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LEGON

ASSESSMENT OF WORK-RELATED LOW BACK PAIN DISORDERS AMONG HEAVY EQUIPMENT OPERATORS AT GPHA TEMA PORT

BY

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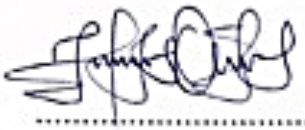
DECLARATION

I, **EMMANUEL MINTAH-BENYIN**, do hereby declare that apart from cited literature that have been duly acknowledged, this dissertation is the result of my own original research carried under able supervision of **DR. REGINALD QUANSAH**, School of Public Health. This research has not been presented elsewhere either in part or in whole for the purposes of the award of another degree.



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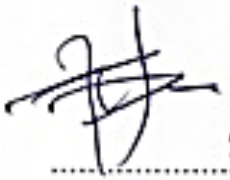

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DEDICATION

This research proposal is dedicated to my family for their prayers and support in diverse ways during my studentship.

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ABSTRACT

Introduction: Among working-class people between the ages of 25 and 49, low back pain (LBP) ranks as the fourth most common cause of disease burden. Acute or chronic forms of low back pain usually results in worker poor job performance and absenteeism due to the prolonged duration needed for full recovery to return to work. The period of absenteeism caused by LBP may vary, but the longer the period, the less likely the chance of returning to work. As previously indicated only a handful of persons with low back pain who have been away from work for at least six months will return to work. LBP is sometimes disregarded since it is not life-threatening although it results in significant disability and health related costs. Also, due to epidemiologic challenges faced in Africa and the lack of accurate data revealing the true state of disease, the problem seems to have been shelved.

Objective: To assess the prevalence and associated factors of work-related low back pain disorders among heavy equipment operators.

Methods: An analytical cross-sectional study was used to assess the prevalence of low back pain disorders (LBPD) among 189 workers who operate heavy machines in the Ghana Ports and Habours Authority (GPHA), Tema Port from November 2021 to February 2022. A structured questionnaire was used to elicit information from study participants. Data was analysed with STATA v.16 using multiple logistic regression with statistical significance set at $p<0.05$

Results: The prevalence of low back pain disorders among heavy equipment operators at GPHA, Tema was 44.4% (p = 44.4%, 95% CI = 37.2% – 51.8%). Age (aOR = 1.06; 95% CI = 1.00 – 1.12; p = 0.050), working overtime (aOR = 3.68; 95% CI = 1.76 – 7.68; p = 0.001), awkward posture of frequently bending their trunks sideway (aOR = 3.51; 95% CI = 1.39 – 8.84, p = 0.008), and physical activity (aOR = 0.40; 95% CI = 0.20 – 0.80; p = 0.010) were significant predictors of low back pain among heavy equipment operators.

Conclusion: The prevalence of low back pain disorders among heavy equipment operators at GPHA, Tema was relatively high. Age, working overtime, and awkward posture of frequently bending their trunks sideways were factors that contributed to the development of back pain among persons who work with heavy machinery at the Ghana Ports and Habours Authority, GPHA, Tema Port. Engaging in physical activities was a beneficial factor against low back pain among heavy equipment operators. However, the study did not find any significant association of LBPD impact on job performance and absenteeism. Once more, the research proved that an amalgamation of risk factors contributes to the occurrence of low back pain disorders. The management at GPHA should implement policies to lessen the likelihood that heavy equipment operators would experience LBPD.

