environments with slippery surfaces or sharp objects, exposure to chemical and biological agents, potential lack of sufficient oxygen, fall hazards, falling objects, and numerous other threats to health and safety (Campbell, 2021). These potential occupational accidents can occur at the site of a fire, during transportation to or from a fire, or during training, and may result in injury or even death (Administration & Fire, 2019). Each year, tens of thousands of firefighters sustain injuries while combating fires, rescuing individuals, and responding to medical emergencies and accidents involving hazardous materials (Campbell, 2018; Orr et al., 2019). An on-the-job

injury occurs when an employee experiences an accident that can be fatal or non-fatal without causing any lost time (ILO, 2020).

Hazards that threaten firefighters' life safety can be categorized into seven groups: building collapse, explosion or rollover, falls, electrocution, gas poisoning, traffic accidents, and other accidents (Wehner et al., 2022).

Firefighters may encounter many chemicals, gases, and other substances in their work environment that can harm their respiratory system. These harmful inhalants that are released can result in the development of respiratory conditions such as bronchitis, pneumonia, tuberculosis, asthma, chronic obstructive pulmonary disease, and even lung cancer (Campbell & Evarts, 2020). Furthermore, firefighters need to minimize the risk of physical injury and take precautions to minimize exposure to contaminants or pathogens that can cause illness, whether through inhalation, ingestion, or absorption through the skin. At the scene of a fire, firefighters are exposed to various pollutants, and even at the fire station, they may encounter diesel exhaust, which is known to have carcinogenic properties (Campbell & Evarts, 2020).

It has been reported that a significant number of firefighters who experienced symptoms of heat-related illness (HRI) reported experiencing these symptoms at least once a year. Additionally, half of the affected firefighters experienced headaches four times, sudden muscle spasms three times, dizziness, confusion, nausea, vomiting twice, and fainting once within a year (Kim et al., 2019).

Unless prompt and effective action is taken, burn injuries are projected to become one of the leading causes of death in Africa alone, leading to an estimated one million deaths per year by 2050 (IFSSC, 2021a). This is partly a result of rapid population growth and urbanization without sufficient improvement in fire safety strategies, land use planning, and understanding of materials and products, all of which increase the risk of fire (IFSSC, 2021a). Ghana has seen its fair share of rampant fire outbreaks; these numerous fire incidents have cost the nation millions of Ghana Cedis, money that could have flowed into development activities (Nunoo-Mensah & Boateng, 2018a). In Ghana, little research exists on occupational injuries among firefighters, although firefighters are exposed to many occupational injuries. Studies on risks in the study area are also insufficient or outdated.

One of the means of avoiding workplace accidents and fatalities as a firefighter is the prompt provision of first aid services to the injured personnel. First-aid training for the staff in no way replaces the rescue service. However, it is an important first step in taking effective and immediate action that will help to reduce injury and improve survival (IFRC report, 2010). Basic first aid training prepares workers and other personnel to respond to a variety of events and provide prompt and efficient treatment including but not limited to alerting the emergency medical services system (EMS), maintaining the airway, ensuring respiratory, circulation, protecting airway and cardiac arrest and hemorrhage control (Anderson et al., 2011). Meanwhile, studies have shown that building first aid skills among vulnerable staff could help create a safer and healthier work environment (Mahmoud, 2017).

1.2 Problem Statement

Every job comes with some level of safety risk, and one of the higher-risk jobs is firefighting. On the scene or end route to a fire, multi-vehicle accident, explosion, or even during training, firefighters face a relatively high probability of being injured and possibly killed (Equipment, 2021). At the place of action, they are exposed to heat stroke, burns, physical, and mental stress. In addition, they frequently come into contact with high levels of carbon monoxide and other toxic hazards. With these hazardous exposures, this workplace or the operational field becomes a conducive place for workers to contract many diseases and conditions, such as heart disease, cancer, respiratory disease, stress, and poorer medical outcomes that can lead to their deaths (Isaac & Buchanan, 2021).

In Ghana, there are limited studies on occupational health, safety, and injuries among firefighters, particularly in the Western Region. Although firefighters experienced significant injuries and even death during rescue missions, many of them know little about the health and the legal and financial consequences of their work-related activities. In addition, little is known about occupational regulations, policies, and professional standards that exist to guide firefighter rescue and survival techniques. Fire service work has inherent dangers, and risk management policies and procedures are in place, but are not being used.

1.3 Justification

Currently, there is limited material on accidents at work and occupational diseases in the formal sector of the economy, particularly within the Ghana National Fire Service facilities. Although workers suffer from musculoskeletal disorders, heat-related

illnesses, and firefighter eye injuries, there is no comprehensive study on occupational injuries and diseases among firefighters in the Western Region of Ghana. Again, employees are the people who suffer the most from the brunt of work-related occupational injuries and diseases compared to employers. The research material, therefore, sought to amplify the impact of high medical bills and lost wages on the worker and his /her family at large. Additionally, this study is required to provide firefighter management with deeper insight into areas where investment can be directed, particularly in the health and safety department.

The hazards and risks that firefighters face everyday have necessitated the development of policies and procedures to address the long-term health risks of firefighting activities, including prevention efforts related to cardiovascular health and protection from exposure to toxic materials (Campbell & Evarts, 2020a). In addition, these occupational injuries and exposures can result in job dissatisfaction, lost work days, post-injury disability, and career-ending injuries that may result from moving or picking up hand tools, equipment, or hoses at the scene; operating apparatus; providing EMS or rescue assistance; accessing or exiting a structure; or driving or riding in vehicles (Campbell, 2021).

As an occupational health professional, the key to implementing an effective workplace health and safety programme to reduce occupational injuries and diseases among firefighters is to appreciate the factors that increase firefighters' risk of occupational injury and the possible diseases they incur from their firefighting activities. Again, knowledge of occupational injury characteristics (i.e., injury location, activity being performed, cause of injury, body part injured, treatment

sought, and return to work outcome) and injury predictors among career firefighters is important information that authorities of firefighters will need to take an informed decision. Firefighters' work is demanding, often unpredictable, in stressful environments where they are routinely exposed to mental and physical occupational hazards. More emphasis should be placed on creating a healthy workforce that advances firefighters' well-being through total worker health policies, programmes, and practices. Stress prevention programmes and crisis counseling may assist firefighters in coping with issues that negatively impact their job performance, health, and well-being.

1.4 Research Questions

The following research questions were asked by the researcher to probe for answers:

1. What proportion of firefighters sustained injuries at the workplace?
2. What occupational health and safety measures are put in place by the management to ensure minimized injuries among firefighters at the workplace?
3. What are the proximate determinants of occupational injuries and diseases among firefighters at the workplace?
4. What is the association between first aid training on the prevalence of occupational injuries among Firefighters at the workplace?

1.5 Research Objectives

The main objective of this study was to assess occupational health, safety, and injuries among firefighters in the Western Region.

1.5.1 Specific Objectives

To achieve the general objective, the research addressed the following specific objectives:

1. To determine the prevalence of occupational injuries and diseases among firefighters at work.
2. To assess occupational health and safety measures at the Ghana National Fire Service among firefighters.
3. To identify proximate factors for occupational injuries and diseases among firefighters at work.
4. To determine the association between first aid training and occupational injuries among firefighters.

1.6 Scope of the Study

Although the research was conducted in the Ghana Fire Service, geographically, the scope of the study covered the whole of fire stations within the Western Region. Generally, the reporting of this study establishes the proximate factors, prevalence, and association between first-aid training and occupational accidents and diseases among firefighters.

1.7 Significance of the Research

Fire outbreaks occur without any notification. In Ghana, the frequency of its occurrence and physical and psychological damages to the affected communities will affect firefighters, whose mandate is to quench these fires. This research would therefore be a source of information for the formulation of a fire safety policy for managers within the fire service institution. It would also serve as a guide for the fire

personnel on the dos and don’ts at the fire ground. The general public would benefit from the research output, helping instill in them fire safety habits in the communities, which in the long run will lead to the reduction of fire incidence and, to some extent, occupational injuries and diseases involving firefighters in the Western Region. The research would also be of significance to the Ghana National Fire Service in general, to come out with appropriate fire standards in communities. The implementation of the findings and recommendations in the final report can be the foundation of a structured approach to fire safety management in Ghana.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews existing literature on occupational health, safety, and injuries among firefighters during and after their firefighting operations. Areas like occupational illness and diseases among firefighters, profile of injuries sustained by firefighters, proximate factors to occupational injuries, occupational health and safety, firefighters and first aid training, personal protective equipment, and hazards will be covered.

2.2 Sociodemographic Characteristics of Firefighters

Firefighters are a vital component of emergency response teams, putting their lives at risk to save others. Understanding the sociodemographic characteristics of firefighters can provide valuable insights into their backgrounds, experiences, and needs. Firefighters are predominantly male (Brinchmann et al., 2022; International Labour Organization, 2012). A study conducted in the United States by Ras & Leach, 2022) found that 87.4% of firefighters were male, while 12.6% were female. In terms of age, firefighters tend to be between 20-39 years old, with a median age of 32 years (International Labour Organization, 2012). Firefighters typically have a high school diploma or equivalent (Ras & Leach, 2022). A study conducted in Australia found that 70.4% of firefighters held a vocational or technical qualification, while 24.8% held a university degree (Brinchmann et al., 2022). Only a small proportion of firefighters hold a first degree or higher (Butry et al., 2019). Firefighters tend to be single or married, with a study in the United States finding that 40.7% were married

and 52.6% were single(Ras & Leach, 2022). A study in Canada found that 45.5% of firefighters were married and 44.5% were single(Brinchmann et al., 2022).

Firefighters typically have between 1-10 years of experience in the profession (International Labour Organization, 2012). A study in the United Kingdom found that 54.8% of firefighters had less than 5 years of experience, while 24.8% had between 6-10 years of experience (Brinchmann et al., 2022). In terms of rank, firefighters can range from junior officers to senior officers, with studies showing varying levels of representation across these ranks(Ras & Leach, 2022). Firefighters perform a variety of duties, including driving fire trucks, conducting rescue operations, and providing emergency medical services (Brinchmann et al., 2022). A study in Australia found that the most common duties performed by firefighters were driving duties (11.5%), followed by assistant duties (14.8%), and branch duties (28.1%) (Brinchmann et al., 2022).

In conclusion, the sociodemographic characteristics of firefighters reveal a predominantly male population with a high school diploma or equivalent education. Firefighters tend to be between 20-39 years old and are often single or married. They have varying levels of job experience and rank within their organizations. Understanding these characteristics can inform fire departments' recruitment and retention strategies as well as provide valuable insights into the needs and experiences of firefighters.

2.3 Prevalence of Injuries and Diseases among Firefighters

2.3.1 Occupational Injuries among Firefighters

Occupational injuries are a common occurrence in the firefighting industry, with firefighters facing a range of risks including burns, respiratory problems, and musculoskeletal disorders (El-Menyar et al., 2016). Studies have consistently shown that occupational injuries are a significant problem in the firefighting industry. A study by Thomas et al., (2020) found that 54.3% of firefighters in China experienced work-related injuries, with the majority occurring during firefighting activities. Similarly, a study by the Health and Safety Executive (2019) reported that 62% of firefighter injuries were related to firefighting activities.

Several factors contribute to the high risk of occupational injuries among firefighters. El-Menyar et al. (2016) identified inadequate safety protocols and equipment as significant contributing factors to firefighter injuries. Phelps et al., (2012) found that peak fire season, which typically occurs during daytime hours, was associated with a higher risk of firefighter injuries. Additionally, Jong-hyun et al., (2020) reported that work-related stress was a significant predictor of mental health problems among firefighters. Occupational injuries can have significant consequences for firefighters, including prolonged periods off work, permanent disability, and increased risk of long-term health problems (Thomas et al., 2020). A study by Jong-hyun et al., (2020) found that work-related stress was associated with increased symptoms of depression and anxiety among firefighters. Furthermore, the Health and Safety Executive. (2019) reported that firefighter injuries can result in significant economic costs to individuals and society as a whole.

2.3.2 Commonly Injured Sites of Firefighters

The lower extremity and the back were the two most prevalent aggregated sites of injury, with lower extremity rates comparable to (Katsavouni et al., 2016a; Kim et al., 2018) or above (Kim et al., 2018). However, in three studies (Katsavouni et al., 2016b; Yoon & Kim, 2016) that were more specific in injury site regions, the back was the most common site of injury, with reported injury proportions ranging from 20% (Ahmed Siddiqui et al., n.d.; Orr et al., 2019) to 32% (Szubert & Sobala, 2002b). The proportion of knee and ankle (Orr et al., 2019) and knee and foot injuries tended to be similar among lower limb injury locations, while one study(Szubert & Sobala, 2002b) showed knee injuries to be almost twice as common ankle injuries (22.6% versus 10.7%, respectively). Shoulder injuries were the lowest proportion of injuries by bodily location in two of the three studies reporting shoulder injuries (Orr et al., 2019; J. Yoon & Kim, 2016), but were higher than ankle injuries in a third research (Szubert & Sobala, 2002b) ankle = 10.7%; shoulder = 14.5%). When it comes to injury sites, the findings of (Szubert & Sobala, 2002b), who identified the knee joint as the most expensive, followed by the back, are worth examining.

2.3.3 Common Nature of Injury

Sprains and strains were found to be the most commonly reported kind of injury (Son et al., 2013), ranging from 16% (Soteriades et al., 2019) to 74% (Walker, 2020). While two studies found sprains and strains to be the second most common type of injury, with wounds, cuts, and bleeding (42.3%) (Ras et al., 2022) or lacerations and contusions (28.9%) (Svendsen et al., 2020), sprains and strains remained the most common type of musculoskeletal injury. Walker. (2020) discovered a mean cost associated with sprains and strains to be $8031 per person when measuring the costs

of various sorts of ailments. As a result, given that 74% of reported injuries are of this type, the expenses associated with these injuries might be significant. These findings are consistent with those reported in law enforcement, with sprains and strains being the most common types of injuries (Nazari et al., 2020a). However, the rates of injuries recorded by law enforcement officers ranged from 42.4%(Evarts et al., 2021) to 94.6% (Madrzykowski, 2017). Sprains and strains are also the most common types of injury in military populations(Mohamed et al., 2017). As a result, the findings of this study imply that, similar to law enforcement and military personnel, firefighter musculoskeletal injuries are most typically sprains and strains. As a result, methods of minimizing or lowering the severity of, or maximizing the recovery for, these types of injuries may benefit a variety of tactical organizations.

2.3.4 Common Mechanisms of Injury

Slips, trips, and falls were identified as the most prevalent mechanism of injury in two studies (Kimaro et al., 2018) of the five studies that assessed how documented injuries happened (Berhan, 2020). Slips, trips, and falls were the second most prevalent mechanism after bending, lifting, and squatting in two investigations (Nazari et al., 2020b), with little difference between these two mechanisms. For example, Brandt-Rauf et al., (1989) discovered that bending, lifting, and squatting caused 23% of injuries, whereas slips, trips, and falls caused 21% of injuries. In the fifth study, muscle stress accounted for three of the top five injury mechanisms, while falls (both on the same level and from a height) accounted for the remaining two (Negm et al., 2017). Muscle stress contributed to 74 injuries per 1000 full-time employed firefighters each year, whereas slips, trips, and falls accounted for 40 injuries.

Notably, Sahebi et al., (2020) discovered that slips, trips, and falls accounted for over half of all sprains and strains (49%) and fractures and dislocations (43%).

Compensation expenses connected with these mechanisms of harm have been reported to average US $8662 per person (Rajabi et al., 2020). It should be highlighted that the studies in which slip, trip, and fall injuries were the most common were of wildland firefighters (Palanci et al., 2021) or firemen from all across Greece. This could have included wildfire fighters. The remaining three investigations (Koopmans et al., 2020) involved urban firemen, and other causes (such as bending, lifting, and squatting or muscular straining) preceded slips, trips, and falls.

This review's injury mechanisms are similar to those documented in military groups(Mohamed et al., 2017). Slips, stumbles, and falls, for example, were identified as the major mechanism of injury (21.4%) in the Australian Defense Force (Paterson et al., 2022). Body stressing, the fourth most common mechanism of injury (16.3%), was related to the highest number of working days lost (26.9%), followed by slips, trips, and falls (25.2%). Even in a combat zone, falls have been identified as the greatest cause of non-battle injuries, accounting for 21.3% of injuries sustained by US service members deployed to Iraq and Afghanistan over 12 years (Evarts et al., 2021). As a result, initiatives to avoid slips, trips, and falls, as well as muscle stress, may have an influence on both the firefighter and military populations.

Other studies by the same authors (Abelsson & Lundberg, 2019) reported general activities at the fire station as the main job activity associated with injuries, one (Lovejoy et al., 2015) reported physical training activities (33%) as the leading cause,

and one (Gordon & Larivière, 2014) listed firefighting as the leading cause (38%). The location of data collection is one cause for these discrepancies in stated methods. For example, M Harthi & Rachman. (2019) used data from firefighters treated in emergency departments in their study. In contrast, Campbell & Evarts. (2020b) used injury reports from a fire station to guide their analysis. Furthermore, only the two studies by Campbell employ the same criteria to report the nature of the duties when compared. Whereas Campbell & Evarts. (2020) utilized categories such as patient transport and training, and drilling, M Harthi & Rachman. (2019) used firefighting, patient care, and training, and Leduc et al., (2022) used firefighting, patient care, and training. Job duties categories, such as fire station, training center, and gymnasium, were employed. The lack of mechanism consistency between research is noticeable, posing a problem in finding and hence implementing mitigation methods that may extend beyond a single department.

2.4 Diseases

2.4.1 Work-related Diseases among Firefighters

Firefighting is a high-risk profession that exposes individuals to various health hazards, leading to a range of work-related diseases. Hearing loss is a common occupational health concern among firefighters, resulting from prolonged exposure to loud noises from fire apparatus, equipment, and explosions (Asbury, 2019). A study by the International Association of Fire Fighters found that 1 in 5 firefighters suffer from hearing loss due to occupational noise exposure(Kumah et al., 2017; Oppong et al., 2016). Hearing loss can have significant impacts on an individual's quality of life, including difficulty communicating and social isolation.

Eye injuries are another significant concern among firefighters, often resulting from flying debris, chemical splashes, and other hazards (Kumah et al., 2017). A study by the American Academy of Ophthalmology found that eye injuries are a common occurrence in the fire service, with many cases resulting in permanent vision loss(Almahmoud et al., 2020).

Firefighting work is physically demanding, requiring individuals to perform tasks that can lead to cardiovascular disease (Cherry et al., 2021; Jeung et al., 2022). A study by the National Institute for Occupational Safety and Health found that firefighters are at a higher risk of developing cardiovascular disease due to physical exertion and exposure to stressors(Wolffe, Clinton, et al., 2023). Firefighting is a traumatic profession that exposes individuals to multiple traumatic events, leading to post-traumatic stress disorder (PTSD) (Jitnarin et al., 2022; Wolffe, Robinson, et al., 2023). A study by the National Institute for Occupational Safety and Health found that PTSD is a significant concern among firefighters, with symptoms including anxiety, depression, and substance abuse (Jitnarin et al., 2022; Wolffe, Robinson, et al., 2023).

Firefighters often work irregular schedules and experience sleep disturbances due to shift work and stress (Bender, 2018). A study by the National Institute for Occupational Safety and Health found that sleep disturbances are common among emergency responders, including firefighters (Bender, 2018; Nag, 2019). Heat stress is another significant concern among firefighters, particularly during intense firefighting operations(Wolffe, Clinton, et al., 2023). A study by the National Institute for Occupational Safety and Health found that heat-related illnesses can be severe and

even life-threatening if not properly managed (Wolffe et al., 2023). Work-related diseases are a significant concern among firefighters, with a range of health hazards posing risks to their well-being. Future research should continue to explore the prevalence and consequences of work-related diseases among firefighters to inform evidence-based interventions.

2.5 Occupational Health and Safety among GNFS

2.5.1 International Labour Organization's (ILO) View on OHS

Firefighters are susceptible to occupational diseases and injuries, and occupational health and safety (OHS) is a critical concern for them, according to the International Labour Organization (ILO) (ILO, 2020). The ILO emphasizes the need for a comprehensive and proactive approach to preventing injuries and illnesses, which can be achieved through risk assessment, management, and training (ILO, 2015). The group advises fire departments to create thorough OHS policies that cover hazard management, frequent risk assessments, and training programmes for firefighters(ILO, 2015). In addition, the ILO stresses how critical it is to give firemen access to personal protective equipment (PPE) and medical treatment and rehabilitation facilities if they get ill or injured(ILO, 2020).

The ILO emphasizes these recommendations in addition to the importance of workplace culture and communication in enhancing OHS among firefighters. According to the company, creating a positive work atmosphere that values safety and encourages open communication can help avoid illnesses and injuries by creating a culture of safety awareness (ILO, 2020). Additionally, the ILO recommends that fire departments establish a system for recording and investigating mishaps and near-

misses, and that these reports be used to inform training and feedback for firefighters (ILO, 2020).

2.5.2 Ghanaian Laws and Regulations on OHS

To guarantee OHS in the workplace, the Ghanaian government has passed many laws and regulations. The main piece of legislation controlling labor relations in Ghana is the Labour Act, 2003 (Act 651)(Service, 1997). The Act places a strong emphasis on the need to protect employees' health and safety, maintain a safe workplace, and penalize employers who disregard OHS requirements (Amponsah-Tawiah, 1992; Asumeng et al., 2015).

Specific guidelines for OHS in Ghana are provided by the Occupational Safety and Health Regulations (Journal, 2021), 2012 (L.I. 2189) documents. According to the regulations, companies must create a safe workplace, recognize potential risks, and put precautions in place to avoid mishaps and injuries (Kodom-Wiredu, 2019). The standards also set forth how accidents at work are to be reported and investigated.

2.5.3 Occupational Health and Safety among Firefighters

Physical risks like heat, smoke, and hazardous materials (HMs) are encountered when combating fires (ILO, 2019). Heat stress is a serious issue, especially in hot weather or when battling fires in small areas (Kim et al., 2019). According to Cartwright (2021), Gainey et al., (2018), exposure to heavy metals (HMs) such as asbestos, lead, and pesticides has been connected to a number of health issues, including cancer and respiratory disorders.

Another high-stress job that can cause psychological distress and post-traumatic stress disorder (PTSD) is firefighting (Kim et al., 2019). Firefighters frequently encounter horrific incidents, such as injuries and fatalities, which might negatively impact their mental health over time (Zheng et al., 2018). According to Zheng et al., (2018), these problems may get worse due to a lack of social support and insufficient coping techniques. Numerous measures have been taken to reduce the risks involved with combating fires. According toHse, (2021), personal protection equipment (PPE) is crucial for preventing injuries caused by physical dangers. PPE can only be used to a certain extent, hence in order to achieve efficient hazard control, additional measures such as communication systems and clothes resistant to fire are required(OSHA, 2015b).

Programmes for training firemen are also essential in lowering their risk of disease or injury. Hazard identification, risk assessment, and incident response planning have to be the main focuses of these programmes (Fahy et al., 2019). Furthermore, stress management instruction and mental health resources are available to firefighters, which can lessen the impact of PTSD (Kim et al., 2019).

2.5.4 Health and Safety Training among Firefighters

Firefighting is a hazardous occupation that requires firefighters to face various physical and psychological challenges. Firefighters are exposed to a range of risks, including burns, trauma, and exposure to hazardous substances(OSHA, 2015b). As a result, firefighters must receive adequate training on occupational health and safety to minimize the risk of injuries and illnesses. Several studies have investigated the frequency of occupational health and safety training among firefighters. A study by

Garcia, (2019) found that frequent training was associated with a reduced risk of injury among firefighters. The same study suggested that formal training programmes should be conducted at least once a month. A systematic review by the States Fire Administration., (2020) found that fire departments with effective health and safety programmes had lower rates of injury and illness among their firefighters.

The methods used for conducting occupational health and safety training have also been investigated. A study by Salar et al., (2017) found that interactive training methods, such as scenario-based training, were more effective than traditional lecture-based training in improving firefighters' knowledge and skills. A study by Afzal et al., (2019) found that incorporating ergonomics into firefighter training programmes can reduce the risk of musculoskeletal disorders. According to the literature, to increase knowledge and skills, interactive techniques like scenario-based training should be applied. To further lower the risk of musculoskeletal illnesses, ergonomics education must be incorporated into training programmes.

2.5.5 Fireground Safety Rules among Firefighters

Firefighters must adhere to fireground safety regulations, which serve as standards during emergency reactions, to effectively fight fires. According to research, following fire-ground safety regulations is essential to reducing the risk of injuries and firefighter fatalities (Life, 2008; Pepper & Pepper, 2021). Guo & Liu. (2021) conducted a study that emphasized the significance of unambiguous communication among firefighters during emergency reactions. This communication is a crucial component of fire-ground safety regulations. Another crucial element of fire-ground safety regulation is personal protective equipment (PPE). Studies have repeatedly

demonstrated that inappropriate use or insufficient PPE is a major contributor to firefighter injuries and fatalities (Life, 2008; Pepper & Pepper, 2021). A study conducted by Park et al., (2014) found that a significantly higher risk of injury among firefighters was associated with inadequate PPE use. Size-up procedures are another essential component of fire-ground safety regulation. Research has demonstrated that insufficient size-ups can result in poor decision-making and an increased risk of accidents (Life, 2008; Pepper & Pepper, 2021). A study conducted by Fahy & Petrillo (2021) discovered that size-up errors were a common contributing factor in firefighter fatalities. Another crucial element of fire-ground safety regulation is personal protective equipment (PPE). Studies have repeatedly demonstrated that inappropriate use or insufficient PPE is a major contributor to firefighter injuries and fatalities (Life, 2008; Pepper & Pepper, 2021). A study conducted by(H. Park et al., (2014) found that a significantly higher risk of injury among firefighters was associated with inadequate PPE use. Size-up procedures are another essential component of fire-ground safety regulation. Research has demonstrated that insufficient size-ups can result in poor decision-making and an increased risk of accidents(Life, 2008; Pepper & Pepper, 2021). A study conducted by Fahy & Petrillo (2021) discovered that size-up errors were a common contributing factor in firefighter fatalities.

2.6 Personal Protective Equipment (PPE)

There have been various approaches to researching the personal protective equipment (PPE) used by firefighters. For instance, according to the National Occupational Health and Safety Commission, (2004) study conducted by the National Occupational Health and Safety Commission, 88% of firefighters reported wearing pants, 92%

reported wearing coats, and 95% of firefighters reported wearing helmets when responding to emergencies. The Journal of Occupational and Environmental Medicine published a study by Soteriades et al., (2022) that revealed 85% of firefighters said they wore face masks. The use of PPE by firefighters has been the subject of numerous studies. According to Xia et al., (2017), 83% of firefighters utilized earplugs when battling fires, and 71% of firefighters said they regularly used protective goggles or glasses (Combs, 2024). According to a different Aid & Protection (2020) survey, 93% of firemen said they wore face masks when combating fires. Although there is a high degree of compliance with the usage of some PPEs, the results indicate that there is still room for improvement.

Despite PPE's significance, many obstacles and difficulties have been found when using it. According to Xia et al., (2017), firefighters' inability to utilize PPE was significantly hampered by their lack of training. Poor fitting was noted by Aid & Protection (2020) as a key problem, whereas Combs. (2024) indicated that lack of equipment availability was a big barrier. Many suggestions have been made to enhance firefighters' use of personal protective equipment (PPE). Edition. (2020) recommended holding frequent training sessions to instruct firefighters on how to properly wear and maintain personal protective equipment. According to Xia et al., (2017), it is advised to provide sufficient tools and resources to guarantee that PPEs are available and fitted correctly. Implementing routine inspections to make sure PPEs are available and in good condition is advised by Aid & Protection. (2020). Future studies should concentrate on figuring out practical ways to get around obstacles to PPE utilization and enhancing PPE's general quality.

2.6.1 Injuries Related to the PPE Turnout

Firefighter personal protective equipment (PPE), particularly the turnout ensemble, can contribute to various injuries if not designed or used properly. The turnout ensemble's weight and size, along with the face mask and self-contained breathing apparatus (SCBA), could seriously hinder firefighters' balance and movement (Kim et al., 2022). According to the study, using a face mask or not while wearing turnouts with a SCBA negatively affected dynamic balance, raising the risk of slips, trips, and falls all of which are frequent ways that firefighters sustain injuries. When wearing the turnout suit and SCBA, lower body range of motion can be significantly limited, particularly in the sagittal and transverse planes(O'Driscoll et al., 2008). Limitations on movement can lead to strained bodies and possible musculoskeletal ailments, especially in the lower limbs and back.

According to Mohamad,& Ali. (2021), there is evidence linking the design of turnout boots to foot ailments and physical strains. Insufficient cushioning, traction, stability, and flexibility in turnout boots might make firefighters more susceptible to falls, lumbar injuries, and muscle strains. The physiological strain brought on by wearing personal protective equipment (PPE) can raise body temperature, heart rate, and oxygen consumption, all of which can lead to fatigue and perhaps raise the risk of injury even though they are not directly linked to injuries(McQuerry et al., 2018). In addition, a study by J. Park (2019) emphasized the significance of taking gender physiological differences into account while developing and assessing personal protective equipment (PPE) to avoid heat-related illnesses.

2.7 First Aid for Firefighters

2.7.1 First aid Training among Firefighters

According to research, firemen who complete extensive first aid training are better prepared to manage complicated medical emergencies and are more likely to administer proper care (Canadian Red Cross, 2017). Furthermore, research has demonstrated that receiving first aid training can enhance patient outcomes and lower the chance of damage (Fromm et al., 2019). Firefighters must have first aid training to respond to medical situations efficiently. Despite the need for first aid training, there are several barriers to effective training provision. Time is a common barrier, as firefighters often have limited time for training(Fry et al., 2017). Resources and specialized equipment are needed, but getting them can be costly and difficult (Buck et al., 2020). This creates an additional challenge. Moreover, some research results suggest that firefighters may not prioritize first aid training due to competing demands on their time and resources (Anita et al., 2021; Fatoni et al., 2022).

There are several ways to improve the first aid training provided to firefighters. As they can be more adaptable and convenient than traditional classroom-based learning, providing online or hybrid training programmes is one strategy (Fry et al., 2017). A further strategy to boost learner interest and realism in first aid programmes is to use simulation-based training (Huchim-Lara et al., 2018; Marc et al., 2018). Peer-led training programmes have the potential to be an effective technique for improving firefighters' first aid proficiency according to (Bakke et al., 2017). Several studies have examined the impact of first aid training on firefighter performance and patient outcomes. A Garcia, (2019) study found that firefighters with first aid training felt more competent to manage medical emergencies. Similarly, a study by McCabe et al.,

(2011) found that first aid training enhanced patient outcomes by lowering reaction times by an average of thirty seconds.