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LIST OF ABBREVIATIONS

EMTs	Emergency Medical Technicians
GPHA	Ghana Ports and Harbours Authority
HSA	Health Safety and Authority
LBP	Low Back Pain
LBPD	Lower Back Pain Disorders
LMIC	Low-to-Middle Income Country
MPS	Meridian Port Services
MSDs	Musculoskeletal Disorders
NMQ	Nordic Musculoskeletal Questionnaire
PNDCL	Provisional National Defense Council Law
WBV	Whole Body Vibration

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of Study

Globally, low back pain (LBP) is one of the commonest musculoskeletal disorders associated with working conditions individuals find themselves in (Keriri et. al, 2013). Yearly estimates from studies show that between 70 - 80% of the public experience or develop a condition with their back at certain point in time in their lives (Chou, 2011; Mafuyai et. al, 2014). According to Chou (2011), between 15 – 45% of adults experience low back pain with 5% of such persons presenting to the hospital with a new episode. He also stated that about 10% of persons suffering from low back pain cannot work and about 20% report to suffer persistent symptoms of back pain for a whole year. Low back pain is a multifactorial disease implying that there are numerous risk factors that may contribute to its development and process (Keriri et al, 2013). According to Brebbia (2012), heavy equipment or machine operators suffer low back pain due to work related exposure to various risk factors. These risk factors include prolonged sitting down for long time, vibration of whole body and body parts in repetitive movements (Brebbia, 2012). Heavy equipment or machine operators are persons who drive or control powerful equipment including excavators, bulldozers, scrapers, power shovels, trucks, cranes, loaders and forklifts (Asangbah, 2016). Asangbah (2016) also reiterates that such heavy equipment operators suffer higher rates of musculoskeletal injuries resulting in conditions including low back pain. She also noted that ports and harbours around the world employ and utilise the services of these heavy equipment operators such as professional truck, fork-lift, trailer, crane operators or drivers who are likely to be exposed to or suffer musculoskeletal injuries (Asangbah, 2016). Chou (2011) also cites heavy physical labor, regular bending, twisting, and lifting, extended static posture, personal risk factors, psychosocial risk factors including

depression, anxiety, and work-related stress, and a history of low back pain are all possible causes of low back pain.

1.2 Statement of the Problem

According to data from the 2019 Global Burden of Disease, LBP is the fourth most common contributor to overall disease burden among working class persons aged 25 – 49 years of age (Vos et al., 2020). Acute or chronic forms of low back pain usually results in worker absenteeism due to the prolonged duration needed for full recovery to return to work. Chou (2011) notes that the period of absenteeism caused by low back pain may vary, but a longer period reduces the chance of returning to work stating that only a handful of persons with the disorder who have been away from work for six months will return to work. He also noted that person who absent themselves for as long as two years are highly unlikely to return to work (Chou, 2011) resulting in huge financial hardship to the sufferer, their relatives, working institutions and the society (Awosan et al., 2017; Alnaami et al., 2019; Kahere & Ginindza, 2020). Low Back Pain (LBP) can limit the ability of people to do their jobs, particularly if they perform physically demanding tasks.

Low back pain is the main cause of musculoskeletal disorders worldwide (Chen et. al., 2017). Over 156 million lost workdays and 5.2 million disabilities, of which 2.6 million are permanent, are attributed to LBP in the US, where it is estimated that over 80 billion US dollars are spent on it each year (Hartvigsen et.al, 2018).

In Sub Saharan Africa, a study with a population of 65 nurses showed that the lifetime prevalence of low back pain was 47% with an annual prevalence of 57% and a point prevalence estimated at 39% (Morris et al., 2018) which was found to have been considerably higher than or equal to the prevalence estimates of LBP reported on a global scale. According to Morris et al. (2018), although cases of low back pain are fast rising,

there seems to be little or no priority given to low back pain in Low Middle Income Countries (LMIC) including Ghana. They noted the fact that low back pain is not considered a big issue because it is not life-threatening, although it results in significant disability and health related costs, (Morris et al., 2018; Hoy et al., 2014). Another reason may be due to epidemiologic challenges faced in Africa and the lack of accurate data revealing the true state or burden of low back pain (Morris et al., 2018) and its associated factors.

Some occupations with a higher risk of includes, but not limited to, truck, taxi and bus drivers; construction workers; mining workers; operators of heavy machinery; pilots; as well as numerous others.