2.7.2 Perceptions of First Aid Training among Firefighters

Based on the analyzed studies, it appears that firemen are generally in favor of first aid training and understand its value for their line of work. However, there is also evidence of variation in their attitudes and beliefs regarding first aid training, which can be attributed to several factors including age, experience level, and the caliber of the training(Lingard, 2004a; Wang et al., 2021). For instance, a study by Avau et al., (2019) found that younger firefighters were more likely to report feeling confident in their first aid skills than older firefighters.

The kind of training acquired also has an impact on firefighters' opinions of first aid training. OSHA, (2006) discovered that firemen who had thorough first aid training expressed more confidence and self-efficacy in administering first aid as opposed to those who only received rudimentary training. The World Health Organization. (2020) also noted in its study the value of routine refresher training in preserving firefighters' expertise. Firefighters' attitudes on first aid training are also influenced by workplace culture and organizational support, It is important for future studies to keep looking into what influences firefighters' impressions of first aid training and to figure out how to improve them.

2.8 Proximate Factors for Occupational Injuries and Diseases among Firefighters

Firefighters are susceptible to a variety of injuries, including traumatic injuries, heat injuries, and musculoskeletal diseases. Because of the physical demands of their work, which involve lifting, hauling, and climbing, musculoskeletal diseases are widespread among firefighters (Harthi & Rachman, 2019). According to Hazards. (2022), thermal injuries are also frequent among firefighters, especially for those who work in hot conditions or are subjected to heat stress. According to Yoon et al., (2016), accidents, falls, and other mishaps during the fighting of fires might result in traumatic injuries.

In addition, firefighters run the risk of contracting skin conditions, mental health issues, and respiratory ailments as a result of their work. Exposure to airborne pollutants, including particulate matter and volatile organic compounds (VOCs) found in smoke and combustion byproducts, might result in respiratory issues (Hazards, 2022). Chemical exposure, including that from fuel and pesticides, can result in skin illnesses by irritating the skin and triggering allergic reactions (Yoon et al., 2016). Stress and trauma related to working as a firefighter can result in mental health illnesses such as depression, anxiety, and post-traumatic stress disorder (PTSD) (Kim et al., 2016).

For firefighters, Future studies should concentrate on determining the best preventative techniques and assessing how well they work to lower occupational illnesses and injuries among firefighters.

2.8.1 Chemical Hazards among Firefighters

During emergency reactions, firefighters are subjected to a variety of hazardous materials, such as fuels, chemicals, and other harmful compounds. According to Hazards, (2022), these exposures may have a serious negative impact on their health and well-being, resulting in skin irritation, respiratory issues, and even mortality. Examining the chemical risks that firefighters encounter and the steps that might be taken to reduce those risks is the aim of this review.

During emergency responses, firefighters are exposed to a wide range of substances, such as industrial chemicals, fuels, and pesticides (Santiago et al., 2018). Firefighters' health may suffer greatly as a result of these exposures, which can happen by ingestion, skin contact, or inhalation Garcia,(2019) and Hazards. (2022). For instance, breathing in petroleum-based fuels can lead to lung issues, while skin irritation and brain damage can result from pesticide exposure (States Fire Administration, 2020). During emergency responses, firefighters may come into contact with various dangerous compounds in addition to the obvious risks posed by chemicals. For instance, hazardous materials may be released into the air during fires containing biological or industrial chemicals, endangering the health of firefighters (Ryu et al., 2017). Additionally, using personal protective equipment (PPE) may not always be sufficient to shield them from hazardous pollutants(Ryu et al., 2017).

Many actions can be performed to reduce the risks associated with chemical dangers. Making sure firefighters are wearing PPE when responding to emergencies is a crucial first step. To assist in preventing exposure to hazardous compounds, this involves donning masks, gloves, and other protective gear (Garcia, 2019). Firefighters should

also receive training on how to properly utilize personal protective equipment (PPE) and be informed of the potential risks associated with various kinds (National Fire Administration, 2020).

Enhancing communication between firefighters and emergency responders is a crucial next step. This can guarantee that during emergency responses, all responders are informed of the risks posed by various substances and can take the necessary precautions (Santiago et al., 2018). Moreover, enhanced communication can assist in lowering the possibility of unintentional exposure to dangerous substances. Last but not least, studies have shown several variables that may affect firefighters' compliance with wearing PPE when responding to emergencies. PPE, for instance, may not always be available, which could hinder its use (Ryu et al., 2017). Inadequate instruction in its use could also lead to non-adherence (Hazards, 2022). To sum up, while responding to emergencies, firemen are at serious risk from chemical threats. Firefighters must be trained in the proper usage of personal protective equipment (PPE) and wear it during emergency responses to reduce these dangers.

2.8.2 Physical Hazards among Firefighters

As a high-risk occupation, firefighting exposes workers to a variety of physical risks that can cause illnesses, injuries, or even fatalities. According to Lane et al., (2022), firefighters work in physically demanding environments with high temperatures and hazardous chemicals. These conditions can cause musculoskeletal illnesses, respiratory issues, and cardiovascular disease. In addition to discussing the consequences for firefighters' health and well-being, this article seeks to provide an overview of the physical risks they encounter.

Heat stress is a major physical issue that firefighters must deal with. People who work in the fire service may be exposed to extreme temperatures, which can cause heat exhaustion and heat stroke (Kodom-Wiredu, 2019). According to Bender, (2018), several elements like clothes, humidity, and personal characteristics like age and physical fitness can all make heat stress worse. Inhaling smoke presents a serious physical risk to firefighters. A variety of harmful substances, such as carbon monoxide, particulate matter, and volatile organic compounds (VOCs), are present in fire smoke and can result in respiratory issues such as pneumonia, ARDS, and bronchitis (Witt et al., 2017).

A variety of physical demands are placed on the body during firefighting operations. Due to their physical duties, which include lifting large objects and donning bulky protection gear, firefighters run the risk of developing musculoskeletal diseases (Lane et al., 2022). Furthermore, the mental strain of firefighting tasks might eventually result in exhaustion and a decline in performance(Bender, 2018). In addition, people who combat fires may come into contact with dangerous substances, including lead, asbestos, and other toxins. According to Francisco & Departments (2016) and Wolffe et al., (2022), these materials can lead to a variety of health issues, such as cancer, brain damage, and respiratory ailments.

Personal protective equipment (PPE) can help protect firefighters from heat stress, smoke inhalation, and other physical hazards (Ashford, 2013). Firefighting departments must also implement strategies to reduce the physical demands of firefighting activities. Some of these strategies include regular training programmes

and encouraging firefighters to take regular breaks. Wearing PPE is one way to mitigate these physical hazards.

2.8.3 Biological Hazards among Firefighters

The transmission of blood-borne pathogens, including HIV, hepatitis, and tuberculosis, through contact with infected bodily fluids, is a major concern for firefighters because these fluids can pose a significant biological risk to firefighters. Human body fluids, such as blood, saliva, and other bodily secretions, can pose significant biological hazards for firefighters (Asbury, 2019; Contrera-Moreno et al., 2012). Firefighters may be exposed to these fluids while responding to emergencies or during rescue operations.

Diseases known as zoonosis conditions are those that humans can contract from animals. While responding to animal-related situations or performing search and rescue missions, firefighters may come into contact with zoonotic conditions (Faisal, 2017). Firefighters are at serious risk of contracting zoonotic diseases like rabies, leptospirosis, and Lyme disease (Stanbury et al., 2004).

For firefighters, blood-borne viruses like HIV, hepatitis B, and hepatitis C pose serious biological risks (Fernandes Da Silva et al., 2013). Firefighters may come into contact with bodily fluids that are infectious or sustain needlestick injuries that expose them to these viruses(World Health Organization, 2020). According to Paper et al., (2018), firemen are at risk of contracting diseases spread by insects, such as dengue fever and the Zika virus, which are spread by mosquitoes. When responding to

emergencies in places where these insects are common, firefighters may come into contact with these diseases.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter of the thesis focused on the study area and the methodology employed. It discussed the following sections: Study Design, Study Area, Study Population, Sampling, Sample Size Estimation, Inclusion and Exclusion Criteria, Data Collection Tools, Pre-testing, Data Collection Procedures, Data Handling and Analysis, Data Analysis, Ethical Consideration, and Delimitations of Study.

3.1 Study Design

This study employed a descriptive cross-sectional design to determine the prevalence of occupational injuries among firefighters and subsequently estimate the association with first aid training programmes for the participants. Prevalence and incidence-based related occupational injuries and diseases among firefighters and their association with first aid training were determined.

3.2 Study Area

The Western Region covers an area of approximately 2,391 square kilometers, which is about 10 percent of Ghana's total land area. The region has about 75 percent of its vegetation within the high forest zone of Ghana and lies in the equatorial climatic zone that is characterized by moderate temperatures. It is also the wettest part of Ghana with an average rainfall of 1,600mm per annum. Additionally, there are 410,412 households in the region, which gives an average of 1.6 households per household. Out of this, the number of persons per household is 4.7 as compared to the

national average of 5.1. Many households in the urban areas have access to electricity, while a relatively small but significant number of rural households are gradually gaining access through the rural electrification programme.

The region is endowed with considerable natural resources, it is the largest producer of cocoa, rubber, and coconut, and one of the major producers of oil palm. The rich tropical forest makes it one of the largest producers of raw and sawn timber as well as processed wood products. A wide variety of minerals, including gold, bauxite, iron, oil and gas, diamonds, and manganese, are either being exploited or are potentially exploitable. The region's total geological profile and mineral potential are yet to be fully determined.

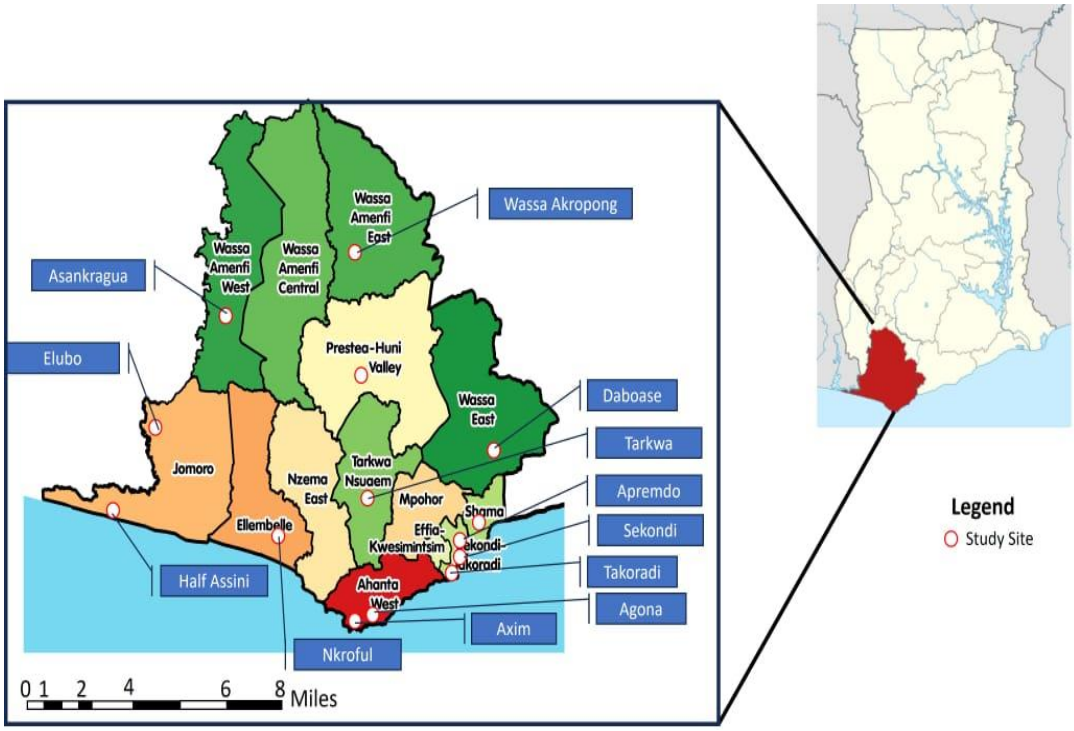

Figure 3.1: Map of Western Region, study location (Owusu-Nimo et al,. 2018)

3.3 Study Population

The Ghana National Fire Service (GNFS) primary aim as established in 1963 by Act 219, is for firefighting, extinguishment, and rendering humanitarian services. This study population consisted of all firefighters in the 15 operating units at the various service stations in the Western Region of Ghana. These included Regional Headquarters, Metro, Market Circle, Apremdo, Shama, Agona, Axim, Daboase, Wassa Akropong, Nkroful, Half Assine, Elubo, Tarkwa, Assankregua, and Prestea Fire Stations with a total population of 438. The operational staff within these stations gave their consent to participate in this study. Moreover, to ensure effective and efficient management of the GNFS activities, the following directorates or departments have been created as required by Act 537: Operations, Finance and Administration, Logistics, Human Resource and Training, Technical Services, Research, Development and Monitoring, Fire Safety, and the Rural Fires department.

3.4 Sampling

3.4.1 Sample Techniques

Purposeful sampling was employed to select the interview subjects for this investigation. A total of 270 firefighters, including officers, commanders, and firefighting managers, participated in this study. The interview venue was chosen with the convenience of the participants in mind, mainly at their workplace. Participants had to have either a theoretical awareness of "firefighting occupational hazards" or prior firefighting and organizational management experience. Important firefighter attributes that are pertinent to the research (e.g, exposures, duties, and experience). The interviews ranged from 25 to 50 minutes, with an average of 40 minutes. In-depth, face-to-face interviews were the main. The technique used to gather data. After

conducting three unstructured interviews, the study team developed semi-structured interviews.

3.4.2 Sampling Size Estimation

A total of 15 Fire Service Stations and 274 Firefighting personnel were estimated for the study based on an assumption of a 25% confidence level and a 5% non-response rate using Slovin's formula by Yamane (Uakarn, 2021). Where

n = design sample size

N = the study population (438)

e = margin of error at a 95% confidence interval

$$\mathrm{n} = \frac{\mathrm{N}}{1 + \mathrm{N}(e)^2}$$

$$n = \frac{438}{1 + 438(0.05)^2}$$

n = 209

The 5% non-response rate was calculated as follows:

0.05 * 209 = 10.45

n = 209 + 10.45 =219.52

Adjusting for design effects of 25%

The total sample size (n) of 274 was used for the study to make up for the non-response and design effect.

3.5.3 Inclusive and Exclusive Criteria

The participant included all the personnel of the operations departments who have been in the service for the past year, and have participated in firefighting activities in

the field. Personnel from non-operational departments and those who have worked for less than a year were excluded from the study.

3.5.4 Data Collection Tools

A semi-structured questionnaire was developed based on the research objectives and from literature analysis as the foundation for the questionnaire's design. Four components made up the questionnaire. The first section consisted of the socio-demographic characteristics of the respondents; the second section, the occupational injury history of the respondents; and the third section, the proximate factors of occupational health and safety measures in place, i.e., first aid training and workplace safety rules, while the fourth section was exposure to physical hazards, biological hazards, and chemical hazards of the respondents. The questionnaire was written in English. The administration of questionnaires was done at the various work locations by well-trained interviewers.

3.5.5 Pre-testing

The questionnaire for data collection was pretested at Bibiani Anhwiaso Bekwai Municipality in the Western North Region. Specifically, the Bibiani fire station. This helped to erase errors, and the challenges that were identified were corrected before the actual administration. It was also helpful in reducing most of the limitations the data would have faced in sections such as content, interpretation, and validity. After the pre-testing, the questionnaire was revised again, and the revised questionnaire was then administered to the study participants.

3.5.6 Data Collection Procedures

Field data collectors were trained on the content and how to administer the questionnaire. Also, research assistants were trained on how to collect data in different ways and on data handling. For this study, both quantitative and qualitative data were collected from the participants. Using the Open Data Kit 30 application, the questionnaire was converted to an electronic format and connected to a personal digital device for data collection. Both electronic and hard copies questionnaire were collected concurrently. The data was collected for three months (September 2023 to November 2023) from the respondents through self-administration or face-to-face.

3.6 Data Handling and Analysis

3.6.1 Data Handling

The data was retrieved from cloud storage in Microsoft Excel and cleaned for analysis. Data was protected on laptops, desktops, external hard drives, USB flash drives, mobile phones, and tablets. Inconsistencies and inaccurate and incomplete data were cleaned and made easier for analysis.

3.6.2 Data Analysis

Every data analysis was done using Microsoft Excel and the Statistical Package for Social Sciences (SPSS) version 20. The data were analyzed using descriptive statistics, such as means, percentages, frequencies, and SDs.

3.7 Ethical Consideration

The KNUST Committee on Human Research, Publications, and Ethics granted the study ethical clearance. Furthermore, authorization and clearance were secured from

the Ghana National Fire Service (GNFS) leadership and staff. Once more, respondents were made aware of the study's objective. They were assured of confidentiality and could choose not to participate in the study. Before the start of data collection, participants gave their written informed consent to participate in the study.

3.8 Delimitations of Study

The researcher focused onkinds of occupational health and safety measures implemented at workplace by the employer to at least prevent the firefighters from suffering from occupational illnesses and injuries. The study did not investigate the knowledge of firefighters in health and safety, as they were trained in those areas. Again, the researcher could have placed more emphasis on occupational injuries and diseases that firefighters endure in the field of operation, but that would mean that the prevalence and pattern of occupational injuries and diseases among firefighters in the Western Region would have been missing.

CHAPTER FOUR

RESULTS

4.1 Sociodemographic Characteristics of Firefighters

Table 4.1: Sociodemographic Characteristics of Study Participants

Variable	Frequency (270)	Percentage (%)	P-Value
Sex			
Male	236	87.4	17.80 (**0.002**)
Female	34	12,6	
Total	**270**	**100**	
Age			
20-29	102	37.8	
30-39	127	47.0	105.04 (**0.002**)
40-49	32	11.9	
50 and above	9	3.3	
Total	**270**	**100**	
Educational Status			
JHS/Middle form	9	3.3	
SHS/O level	190	70.4	141.90 (**0.004**)
Tertiary	67	24.8	
Other	4	1.5	
Total	**270**	**100**	
Marital Status			
Married	110	40.7	
Living Together	14	5.2	
Divorced	4	1.5	415.8 (**0.000**)
Single	142	52.6	
Total	**270**	**100**	
Job title/Rank			
Recruitment fireman	24	8.9	
Fireman	97	35.9	
Senior fireman	13	4.8	
Leading Fireman	57	21.1	283.81 (**0.000**)
Subordinate officer	50	18.5	
Station Officer	5	1.9	
Assistant station officer	24	8.9	
Total	**270**	**100**	
Job experience(years)			
1-5	148	54.8	
6-10	67	24.8	
11-15	33	12.2	366.8 (**0.003**)
16-20	13	4.8	
Other	9	3.3	
Total	**270**	**100**	
Duty as firefighter			
Driver	31	11.5	
An officer	17	6.3	
Assistant	40	14.8	366.8 **(0.003**)
Branch man	76	28.1	
Crew number	59	29.1	

Other	47	17.4	
Total	**270**	**100**	
Nature of Employment			
Trainee	19	7.0	
Junior Officer	236	87.4	56.16 (**0.000**)
Senior Officer	15	5.6	
Total	**270**	**100**	

(Source: Field Data, 2023)

Table 4.1 shows that most (87.4%) participants were males, the highest (47.0%) age group was between 30-39 years, 70.4% had SHS/O level education, and 24.8% had tertiary education. The majority (52.6%) were single, 35.9% were firemen, 54.8% had worked between 1-5 years, and 87.4% were Junior Officers.

4.2 Prevalence of occupational injuries and diseases among firefighters

Table 4.2: Occupational injuries among firefighters

Variables	Frequency (270)	Percentage (%)	X^2 (P-Value)
Ever injured			
Yes	77	28.5	
No	193	71.5	250.04 (**0.000**)
Total	270	100	
Activity before the injury			
Picking tools, equipment, and a hose	14	17.1	
Moving tools, and equipment	15	18.3	
EMS or rescue	15	18.3	56.16 (**0.000**)
Fighting fire	34	41.5	
Other	4	4.9	
Total	82	100	
Time of injury			
6:00am – 11:59 am	22	26.8	
12:00 pm – 5:59 pm	14	17.1	
6:00 pm – 11:59 pm	28	34.1	105.04 (**0.002**)
24:00 pm – 5:59am	10	12.2	
Unknown	8	9.8	
Total	82	100	
How many days off did you get?			
None	37	45.1	
Less than one week	23	28.0	
Between 1 and 4 weeks	14	17.1	51.20 (**0.000**)
Between 2 months and 6 months	8	9.8	
Total	82	100	
Effect of injury on work			
I was able to continue my duties.	36	43.9	
I was unable to perform my duties	46	56.1	119.3 (**0.000**)
Total	82	100	

(Source: Field Data, 2023)

Data presented as frequencies and percentages, mean, standard deviation, p-values computed by Chi-square test, p-values < 0.05, and bolded means statistically significant.

Table 4.2 shows that 28.5% of firefighters have experienced occupational injuries as a result of their work. The most common activities leading to injury were fighting fires (41.5%), followed by picking up/moving tools and equipment (35.4%). Most injuries occurred during the evening shift from 6:00 pm to 11:59 pm (34.1%). The majority of firefighters (45.1%) did not take any time off work due to their injury, while 28% took less than one week off. Over half (56.1%) of firefighters were temporarily unable to perform their regular work duties as a result of the injury.

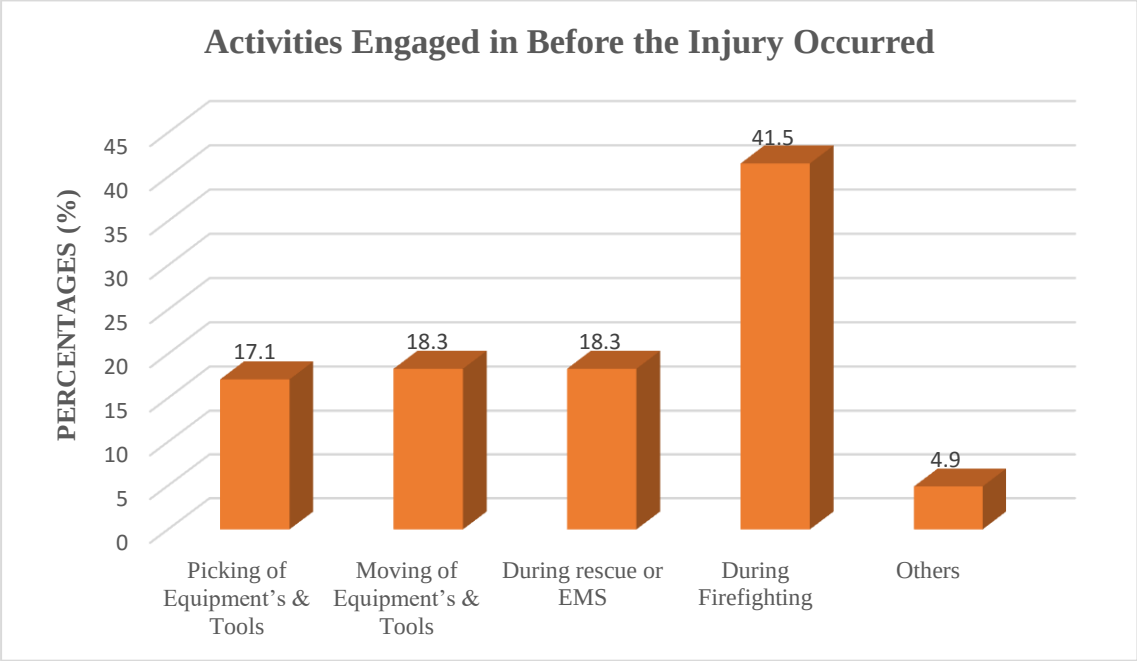

Figure 4.1: Activities engaged in before the injury occurred

From the data, the majority of injuries (41.5%) occurred during the activity of fighting fire, followed by moving tools, equipment at the scene (18.3%) and EMS or rescue (18.3%). Picking tools, equipment, or hose accounted for (17.1%) of the injuries, while the remaining (4.9%) were due to other activities.

Table 4.3: Work-related diseases among firefighters Source

Study Variables	Yes (%)	No (%)	Mean	X^2 (p-value)
Hearing problem	9 (3.3)	261 (96.7)	1.97	119.30 (0.000)
Vision problems	8 (3.0)	262 (97.0)	1.97	460.19 (0.000)
Heart diseases	0 (0.0)	270 (100.0)	2.00	461.82 (0.000)
Respiratory diseases	15 (5.6)	255 (94.4)	1.94	166.47 (0.000)
post-traumatic stress disorders	86 (31.9)	184 (68.1)	1.68	214.40 (0.000)
Sleep troubles	71 (26.3)	199 (73.7)	1.74	113.41 (0.000)
Experience heat stress fighting fire	165 (61.1)	105 (38.9)	1.39	113.41 (0.000)

(source: Field survey, 2023)

Data presented as frequencies and percentages, mean, standard deviation, p-values computed by Chi-square test, p-values < 0.05, and bolded means statistically significant.

Table 4.3 shows that (3.3%) reported having hearing issues, (3.0%) having vision problems, (5.6%) with respiratory diseases, (31.9%) experienced PTSD, however, none were diagnosed with heart diseases. Again, (26.3%) had sleeping trouble, while (61.1%) experienced heat stress during firefighting.

4.3 Occupational Health and Safety Practices among Firefighters at the Fire Stations

Table 4.4 The data showed that the Fire Service has a health and safety policy (52.6%) and a health and safety management system manual in place (55.9%). Fire Service has designated health and safety responsibilities for all staff (57.0%) and has procedures in place for maintaining, inspecting, and assessing hazards (88.1%). Fire Service has procedures for storing and handling hazardous substances (93.7%) and record-keeping procedures for employee training and induction programmes (93.3%). Less than half of the Fire Service have a workplace health and safety committee in place (31.1%), and only slightly more than half involve employees in decision-making processes related to health and safety matters (55.9%).

Table 4.4: Occupational Health and Safety Practices and Policies among Firefighters

Study Variable	Yes (%)	No (%)	X^2 (p-value)
Health and safety policy for GNFS	142 (52.6)	128 (47.4)	113.41(0.000)
Manual on Health and Safety Management	151 (55.9)	119 (44.0)	61.76(0.000)
All staff are responsible for Health and safety	154 (57.0)	116 (43.0)	88.32(0.000)
Procedure for investigation Incident	234 (86.7)	36 (13.3)	407.72 (0.000)
Procedures for assessing hazards	238 (88.1)	32 (11.9)	101.53(0.000)
Procedures for handling hazardous substances	253 (93.7)	17 (6.3)	35 (0.000)
Record for induction training for employees	252 (93.3)	18 (6.7)	154.05(0.000)
Procedure for staff to report hazards at the workplace	252 (93.3)	18 (6.7)	113.41(0.000)
Workplace health and safety committee	84 (31.1)	186 (68.9)	113.41(0.000)
Decision-making for health and safety staff	151 (55.9)	119 (44.1)	61.76(0.000)

(source: Field survey, 2023)

*Data presented as frequencies and percentages, mean, standard deviation, p-values computed by **Chi**-square test, p-values < 0.05, and bolded means statistically significant.*

Table 4.5: PPE Usage as an Occupational Health and Safety Measure for Firefighters

Study Variables	Yes (%)	No (%)	X^2 (p-value)
Enough PPE for all workers	35 (13.0)	235 (87.0)	36.34 (**0.000**)
Usage of safety goggles	219 (81.1)	51 (18.9)	43.45 (**0.000**)
Utilize earplugs	160 (59.3)	110 (40.7)	84.34 (**0.000**)
Wear safety boots/shoes	266 (98.5)	4 (1.5)	40.53 (**0.000**)
Wear a face mask	255 (94.4)	15 (5.6)	32.38 (**0.000**)
Breathing apparatus	260 (96.3)	10 (3.7)	44.96 (**0.000**)
Firefighting tunic	261(96.7)	9 (3.3)	44.96 (**0.000**)

Data presented as frequencies and percentages, mean, standard deviation, p-values computed by Chi-square test, p-values < 0.05, and bolded means statistically significant.

Table 4.5. The data showed that the majority of firefighters did not have enough PPE for all workers (87%), did not use earplugs as required (40.7%), and did not wear

firefighting tunics (6.7%) as needed. In contrast, the majority of firefighters did use safety glasses or goggles (81.1%), wore safety boots/shoes (98.5%), and used their breathing apparatus (96.3%) when required.

Table 4.6: Occupational Health and Safety (fire-ground safety rules)

Study variables	**Yes (%)**	**No (%)**	**X^2 (p-value)**
Demand apparatus safety	265 (98.1)	5 (1.9)	44.96 (**0.000**)
Use the proper PPE	252 (93.3)	18 (6.7)	149.49 (**0.000**)
Use the right safety equipment at the scene	266 (98.5)	4 (1.5)	172.34 (**0.000**)
Practice size-up 36 at the scene	252 (93.3)	18 (6.7)	149.49 (**0.000**)
Stay aware when communicating	232 (85.9)	38 (14.1)	64.92 (**0.000**)
Stay low and prioritize ventilation	266 (98.5)	4(1.5)	138.67 (**0.000**)

Data presented as frequencies and percentages, mean, standard deviation, p-values computed by Chi-square test, p-values < 0.05 and bolded means statistically significant.

The results showed that most of the firefighters (98.1%) demanded safety apparatus, 93.3% used proper PPE, 98.5% use the right safety equipment at the scene, 93.3% practiced size-up 36, 85.9% stay aware when communicating, and 98.5% stayed low and prioritized ventilation.

Table 4.7: Occupational Health and Safety Trainings for Firefighter

Study Variable	Responses	Frequency (270)	X^2 (p-value)
Had Formal training on occupational health and safety	Yes	186 (68.9)	138.67(**0.000**)
	No	84 (31.1)	
Rate your health and safety training programmeme	Extremely effective	10 (3.7)	
	Effective	154 (57.0)	
	Neither effective nor ineffective	58 (21.5)	
	Extremely ineffective	25 (9.3)	169.4(**0.000**)
	We don't have health and safety	23 (8.5)	
Frequency of meetings on health and safety	At least every two months	40 (14.80	
	At least every three months	78 (28.1)	
	At least every four months	36 (13.3)	0.116 (0.733)
	Middle of every year	118 (43.7)	
Frequency for conducting safety training for new employees	Always	81 (30.0)	
	Generally, but not always	92 (34.1)	
	Occasionally	65 (24.1)	
	Rarely	19 (7.00)	0.95 (0.33)
	Never	13 (4.8)	
How do you conduct safety training?	Verbal orientation	158 (58.5)	
	Written booklet	26 (9.6)	
	Video presentation	17 (6.3)	214.4(**0.000**)
	Multimedia presentation	48 (17.8)	
	Others	21 (7.8)	
Training include ergonomics	Yes	115 (42.6)	
	No	155 (57.4)	214.4(**0.000**)
Where do you conduct your safety training?	Formally at the stations	227 (84.1)	
	Informally at the stations	5 (1.9)	
	Outside the stations	38 (14.1)	

Data presented as frequencies and percentages,mean, standarrd deviation, p-values computed by Chi-square test, p-values < 0.05 and bolded means statistically significant.