At GPHA Tema port, the job of heavy-duty equipment operators is mechanical in nature and involves operation of heavy machines that comes with postural challenges. Such jobs that are mechanical have been linked with low back pain (Adhikari et al., 2021), but there is no documented empirical evidence on low back pain and its associated factors among heavy duty equipment operators at the GPHA Tema Port. Meanwhile, reports from Human Resource Department and personal experiences as a medical doctor in GPHA Tema Port reveal frequent cases of absenteeism from work and poor job performance because of low back pain. Hence, this study seeks identify some causes of this disorder among heavy equipment operators and recommend measures to reduce the occurrence. The findings from this study will influence occupational health policies including periodic screening, task assignments and ergonomic policies in various institutions.

1.3 Research Questions

1. What is the prevalence of work-related low back pain disorders among heavy equipment operators?
2. What are the factors associated with work-related low back pain disorders among the heavy equipment operators?
3. Is there an association between work-related low back pain disorders and job performance among heavy equipment operators?
4. Do work-related low back pain disorders influence absenteeism among heavy equipment operators?

1.4 Objectives of the study

1.4.1 General Objective

To assess the prevalence and associated factors of work-related low back pain disorders among heavy equipment operators at GPHA, Tema Port.

1.4.2 Specific Objectives

The specific objectives of this study are to:

1. Determine the prevalence of work-related low back pain disorder among heavy equipment operators.
2. Determine the risk factors associated with work-related low back pain
3. Assess the association between work-related low back pain disorders and job performance among heavy equipment operators.
4. Investigate the association between work-related low back pain disorders and absenteeism among heavy equipment operators.

1.5 Significance of the study

Although quite several studies have been done and published on musculoskeletal health in Ghana, a good number of these studies focused on the general population as well as health workers. It is also noteworthy that only few focused on low back pain among these groups of people. Hence, this study seeks to report on the prevalence and associated risk factors among equipment or machinery operators at the GPHA, Tema Port. The study will also evaluate the effect of work-related back pain disorders on job performance and absenteeism at work. Research findings and public beliefs and expectations regarding issues surrounding low back pain may differ and public health significance of this study may be crucial in bridging this gap.

1.6 Operational Definition of Terms

For purposes of this study,

Lower Back Pain (LBP): Is any pain that ranges from gradual mild pain to sudden, severe, or persistent pain felt below the rib cage and above the inferior gluteal folds.

Heavy Equipment Operator: Is a trained worker that drives or controls a heavy machine used in the ports including, forklift driver, crane operator, reach stacker operator and mafi driver.

Whole Body Vibrations: Is a term used when vibrations of any frequency are transferred to the human body during operating a heavy equipment.