4.4 Proximate Factors for Occupational Injuries and Diseases among Firefighters at Work

The result showed that 68.9% of firefighters have received formal training on occupational health and safety, while 31.1% have not (Table 4.7). Additionally, 57.0% of respondents rated their health and safety programme as "effective", while 21.5% rated it as "neither effective nor ineffective". 14.8% of respondents reported health and safety meetings at least every two months, while 43.7% reported meetings in the middle of every year. Furthermore, the data showed that 30.0% of firefighters conducted safety training for new employees always, while 34.1% did so generally but not always. In terms of the method of safety training, 58.5% of respondents used verbal orientation, while 9.6% used written booklets, 6.3% used video presentations, and 17.8% used multimedia presentations.

Table 4.8a showed that the majority of firefighters (63.0%) have been exposed to chemicals, and 81.5% have been at risk from fuel products. Other common factors include fire development (71.1%), burns from battery acid (39.6%), and slips, trips, and falls (59.6%). On the other hand, exposure to lead (41.9%) and dealing with hostile customers (41.1%) were less prevalent. The majority of the p-values are less than 0.05, indicating a statistically significant association between each factor and the outcome.

Table 4.8a: Proximate factors for occupational injuries and diseases among Firefighters

Study variables	Yes(n/%)	No (n/%)	Mean	X^2 (p-value)
Exposure to chemicals	170 (63.0)	100 (37.0)	1.37	130.82(**0.00**)
Exposure to gasoline or diesel.	171 (63.3)	99 (36.7)	1.37	40.53(**0.00**)
Fire development.	192 (71.1)	78 (28.9)	1.29	80.26(**0.00**)
Fire risk from fuel products.	220 (81.5)	50 (18.5)	1.19	130.82(**0.00**)
Burns from battery acid.	107 (39.6)	163 (60.4)	1.60	130.82(**0.00**)
Slippery or uneven surfaces.	166 (61.5)	104 (38.5)	1.39	149.49(**0.00**)
Fire progress	232 (85.9)	38 (14.1)	1.14	226.31(**0.00**)
Extreme temperature.	199 (73.7)	71 (26.3)	1.26	226.31(**0.00**)
Risk from awkward positions.	125 (46.3)	145 (53.7)	1.54	172.34(**0.00**)
Injury from repetitive tasks.	130 (48.1)	140 (51.9)	1.52	149.49(**0.00**)
Lifting of heavy objects.	161 (59.6)	109 (40.4)	1.40	64.92(**0.00**)
Risk of falling objects.	137 (50.7)	133 (49.3)	1.49	138.67(**0.00**)
Eye injury from flying particles.	111 (41.1)	159 (58.9)	1.59	169.4(**0.00**)
Slips, trips, and falls.	161 (59.6)	109 (40.4)	1.40	168.4(**0.00**)
Working tools and equipment.	213 (78.9)	57 (21.1)	1.21	229.72(**0.00**)
Stress.	224 (83.0)	46 (17.0)	1.17	229.72(**0.00**)
Loose materials on the surfaces.	120 (44.4)	150 (55.6)	1.56	88.32(**0.00**)
Possible asbestos exposures.	138 (51.1)	132 (48.9)	1.49	78.32(**0.00**)
Noise exposure.	220 (81.5)	50 (18.5)	1.19	101.53(**0.00**)
Dealing with hostile customers.	159 (58.9)	111 (41.1)	1.42	169.4(**0.00**)
Exposure to lead.	113 (41.9)	154 (57.0)	1.59	35(**0.00**)
Lost, caught, trapped, or confined.	180 (66.7)	90 (33.3)	1.35	154.05(**0.00**)

Data presented as frequencies and percentages, mean, standard deviation, p-values computed by Chi-square test, p-values < 0.05, and bolded means statistically significant. σ = standard deviation; Decision = Individual Mean compared with the weighted average (30.5315/22 = 1.3878).

Table 4.8b, showed that, lifting loads over 5kg had (64.4%), working with hands (53.7%), and exposure to long work hours (50.0%) were perceived as high physical hazards, while exposure to dusty conditions (55.6%) and slipping/falling (62.2%) were perceived as low hazards among the firefighters surveyed.

Table 4.8c. showed that the hazards that were most commonly reported as causing concerns were human body fluids (56.7%), zoonosis conditions (64.8%), blood-borne viruses (67.8%), and presence of stingy insects (58.9%).

Table 4.8d, majority (70.7%) of the participants wore PPE when dealing with chemical, however, 12.6, 11.1, 9.6 and 5.2 %, indicated exposed to substances that can be inhaled or ingested or absorbed into the body, availability of chemical containers, exposed to chemicals poisonous and corrosive, and skin exposed to oils at the fire-ground, respectively.

Table 4.8b: Proximate factors for occupational injuries and diseases: Ergonomic Hazards

Hazards	N (%)	S (%)	O (%)	A (%)	Mean	Decision	P-Value
Lifting loads of (over 5kg)	42 (15.6)	174 (64.4)	26 (9.6)	28 (10.4)	2.15	High Perception	415.8 (**0.000**)
Exposed to dusty conditions.	78 (28.9)	150 (55.6)	22 (8.1)	20 (7.4)	1.94	Low Perception	283.81(**0.000**)
Working with your hands.	47 (17.4)	145 (53.7)	39 (14.4)	39 (14.4)	2.26	High Perception	333.4 (**0.000**)
Exposure to long hours at work.	33 (12.3)	135 (50.0)	45 (16.7)	57 (21.1)	2.47	High Perception	12.6 (**0.003**)
Slipping or falling.	85 (31.5)	168 (62.2)	13 (4.8)	4 (1.5)	1.76	Low Perception	366.8 (**0.003**)

Data presented as frequencies and percentages,mean, standarrd deviation, p-values computed by Chi-square test, p-values < 0.05 and bolded means statistically significant. ***NOTE:*** *N = 270; N= Never; S= Sometimes; O= Often; A= Always; σ = Standard deviation; Decision = Individual Mean compared with the weighted average (10.5778/5 = 2.116).*

Table 4.8c: Proximate factors for occupational injuries and diseases: Biological hazards

Hazards	N (%)	S (%)	O (%)	A (%)	Mean	σ	Decision	P-Value
Human body fluids.	153 (56.7)	101 (37.4)	8 (3.0)	8 (3.0)	1.52	.69882	High Perception	154.05(**0.000**)
Zoonosis conditions.	175 (64.8)	79 (29.3)	8 (3.0)	8 (3.0)	1.44	.69665	Low Perception	166.47(**0.000**)
Blood borne viruses.	183 (67.8)	79 (29.3)	4 (1.5)	4 (1.5)	1.37	.59333	Low Perception	214.4(**0.000**)
Presence of stingy insects.	159 (58.9)	84 (31.1)	14 (5.2)	14 (5.2)	1.56	.80091	High Perception	232.4(**0.000**)

Data presented as frequencies and percentages, mean, standard deviation, p-values computed by Chi-square test, p-values < 0.05 and bolded means statistically significant. NOTE: N = 270; N= Never; S= Sometimes; O= Often; A= Always; σ = Standard deviation; Decision = Individual Mean compared with the weighted average (5.8889/4 = 1.472).

Table 4.8d: Proximate factors for occupational injuries and diseases: Chemical hazards

Hazards	N (%)	S (%)	O (%)	A (%)	Mean	σ	Decision	P-value
Wears PPE when dealing with chemicals?	5 (1.9)	25 (9.3)	49 (18.1)	191 (70.7)	3.58	.73638	High Perception	214.4 (**0.00**)
Availability of chemical containers?	85 (31.5)	138 (51.1)	17 (6.3)	30 (11.1)	1.97	.90796	Low Perception	146.76 (**0.00**)
skin exposed to oils at the fire-ground?	138 (51.1)	104 (38.5)	14 (5.2)	14 (5.2)	1.64	.80396	Low Perception	461.82 (**0.00**)
Exposed to chemicals poisonous and corrosive?	61 (22.6)	138 (51.1)	45 (16.7)	26 (9.6)	2.13	.87340	Low Perception	119.3 (**0.00**)
Exposed to substances that can be inhaled, ingested, or absorbed into the body?	47 (17.4)	140 (51.9)	49 (18.1)	34 (12.6)	2.26	.89162	Low Perception	35.00 (**0.00**)

NOTE: N = 270; N= Never; S= Sometimes; O= Often; A= Always; σ = Standard deviation; Decision = Individual Mean compared with the weighted average (11.5852/5 = **2.317**).

4.5 Association between First Aid Training and Occupational Injuries among Firefighters

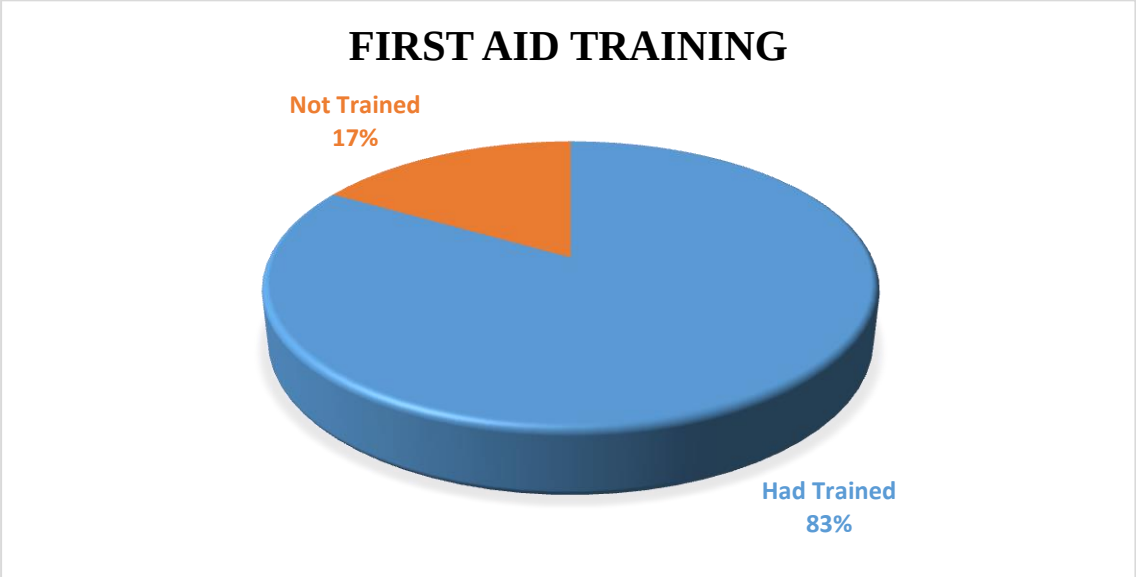

Figure 4.2: First Aid Training

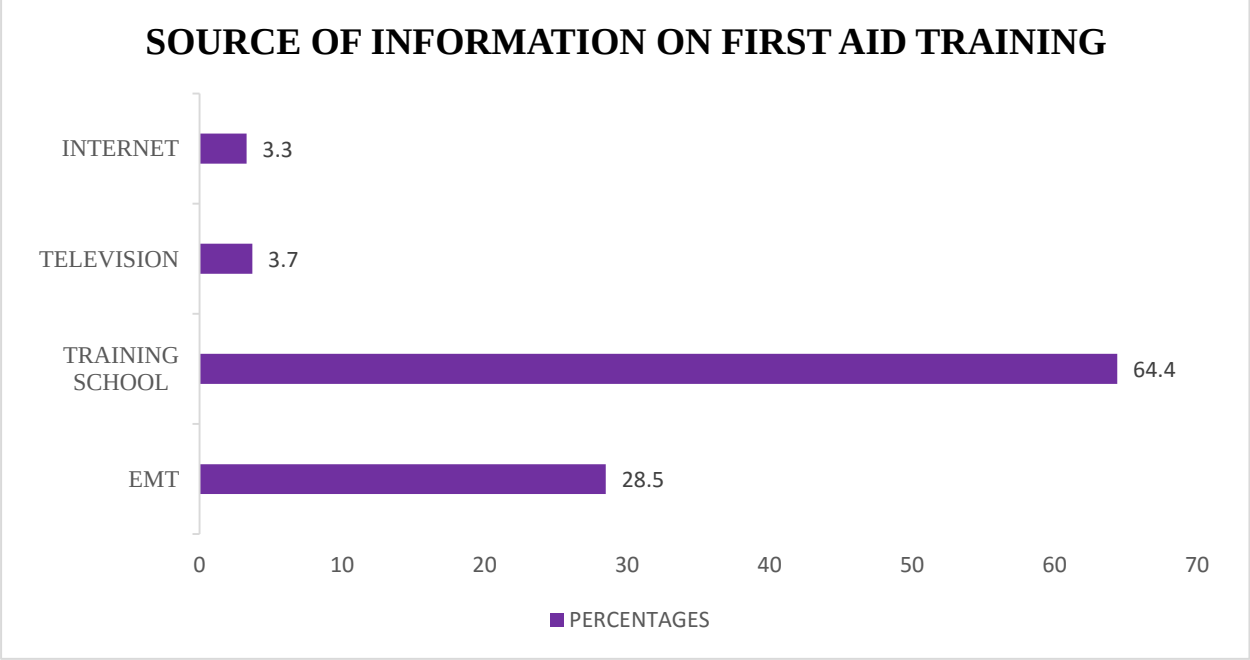

Figure 4.3: Source of Information

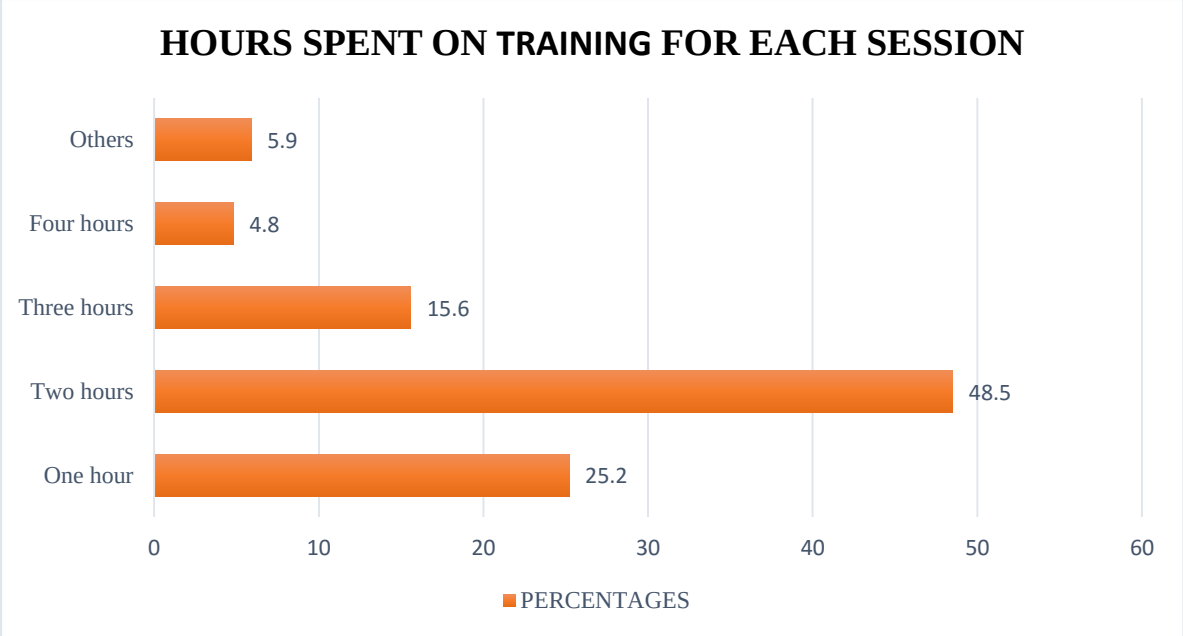

Figure 4.4: Number of hours for training

In Figure 4.2, the majority (83%) of the participants indicated they had ever received first aid training in the past. **Figure 4.3** shows that 28.5% of the respondents obtained first aid training from EMT, 64.4% from training schools, 3.7% from television, and 3.3% from the internet. From **Figure 4.4**, the result shows that the most favored durations are two hours (48.5%) and one hour (25.2%). Three- and four-hour sessions are less popular, with 15.6% and 4.8% preference, respectively. Only 5.9% preferred other durations.

Table 4.9: Firefighters' perceptions of First Aid Training Needs

Study Variable	SA (%)	A (%)	D (%)	Mean	σ	Decision	X^2 (P-Value)
Giving first aid training at the stations is fair.	191 (70.7)	79 (29.3)	-	1.29	.45580	High Perception	214.4 (**0.00**)
Giving first aid to colleagues is pleasant.	120 (44.4)	146 (54.1)	4 (1.5)	1.57	.52507	High Perception	61.76 (**0.00**)
Giving first aid is very good.	207 (76.6)	63 (23.3)	-	1.23	.42374	Low Perception	101.53 (**0.00**)
It is good for me to learn first aid.	229 (84.8)	41 (15.2)	-	1.15	.35954	Low Perception	35(**0.00**)
Employers should provide first aid to employees.	161 (59.6)	86 (31.9	23 (8.5)	1.49	.64947	High Perception	101.53 (**0.00**)
Training and PPEs usage reduce the risk of injuries.	242 (89.6)	28 (10.4)	-	1.10	.30544	Low Perception	36.34 (**0.00**)
First aid training is a joint f the employees and the employer.	226 (83.7)	44(16.3)	-	1.16	.37002	Low Perception	84.34(**0.00**)
First aid needs to be taken seriously at our workplace.	225 (83.3)	45(16.7)	-	1.17	.37337	Low Perception	130.82 (**0.00**)

NOTE: SA = Strongly agree; A= Agree; D= Disagree; σ = Standard deviation; Decision = Individual Mean compared with the weighted average.

In Table 4.9, most respondents (70.7%) indicated that giving first aid training at the stations was fair, (84.8%) said it was good for me to learn first aid, whereas 83.3% said first aid training should be taken seriously at workplace. Meanwhile, majority (59.6%) of the respondents agreed that employers are responsible for providing first aid to employees and 44.4% agreed that colleagues could give first aid.

Table 4.10: Association between first aid training and occupational injuries among firefighters.

Variable	Work-related Injury		X^2 (P-Value)	OR (P-Value)
	Yes (%)	No (%)		
Prior training in first aid				
Yes	72 (32)	153 (68)	8.03 (**0.005**)	3.461 (< **0.001**)
No	5 (11.11)	40 (88.89)		**Ref**

(Data Source: Field Survey, 2023)

In **Table 4.10**, 32% of participants who had prior training in first aid had experienced work-related injuries, however, 11.11% without prior training in first aid had also experienced work-related injuries. There is a significant association between prior first aid training and workplace-related injuries (X^2= 8.03, p=0.005). Participants with prior first aid training were 3.5 times more likely to experience workplace-related injuries than their counterparts.

CHAPTER FIVE

DISCUSSION

5.1 Introduction

This chapter presents a discussion of the findings regarding relevant literature on the subject. The current study assessed the occupational health, safety, and injuries among firefighters in the Western region of Ghana. Key findings of the specific objectives are discussed in these thematic areas: prevalence of occupational injuries and diseases among firefighters at work; occupational health and safety of the Ghana National Fire Service among firefighters; proximate factors for occupational injuries and diseases among firefighters at work; and the association between first aid training and occupational injuries among firefighters.

5.1.1 Socio-demographic Characteristics of Firefighters

The demographic characteristics of the study participants were analyzed to provide a comprehensive understanding of the sample population. The results showed that the majority of the participants were male (87.4%), which is consistent with previous studies that have reported a higher representation of men in firefighting occupations (Brinchmann et al., 2022). In terms of age, the majority of the participants fell within the 20-39 age range (84.8%), which is a common age range for individuals in this occupation (International Labour Organization, 2012). The educational status of the participants was predominantly middle-level, with 70.4% holding a secondary school certificate or higher, which is consistent with the requirements for firefighting training programmes (Ras & Leach, 2022).

Marital status analysis revealed that 40.7% of the participants were married, which is lower than the national average in many countries(UN Resident Coordinator's Office (RCO), 2018). The majority of the participants (52.6%) were single, which is consistent with previous studies that have reported a high proportion of single individuals in firefighting occupations (Brinchmann et al., 2022). Job title and rank analysis showed that 35.9% of the participants were firemen, followed by subordinate officers (18.5%), leading firemen (21.1%), and station officers (1.9%). These findings are consistent with previous studies that have reported variations in job titles and ranks starting within firefighting organizations (Ras & Leach, 2022). Again, analysis of job experience showed that 54.8% of the participants had 1-5 years of experience, followed by 24.8% with 6-10 years of experience. These findings are consistent with previous studies that have reported varying levels of job experience among firefighters (International Labour Organization, 2012). Duty analysis revealed that a few of the participants were engaged in driving duties (11.5%), followed by assistant duties (14.8%), and branch duties (28.1%). These findings are consistent with previous studies that have reported variations in duties within firefighting organizations (Ras & Leach, 2022). Finally, analysis of the nature of employment showed that the majority of the participants were employed as junior officers (87.4%), followed by senior officers (5.6%). These findings are consistent with previous studies that have reported variations in employment status within firefighting organizations (Brinchmann et al., 2022).

5.2 Prevalence of Occupational Injuries and Diseases among Firefighters

5.2.1 Occupational Injuries among Firefighters

This current study reported that a significant proportion, 41.5%, of injuries occurred during firefighting activities. Fairly consistent with a study by El-Menyar et al., (2016) that indicated that 62% of firefighter injuries were related to firefighting activities. Similarly, the Health and Safety Executive. (2019) reported that inadequate safety protocols and equipment were contributing factors to firefighter injuries, which aligns with the current study's findings that many participants took extended periods off work due to their injury.

The current study's findings on the timing of injuries also support previous research. Phelps et al., (2012) found that firefighter injuries were more likely to occur during peak fire season, which typically occurs during daytime hours. The current study's results showed that 26.8% of injuries occurred during daytime hours, supporting this finding. A study by Wu et al., (2021) found that 54.3% of firefighters in China experienced work-related injuries, which is higher than the current study's findings of 28.5%. This may be due to Ghana having a lean Fire incidence and equipment. Another study by Jong-hyun et al., (2020) reported that 34.6% of Korean firefighters experienced work-related stress, which may contribute to their overall injury rate.

The consequences of occupational injuries among firefighters are also significant. As reported by this study, many participants took extended periods off work due to their injury, which can lead to significant economic and personal costs (Thomas et al., 2020). Furthermore, the physical and emotional toll of injury can have long-term effects on firefighters' well-being and quality of life (Jong-hyun et al., 2020). The

current study's findings highlight the importance of considering the timing and characteristics of occupational injuries among firefighters. The high frequency of injuries during firefighting activities and peak fire season suggests that fire departments should prioritize measures to prevent these types of injuries. Additionally, providing adequate support and resources for injured firefighters is crucial to minimize the consequences of occupational injuries.

5.2.2 Occupational Diseases among Firefighters

Several studies have investigated the health risks associated with firefighting work. For example, a study by Asbury. (2019) found that 1 in 5 firefighters suffer from hearing loss due to occupational noise exposure. In contrast, our study found that 3.3% of firefighters reported having hearing issues, which is a concerning finding considering the loud nature of firefighting work. This suggests that further education and training on proper hearing protection measures are necessary**.**

Another study by Kumah et al., (2017) reported that eye injuries are a common occurrence in the fire service. Our study found that 3.0% of firefighters reported having vision problems, which may be attributed to the physical demands and environmental factors associated with firefighting work. This highlights the importance of proper protective gear and regular eye exams for firefighters.

A study by Cherry et al., (2021) found that firefighters are at a higher risk of developing cardiovascular disease due to physical exertion and exposure to stressors. Our study found that none of the participants reported being diagnosed with heart disease, which may be attributed to the relatively young age range of the sample

population. However, this does not diminish the importance of monitoring firefighters' cardiovascular health closely.

The high prevalence of post-traumatic stress disorders (PTSD) among firefighters (31.9%) is consistent with previous research (Wolffe et al., 2023). This highlights the need for mental health support and resources within the fire service. A study by Jitnarin et al. (2022) found that PTSD is a significant concern among firefighters, with symptoms including anxiety, depression, and substance abuse.

The findings on heat stress (61.1%) are also consistent with previous research (Asbury, 2019). Heat-related illnesses can be severe and even life-threatening, emphasizing the importance of proper personal protective equipment (PPE), hydration strategies, and heat acclimatization programmes.

This study's findings contribute to our understanding of the various work-related diseases among firefighters. The high prevalence of hearing issues, vision problems, respiratory diseases, PTSD, sleep troubles, and heat stress underscores the need for proactive measures to mitigate these risks. Fire departments must prioritize firefighter health and well-being through education, training, and resource allocation.

5.3 Occupational Health and Safety at the GNFS) among Firefighters

5.3.1 Health and Safety Training among Firefighters

The findings of this study are consistent with previous research that highlights the importance of formal training on occupational health and safety for firefighters (OSHA, 2015b). The high rate of 68.9% formal training on health and safety suggests

that many firefighters are receiving some level of training on this topic. However, it is of concern that nearly one-third of the participants did not receive formal training, which may put them at risk for injuries or illnesses.

The results also suggest that there may be a need for improvement in the effectiveness of health and safety programmes, as only a minority of participants rated their programme as extremely effective. This is consistent with previous research that found that many fire departments struggle to implement effective health and safety programmes (States Fire Administration, 2020). The methods used to conduct safety training are also concerning, as verbal orientation was the most common method used, which may not be an effective way to convey important information to firefighters (Garcia, 2019). The inclusion of ergonomics in the training programme is also important, as it can help prevent injuries and illnesses caused by repetitive strain or other ergonomic hazards. While many firefighters received formal training on occupational health and safety, there is still room for improvement in terms of the effectiveness and methods used in these programmes.

5.3.2 Fire Ground Safety Rules among Firefighters

In comparison to other scholarly works in the field of fire science and occupational health, this study's findings align with existing research highlighting the importance of adherence to fire-ground safety protocols. For example, a study by Life. (2008) found that improper use of PPE was a leading cause of firefighter injuries and fatalities, which is consistent with the current study's finding that 6.7% of respondents did not use proper PPE.

Another study by Pepper & Pepper (2021) emphasized the significance of size-up procedures during firefighting operations, as inadequate size-ups can lead to poor decision-making and increased risk of accidents. The current study's finding that 6.7% of respondents did not practice size-up 36 at the scene suggests that there may be a need for further education and training on this critical aspect of firefighting.

Regarding communication awareness, research by Guo & Liu, (2021) highlighted the importance of clear and effective communication among firefighters during emergency responses. The current study's finding that 14.1% of respondents were not aware when communicating suggests that there may be room for improvement in this area.

Finally, the study's results on ventilation priorities are consistent with existing research emphasizing the importance of prioritizing ventilation strategies during firefighting operations (OSHA, 2015a). While the current study provides valuable insights into fire-ground safety practices among firefighters, it is essential to consider these findings in conjunction with existing research in the field to identify areas for improvement and inform evidence-based training and policy development.

5.3.3 PPEs for Firefighters

This study highlights the importance of providing adequate PPE to firefighters to ensure their safety and well-being. The findings are consistent with previous research, which has shown that inadequate PPE is a common issue in firefighting operations (Kim et al., 2014; Park, 2019). For example, Park (2019) found that 75% of

firefighters in their study reported not having access to the required PPE during emergency responses.

The study also suggests that there may be a lack of awareness or knowledge among firefighters about the importance of using PPE. This is consistent with the findings of. Kim et al., (2014) reported that firefighters' knowledge about PPE was a major factor influencing their use of these devices.

Several studies have investigated the use and availability of PPEs among firefighters. For example, a study by Xia et al., (2017) found that 71% of firefighters reported using safety glasses or goggles regularly, which is slightly lower than the 81.1% reported in the current study. Another study by Combs. (2024) found that 83% of firefighters used earplugs during firefighting operations, which is higher than the 59.3% reported in the current study.

A study by Edition, (2020) found that 92% of firefighters reported wearing safety boots/shoes during work, which is similar to the 98.5% reported in the current study. A study by Aid & Protection. (2020) found that 93% of firefighters reported wearing face masks during firefighting operations, which is slightly higher than the 94.4% reported in the current study. The results of the current study suggest that while there is a generally high level of compliance with the use of PPEs among firefighters, there are still areas for improvement, particularly in terms of the availability of PPEs for all workers. This study highlights the need for improved provision and promotion of PPEs among firefighters. Fire departments should prioritize providing adequate PPE

to their personnel and educating them about the importance of using these devices to ensure their safety and well-being.

5.3.4 Perceptions of First Aid Training among Firefighters

Concerning other research work, this study supports previous findings that firefighters' value first aid training and believe it is essential for their work(Lingard, 2004b; Wang et al., 2021). The finding that employers are responsible for providing first aid care to employees aligns with previous research highlighting the importance of employer responsibility in providing a safe working environment (World Health Organization, 2020).

The study also suggests that providing personal protective equipment (PPE) reduces the risk of exposure to occupational injuries, which aligns with previous research highlighting the importance of PPE in preventing injuries (Ramsden et al., 2018). However, it is worth noting that some statements received lower agreement rates, such as "Giving first aid to colleagues is pleasant" (44.4%), which may indicate that firefighters may not always find giving first aid to colleagues a pleasant experience. This study provides insight into firefighters' perceptions of first aid training and highlights the importance of providing adequate training and resources to ensure a safe working environment.

5.4 Proximate Factors for Occupational Injuries and Diseases among Firefighters (Specific Objective 3)

5.4.1 Occupational Injuries and Diseases among Firefighters

The findings are consistent with previous research that has identified similar hazards as major contributors to occupational injuries and diseases among firefighters. For example, a study by the International Fire Safety Standard Committee (IFSSC) found that firefighters are at risk of exposure to hazardous chemicals, including pesticides, solvents, and fuels (IFSSC, 2021b). Another study published in the Journal of Occupational and Environmental Medicine found that firefighters are at risk of developing respiratory problems due to exposure to particulate matter and other airborne contaminants (Hazards, 2022).

The results also highlight the importance of personal protective equipment (PPE) and training in mitigating the risks associated with these hazards. For example, a study published in the Journal of Fire Sciences found that wearing PPE can reduce the risk of injury from chemical exposure by up to 90% (Yoon et al., 2016). Similarly, a study published in the Journal of Emergency Medical Services found that training programmes can reduce the risk of injury from falls by up to 50% (Harthi & Rachman, 2019).

The study's findings also suggest that stress is a significant contributor to occupational injuries and diseases among firefighters. This is consistent with previous research that has identified stress as a major risk factor for burnout and other mental health issues among firefighters (Kim et al., 2016). Therefore, fire departments need to provide resources and support for mental health services to mitigate the impact of stress on

firefighter well-being. This study provides valuable insights into the proximate factors contributing to occupational injuries and diseases among firefighters. The findings highlight the importance of addressing these hazards through education, training, and the provision of PPE. Furthermore, the study underscores the need for fire departments to provide resources and support for mental health services to mitigate the impact of stress on firefighter well-being.

5.4.2 Chemical Hazards among Firefighters

The information supplied sheds important light on the chemical risks that firefighters encounter in the course of their work. Now let's analyze the data from an academic perspective:

The data shows that 51.1% of firefighters are exposed to oils at the fire-ground, while 22.6% are exposed to poisonous and corrosive substances. Furthermore, 51.9% of firefighters are exposed to substances that can be inhaled, ingested, or absorbed into the body. These findings are consistent with previous studies that have highlighted the high risk of chemical exposure faced by firefighters (Hazards, 2022; Krzemińska & Szewczyńska, 2020).

Regarding PPE use, the study found that only 1.9% of firefighters wear PPE when dealing with chemicals. This is concerning, as PPE is essential for protecting firefighters from chemical hazards (Garcia, 2019). The low rate of PPE use may be attributed to factors such as lack of availability of PPE, lack of training on its proper use, or inadequate supervision (Ryu et al., 2017).

The data also suggests that the availability of chemical containers is a significant issue, with only 11.1% of firefighters reporting that containers are always available at the fire-ground. This highlights the need for improved storage and management of chemicals at fire stations(States Fire Administration, 2020). In conclusion, this study highlights the significant chemical hazards faced by firefighters and the need for improved protection measures. The findings suggest that PPE use is a critical issue, and efforts should be made to increase the availability and proper use of PPE among firefighters. Additionally, improved storage and management of chemicals at fire stations are necessary to reduce the risk of exposure.

5.4.3 Biological Hazards Among Firefighters

This current study revealed that human body fluids, zoonosis conditions, and blood-borne viruses, as well as stingy insects, were the biological hazards among firefighters in the Western region of Ghana.

According to previous research studies by Contrera-Moreno et al., (2012), Fernandes Da Silva et al., (2013), biological hazards are a significant concern for firefighters, particularly those involved in rescue operations or responding to emergencies. The results of this study support this finding, as human body fluids are perceived as the most significant biological hazard by firefighters. Regarding zoonosis conditions and blood-borne viruses, previous studies have also highlighted their importance as biological hazards for firefighters (Faisal, 2017). However, the current study suggests that these hazards may not be perceived as highly significant, 1.5% by firefighters, which may be due to various factors such as a lack of awareness or training on these specific hazards. The presence of stingy insects is also an important consideration for

firefighters, particularly in certain regions or situations where insect-borne diseases are prevalent (Matuszkiewicz, 2018). The relatively lower perception of this hazard in this study may be due to factors such as a lack of exposure to these insects or insufficient awareness about their potential risks. In conclusion, this study supports previous research findings on the importance of biological hazards for firefighters. However, the results also highlight the need for increased awareness and training on zoonosis conditions and blood-borne viruses, as well as insect-borne diseases.

5.4.4 Ergonomic Hazards among Firefighters

This current study revealed that most firefighters perceived lifting loads over 5kg as a high-risk hazard, which is consistent with previous studies (Lane et al., 2022; Szubert & Sobala, 2002a) that reported that lifting and carrying heavy equipment is one of the most common physical demands faced by firefighters. This study suggests that firefighters in the Western part of Ghana are highly susceptible to physical hazards known as musculoskeletal disorders, resulting in back injuries and strains (Kodom-Wiredu, 2019).

This current study reported that more than half of the participants perceived exposure to dusty conditions as a high-risk hazard. This is consistent with a previous study by Cartwright. (2021) claimed that firefighters were exposed to high levels of particulate matter and carbon monoxide during firefighting operations, which can lead to respiratory problems. Firefighting activities can generate large amounts of dust and debris, which can aggravate respiratory issues such as asthma and chronic obstructive pulmonary disease (COPD) (Witt et al., 2017).

This current study stated that about 53.7% of the participants perceived working with their hands as a high-risk hazard. This is consistent with previous studies that have highlighted the physical demands of firefighting activities, including manual labor and handling heavy equipment (Lane et al., 2022; Szubert & Sobala, 2002a). Firefighting activities can lead to hand injuries, such as cuts and burns, due to the use of heavy equipment and exposure to heat and flames.

This current study stated that about 50.0% of the participants perceived exposure to long hours at work as a high-risk hazard. This is consistent with previous research that has highlighted the importance of rest and recovery time for firefighters (Bender, 2018). Firefighting activities can be physically and mentally demanding, leading to fatigue and decreased performance over time.

This current study discovered that few (4.8%) participants indicated slipping or falling as a low-risk hazard. However, this may be due to underreporting or a lack of awareness about the risk of slips and falls in firefighting environments. A study by Jennifer, (2018) found that slips and falls were a common cause of injuries among firefighters, often resulting in serious consequences.

5.5 The Association Between First Aid Training and Occupational Injuries among Firefighters

5.5.1 Association Between First Aid Training and Occupational Injuries

This current study discovered a significant association between prior first aid training and workplace-related injuries. This is consistent with a previous study that shows a

link between having prior training in first aid and sustaining injuries as a result of firefighting (McCabe et al., 2011).

Astonishingly, this current study further revealed that firefighters with prior first aid training were four times more likely to experience workplace-related injuries than their counterparts. This disagree with several studies that reported that firefighter with prior first aid training can experience a minimize occupational injuries (Lingard, 2004; Wang et al., 2021). This may be attributed to paying more attention to the theoretical nature of the first aid training and not paying attention to the practical aspect of the first aid training being taught (Prentice, 2024).

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

6.1 Overview

This chapter summarizes the study's major findings, which assessed occupational health, safety, and injuries among firefighters in the Western region of Ghana. The chapter includes a summary of the research findings, conclusions from the results obtained, and recommendations for further studies.

6.2 Summary of Findings

This study shows that most participants were male (87.4%), with the highest age group being 30-39 years (47.0%), and 70.4% had SHS/O level education. About 28.5% of firefighters have experienced occupational injuries, primarily from fighting fires (41.5%) and handling tools (35.4%), mostly during the evening shift (34.1%). Many injured firefighters (45.1%) did not take time off work, while 56.1% were temporarily unable to perform regular duties. Common health issues included PTSD (31.9%) and heat stress (61.1%).

Most organizations have health and safety policies (52.6%) and hazardous substance procedures (93.7%), but 87% of firefighters lack sufficient PPE. Despite this, they frequently use safety glasses (81.1%), safety boots (98.5%), and breathing apparatuses (96.3%). Regarding training, 68.9% of firefighters have received formal occupational health and safety training, with 57.0% rating their programmemes as "effective." Safety meetings occur every two months for 14.8% and biannually for 43.7%. Always

conducting safety training for new employees is practiced by 30.0%, with 58.5% using verbal orientation.

Chemical exposure affects 63.0%, and 81.5% face fuel risks. Common hazards include fire development (71.1%) and slips (59.6%). Human body fluids (56.7%) and blood-borne viruses (67.8%) are top concerns. PPE is worn by 70.7% when handling chemicals. Most participants (83%) had received first aid training, mainly from training schools (64.4%) and EMTs (28.5%). Preferred training durations were two hours (48.5%) and one hour (25.2%).

Most respondents (84.8%) found first aid training beneficial, and 83.3% emphasized its importance in the workplace. Additionally, 59.6% believed that employers should provide first aid, and 44.4% agreed that colleagues could also administer first aid. A significant association exists between prior first aid training and workplace-related injuries, with trained participants being 3.5 times more likely to experience such injuries ($\chi 2 = 8.03$, $p = 0.005$).

6.3 Limitations of the Study

Conceivably, relying on self-reported information from participants introduces the possibility of recall bias, as participants may selectively report information, leading to inaccuracies in the collected data. To help reduce this bias, participants were assured of strict confidentiality regarding the collected data, and their anonymity was guaranteed. Again, the study is limited in terms of its coverage. Even though there are several emergency professions in Ghana, the study was carried out among only firefighters. Also, the study was centered in the Western region of Ghana. Therefore,

results could have been different if the scope of the study were extended to other emergency professions in other geographical regions. Lastly, the use of cross-sectional data limits the strength of causality, hence, future studies may use a different design to enhance the strength of the causal influence on occupational health, safety, and injuries among fire service personnel.

6.4 Conclusion

Sustained Firefighting activities and handling of tools are the predisposing reasons for firefighters' injuries, while PTSD, respiratory conditions, and Heat Stress are the common occupational diseases.

Health and safety policy for GNFS, procedures for investigating incidents, and a manual on health and safety management, but they lack a workplace health and safety committee and sufficient PPE for all operational workers.

Proximate factors for occupational injuries and diseases were slips and falls, exposure to human body fluid, exposure to poisonous and corrosive substances, exposure to inhalation or ingestion, and lifting loads of over 5kg.

The result shows a significant association between prior first aid training and workplace-related injuries.

6.5 Recommendations

Based on the study outcome, the following recommendations are made to improve safe firefighting:

6.5.1 Government

- Should equip firefighters with adequate first aid resources and appropriate PPEs to address emergencies.

6.5.2 Ghana National Fire Service (GNFS)

- Should improve first aid training and make it more practical than theoretical.
- Should ensure that training programmes cover essential areas such as blood-borne disease prevention, CPR and AED training, and management of common injuries and medical emergencies.
- Ensure firefighters adhere to the proper PPE usage.
- Should use effective safety training methods, such as verbal orientation, written booklets, video presentations, and multimedia presentations, to ensure that firefighters receive the necessary training to mitigate the risks they face.
- Should prioritize comprehensive medical screening and fitness programmes for firefighters to identify and address health concerns and ensure that they are physically prepared for the demands of their work.
- Clear and effective SOPs/SOGs should be established and adhered to.
- Should collaborate with recognized training providers such as the National Ambulance Service and Red Cross to ensure that the training programmes meet the highest standards.

6.5.3 Individual Workers

- Should participate in psychological first aid and resilience workshop to help minimize the potential impact of stress.

6.5.4 Stakeholders (GHS, National Ambulance Service, ETC.)

- GHS should collaborate with the GNFS to do regular screening for firefighters.

6.5.5 Future Study

- There is a need for continued support and investment in research and data collection efforts to better understand the occupational risks faced by firefighters.

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APPENDICES

APPENDIX I: QUESTIONNAIRES

INTERVIEWER: INTRODUCTION AND CONSENT. May I begin the interview now?

NO	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS I would like to start by asking a few questions about yourself			
Q1.	Gender	Male……...……1 Female……...…….2	
Q2.	Age	Below 20 years……....1 20 – 29 years……..….2 30 - 39 years……..….3 40 – 49 years……...…4 50 and above …….....5	
Q3.	Educational Status	Non-formal…….…….....1 Primary……..……..….2 JHS/Middle form……....3 SHS/O'level…….…...4 Tertiary….…….…....….5 Other (specify) ……...6	
Q4.	Marital Status	Married (civil, traditional, religious).....1 Living together……...2 Divorced……..…….…….....3 Widowed……..…….....4 Separated…….....5 Single…….....….6	
Q5.	Job Title (Rank)	Recruit fireman……...1 Fireman …….....2 Senior fireman ……....3 Leading fireman……..….....4 Subordinate officer……..5 Assistant station officer ……..…6 Station officer……..…….. 7	
Q6.	How long have you been doing this work?	1 - 5 years……..…..……1 6 – 10 years ……2 11- 15 years ……..… 3 16 – 20 years ……...……...4	

		Other (specify) ……..…..5		
Q7.	What specific job role do you play in the firefighting profession?	Driver (pump operator)…..……1 An officer (Incident commander).....2 Assistant (to the branch man).....3 Branch man…….....4 Crew number 4 (messenger).....5 Other (specify)…….....6		
Q8.	Nature of Employment?	Trainee (attachment)…….....1 Junior officer…….....2 Senior officer……..…3		
SECTION B: OCCUPATIONAL INJURIES				
Q9.	Have you ever had any injuries as a result of your work?	Yes……..1 No……..…..……...2		If No move to Q48
Nature of injury		**Yes**	**No**	
Q10	Sprain / Strain			
Q11	Contusions / Abrasions / Crushing			
Q12	Puncture / Lacerations			
Q13	Fracture/dislocations			
Q14	Pains			
Q15	Burns			
Q16	Electrocution			
Q17	Smoke inhalation			
Q18	Breathing difficulty			
Q19	Exhaustion or Fatigue			
Q20	Eye irritation/eye injury			
Q21	Cardiac symptoms			
Q22	Dizziness, Fainting, and weakness			
Q23	Animal Bite			
Q24	Other			
Which part of your body was injured		**Yes (1)**	**No (2)**	
Q25	Upper extremities			
Q26	Head			
Q27	Eye			
Q28	Ear			
Q29	Neck and Shoulders			
Q30	Chest			
Q31	Hand and Fingers			
Q32	Wrist			
Q33	Elbow			

Q34	Trachea and Lungs			
Q35	Back, except spine			
Q36	Spine			
Q37	Abdominal			
Q38	Lower extremity			
Q39	Pelvic			
Q40	Knee			
Q41	Ankle			
Q42	Toes			
Q43	What activity were you doing before the injury occurred?	Picking up tools, equipment, hose……1 Moving tools, equipment at the scene.....,....2 EMS or Rescue……..……...3 Access or egress……..…4 Operating apparatus.....5 Handling charged hose line ….....6 Using hand tools in extinguishment……7 Fighting fire……....8 Other…….……..9		
Q44	What time did the injury occur?	6:00–11:59……...…..…1 12:00–17:59..……..…...2 18:00–23:59 ……...…...3 24:00–5:59..……4 Unknown...……..……...…5		
Q45 .	How many days off did you get as a result of your injury/illness?	None.....1 Less than one week.....2 Between 1 and 4 weeks.....3 Between 4 and 8 weeks.....4 Between 2 Months and 6 Months……....5 6 Months and over.....6		
Q46 .	What was the effect of your injury/illness on your work?	I was able to continue with all my work duties.....1 I was temporarily unable to do my work duties.....2 I am permanently unable to do some of my work duties …….…3 I am permanently unable to work……....4 Other: specify 5		

Q47	Which type of injury represents the highest proportion of work-related injuries?			
SECTION B1: WORK-RELATED DISEASES				
	Health-related	**Yes (1)**	**No (2)**	
Q48	Any hearing problems due to firefighting?			
Q49.	Do you ask people to repeat their words to hear them?			
Q50	Do you have any vision problems due to firefighting?			If no, move to Q52
Q51	What measures are used to address poor vision?	Eye-glasses……..……...…1 Prescribed lenses……..…2 Eye surgery (Laser)……..…3 None of the above……...…4		
Q52	Have you been diagnosed with any heart diseases as a firefighter?			If no, move to Q54
Q53	If yes, did you receive treatment for this disease?			
Q54	Have you been diagnosed with any respiratory diseases as a firefighter?			If no, move to Q56
Q55	If yes, did you receive treatment for this disease?			
Q56	Did you experience any post-traumatic stress disorder as a result of firefighting?			
Q57	Do you experience any nightmares?	Always…….……...…1 Often…….……..2 Sometimes…….……..3 Rarely…….……4 Never……..……..……..5		
Q58	Do you experience memory vividly as if it were happening all over again?			
Q59	Do you have sleep troubles?			
Q60	Is your sleeping hours sufficient for you?			
Q61	Did you have any heat stress during			

	your firefighting?			
Q62	On average, how many symptoms of heat stress do you experience in a month?	With every fire operation…..…...1 Once every 3 operations……..2 Once every 5 operations…...…...3 Once every 10 operations……4 Irregularly……..…...…..…5		
SECTION C: IDENTIFICATION OF PROXIMATE FACTORS				
	Proximate factors of injuries	**Yes (1)**	**No (2)**	
Q63	Exposure to chemicals, solvents, solder, and other products.			
Q64	Exposure to gasoline or diesel exhaust.			
Q65	Fire development			
Q66	Fire risk from fuels and other products.			
Q67	Burns from battery acid and hot surfaces			
	The explosion of gas cylinders			
Q68	Slippery or uneven surfaces			
Q69	Fire progress, including smoky conditions.			
Q70	Extreme temperatures.			
Q71	Risk of pain or injury from awkward positions.			
Q72	Risk of pain or injury from repetitive manual tasks.			
Q73	lifting of heavy objects			
Q74	Risk of falling objects (including the vehicle) when working under vehicles.			
Q75	Eye injury from flying particles.			
Q76	Slips, trips, and falls.			
Q77	Working with various hand tools, and equipment.			
Q78	Stress.			
Q79	Loose materials on the surface			
Q80	Possible asbestos exposure.			
Q81	Noise exposure.			
Q82	Dealing with hostile customers.			
Q83	Exposure to lead			
Q84	Lost, caught, trapped, or confined			

Q85	Other (specified)			
SECTION D: OCCUPATIONAL HEALTH AND SAFETY MEASURES				
	DOCUMENTATION	**Yes (1)**	**No (2)**	
Q86	Is there a documented health and safety policy for GNFS?			
Q87	Is there a health and safety management system manual or plan in place??			
Q88	Are health and safety responsibilities identified for all levels of staff?			
Q89	Is there a documented incident investigation procedure in place?			
Q90	Are there procedures for maintaining, inspecting, and assessing hazards involving firefighters?			
Q91	Do you have procedures for storing and handling hazardous substances?			
Q92	Do you have a record of all training and induction programmemes undertaken for employees?			
Q93	Do you have a procedure by which leaders and employees can report hazards at the workplace?			
Q94	Is there a workplace health and safety committee in place?			
Q95	Are employees involved in decision-making over health and safety matters?			
SECTION D1: OCCUPATIONAL HEALTH AND SAFETY MEASURES				
	PPE's	**Yes (1)**	**No (2)**	
Q96	Do you know what PPEs are?			If no, move to Q98
Q97	Do you have enough PPE for all workers?			
Q98	Do you use safety glasses and/ or goggles as needed?			
Q99	Do you utilize earplugs when required?			
Q100	Do you wear hand gloves and a helmet when necessary?			

Q101	Do you wear safety boots/ shoes as required?			
Q102	Do you wear a face mask as needed?			
Q103	Do you use breathing apparatus in an irrespirable environment?			
Q104	Do you use a firefighting tunic in your work?			
I. First aid training				
	Variables	**Yes (1)**	**No (2)**	
Q105	Do you have a first aid box in your fire tender?			
Q106	Have you had any prior training in first aid?			If no, move to Q109
Q107	Have you had any injuries after your first aid training?			
Q108	Have you encountered colleges that need first aid training?			
II. Knowledge Acquired		**Yes (1)**	**No (2)**	
	Have you been trained in these areas?			
Q109	Blood-borne disease prevention			
Q110	CPR and AED Training			
Q111	Preventive Care training			
Q112	Controlling bleeding			
Q113	Management of spinal injuries			
Q114	Stroke management			
Q115	Choking management			
Q116	Management of burns			
Q117	Lifting and movement			
Q117	Fracture management			
Q118	How long do you think each class session should be?	One hour…….....….1 Two hours……..….....2 Three hours……..….……..3 Four hours……..…….....4 Other……..…..……..…..……...5		

Q119	Source of information on first aid training.	EMT……..…..…….....1 Training school……...….2 Television…….....…..……...3 Internet……. …...4 Article……..……..……..5 Newspapers……..6 Others (specify)……..…..…7				
	Variables	**Strongly Agree**	**Agree**	**Disagree**	**Strongly disagree**	
Q120	Giving first aid training at the stations is fair.					
Q121	Giving first aid to colleagues is pleasant.					
Q122	Giving first aid is very good.					
Q123	It is good for me to learn first aid.					
Q124	It is the responsibility of the employer to give first aid care to employees.					
Q125	Training of staff and provision of personal protective equipment is necessary to reduce the risk of exposure to occupational injuries.					
Q126	First aid training is a joint responsibility of the employees and the employer.					
Q127	First aid is an issue that should be taken seriously and given quick attention in your workplace.					
II.	**Health and Safety**	**Yes (1)**		**No (2)**		
Q128	Have you had any formal training, workshop, or seminar on occupational health and safety before?					
Q129	How will you rate the health and safety programmeme currently in use in your stations? Will you say it is	Extremely effective……..…1 Effective……..…….2 Neither effective nor ineffective…..…3 Ineffective…….…...4 Extremely ineffective…….…..5 We don't have health and safety…..…6				
Q130	How often does your station have meetings regarding health and safety issues?	At least every two months……..1 At least every three months……....…2 At least every four months…….……..3				

		Middle of every year……..…...4		
Q131	How often do you conduct safety training specifically for new employees?	Always…….……1 Generally, but not always…….…...2 Occasionally…….....3 Rarely……..…….4 Never……..…..5		
Q132	How do you conduct safety training?	Verbal orientation……..…….....1 Written booklet……....2 Video presentation……...…….…...3 Multimedia presentation……..4 Others……..…….....5		
Q133	Does this training include Ergonomics?	Yes……...…..…..1 No……..…...2		
Q134	Where do you conduct safety training?	Formally, at the stations……..….1 Informally, at the stations……....2 Outside the stations…….…..…3		
Q135	How do you ensure employees' health and safety?	Daily safety inspection…….……1 Health and safety committee……..…..2 Availability of injury statistics…….....3 Others……..….4		
Q136	What is your responsibility as a health and safety officer?	I have no responsibility…….....1 Help prevent Biological hazards…..…2 Help prevent chemical Hazards……...3 Help prevent physical hazards….....4 Help prevent Safety hazards……....5 Help prevent ergonomic hazards…....6		
Q137	What are the occupational health and safety procedures?	Maintain correct posture……..…1 Use equipment properly……...…2 Locate emergency exits……...…3 Report safety concerns……..…...4 Make use of mechanical aid …...…….5 Take breaks regularly …….…....6		
Q138	What changes will help prevent these incidents / near misses from happening again?	Train the employee(s)…….…....1 Train the incident commander…….2 Write new policy rule…….....3 Enforce existing policy……...….4 Personal protective equipment…….5 Guard the hazard…….…....6 Others…….....7		
VI. Fire-ground Safety Rules		**Yes (1)**	**No (2)**	
Q139	Do you demand apparatus safety?			
Q140	Do you use the proper PPE?			

Q141	I use the right safety equipment at the scene.			
Q142	Do you practice Size Up/360 at the scene?			
Q143	Do you stay aware when communicating?			
Q144	Do you handle equipment with care on the fire ground?			
Q145	Do you stay low and prioritize ventilation?			
Q146	Do you protect your staff and your small gears?			

PHYSICAL HAZARDS

N	**Hazards**	**1**	**2**	**3**	**4**
Q147	Lifting, pushing, or pulling loads (over 5kg)				
Q148	Employees are exposed to dusty conditions in the workplace				
Q149	Working with your hands above shoulder height				
Q150	Employees work for long hours				
Q151	Slipping or falling in the course of work				

Please Tick Appropriately key: **Never** =1, **Sometimes** = 2, **Often** = 3, **Always** = 4

BIOLOGICAL HAZARDS

N	**Hazards**	**1**	**2**	**3**	**4**
Q152	Human body fluids				
Q153	Zoonosis conditions				
Q154	Blood-borne viruses				
Q155	Presence of stingy insects				

Please Tick Appropriately key: **Never** =1, **Sometimes** = 2, **Often** = 3, **Always** = 4

CHEMICAL HAZARDS

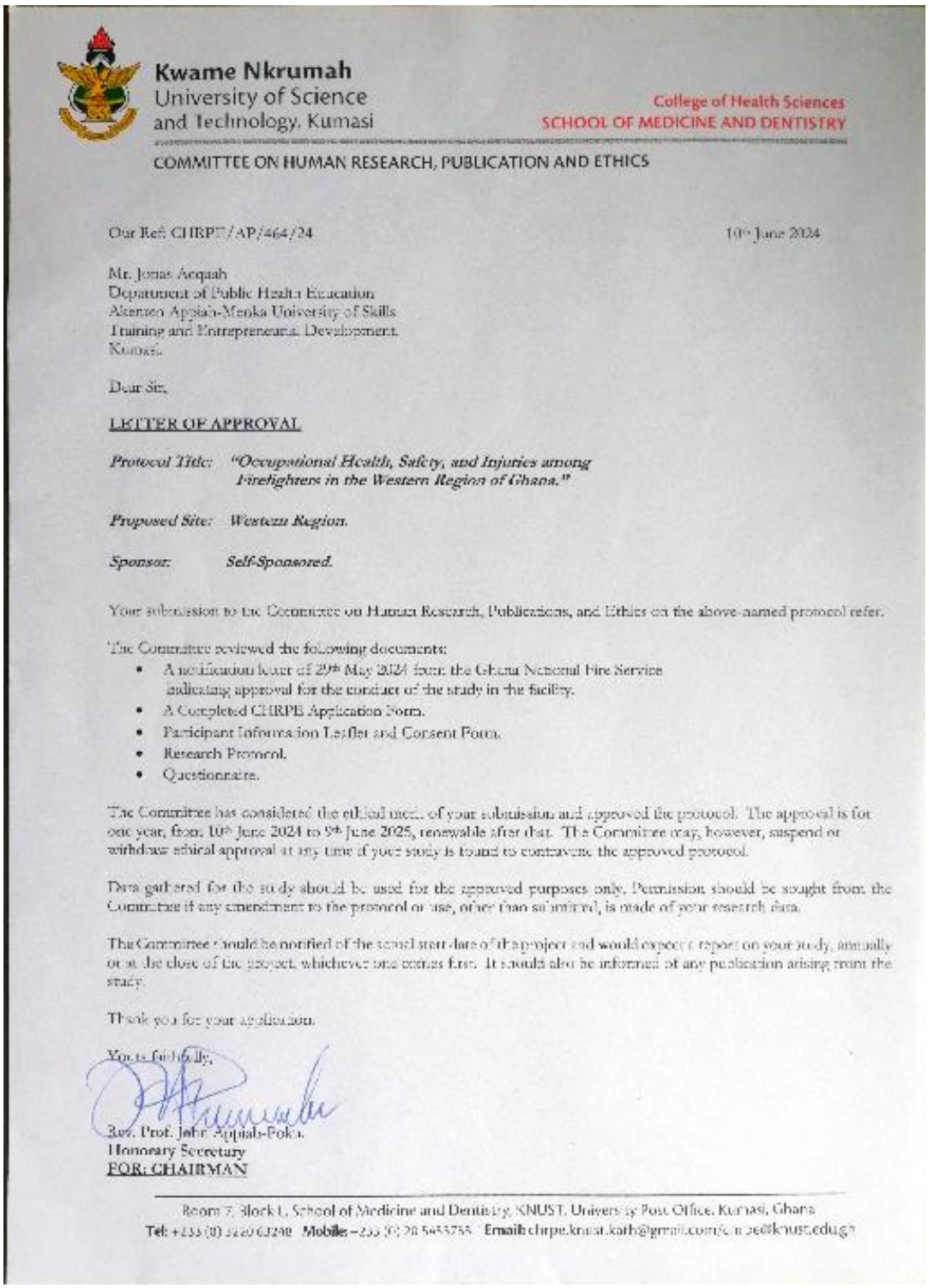
N	**Hazards**	**1**	**2**	**3**	**4**
Q156	When dealing with chemicals, do you wear PPE?				
Q157	Are there chemical containers in your daily activities?				
Q158	Is your skin exposed to various oils at the fire-ground?				
Q159	Are the chemicals poisonous and corrosive?				
Q160	Are you exposed to substances that can be inhaled, ingested, or absorbed into the body?				

Please Tick Appropriately key: **Never** =1, **Sometimes** = 2, **Often** = 3, **Always** = 4

THANK YOU

APPENDIX II: APPROVAL LETTERS

Ethical clearance



Kwame Nkrumah
University of Science
and Technology, Kumasi

College of Health Sciences
SCHOOL OF MEDICINE AND DENTISTRY

COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPT/AP/464/24 10th June 2024

Mr. Jonas Acquah
Department of Public Health Education
Akenten Appiah-Menka University of Skills
Training and Entrepreneurial Development
Kumasi.

Dear Sir,

LETTER OF APPROVAL

Protocol Title: *"Occupational Health, Safety, and Injuries among Firefighters in the Western Region of Ghana."*

Proposed Site: *Western Region.*

Sponsor: *Self-Sponsored.*

Your submission to the Committee on Human Research, Publications, and Ethics on the above-named protocol refer.

The Committee reviewed the following documents:

- A notification letter of 29th May 2024 from the Ghana National Fire Service indicating approval for the conduct of the study in the facility.
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Research Protocol.
- Questionnaire.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for one year, from 10th June 2024 to 9th June 2025, renewable after that. The Committee may, however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Thank you for your application.

Yours faithfully,

Rev. Prof. John Appiah-Poku
Honorary Secretary
FOR: CHAIRMAN

Room 7, Block L, School of Medicine and Dentistry, KNUST, University Post Office, Kumasi, Ghana
Tel: +233 (0) 3220 63298 Mobile: +233 (0) 20 5455755 Email: chrpe.knust.kath@gmail.com/chrpe@knust.edu.gh

Approval Letter from Ghana National Fire Service

In case of reply the number and date of this letter should be quoted

Ghana National Fire Servic
Headquarter
GPS Address: GA-238-081
P. O. Box 412
Accra - Ghan
Tel: 0302 772 44
Fax: 0302 772 45

My Ref: No. NFS/ADM/041[A] VOL.VII/74

Your Ref: No.....

23rd May, 2023

1098/23

GHANA NATIONAL FIRE SERVICE
RECEIVED
Sign.....
Date. 29-5-23
SEKONDI

THE REGIONAL FIRE OFFICER
GHANA NATIONAL FIRE SERVICE
SEKONDI

RE: INTRODUCTORY LETTER
MR. JONAS ACQUAH

1. Receipt is hereby acknowledged of your letter No. NFS/SK/87/VOL.XIX/64 dated 15th February, 2023 with its attachment.

2. The request has been approved.

3. You are to assist the student (Mr. Jonas Acquah) to carry out his research works in your Region, as requested.

FANNY SIMPSON
DCFO
DIRECTOR (ADMIN)
For: CHIEF FIRE OFFICER

cc: Mr. Jonas Acquah
Akenten Appiah – Menka University
P.O.BOX 40
Asante - Mampong