1.7 Conceptual Framework

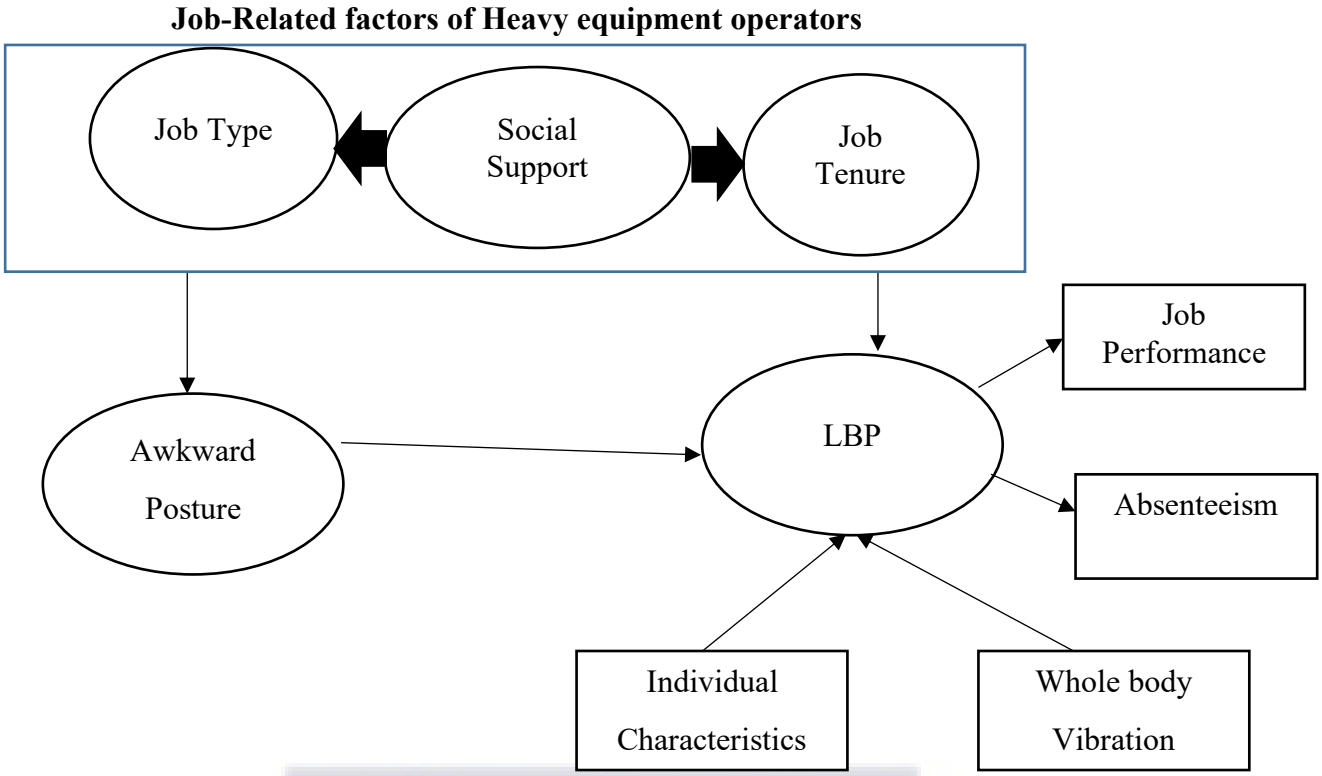

Figure 1.1: Conceptual Framework of Factors influencing Low Back Pain Disorder (Adapted from Dong et al., 2021)

1.7.1 Narrative of Conceptual framework

Low back pain among workers can be explained by several factors ranging from the job-related factors such as job type, job tenure as well as other factors including whole body vibrations, individual factors and awkward posture. Low back pain may be higher among workers who have excessive job demands. Workers who have some flexibility with regards to job tenure and targets to be met at the works place may have varying experience of low back pain. Social support offered by superiors and colleagues at workplace may have some influence on the job type that one is assigned to at the workplace and has a direct influence on health and wellbeing. Vibrations on the whole body from machinery may influence low back pain. The amount of work and time spent executing a particular task with a certain posture deemed awkward may influence low back pain among workers. Low back pain may

reduce work performance in physically demanding work areas. Frequent permission to be absent from work may be common among heavy duty equipment workers who suffer episodes of low back pain. Individual characteristics such as age, alcohol drinking, smoking status and marital status are predisposing factors of health condition including low back pain.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Low back pain is a public health issue of concern and the most prevalent musculoskeletal disorder around the globe resulting in significant disabilities and high financial losses (Kahere & Ginindza, 2020). This type of pain is normally an ache in the lumbar region of the vertebral column (Hoy et al., 2012) and is commonly reported among heavy duty equipment operators who are about 2.5 folds more likely to develop LBP (Asangbah, 2016). Low back pain usually results from acute or cumulative trauma with aetiologies arising from facet joint pain, myofascial pain, sacroiliac joint pain, spinal stenosis, discogenic pain and failed back surgery (Urits et al., 2019). Peng (2013) also notes a change in biomechanical properties of the disc structure, sensitization of nerve endings by release of chemical mediators, and neurovascular ingrowth into the degenerated discs as possible causes of low back pain.

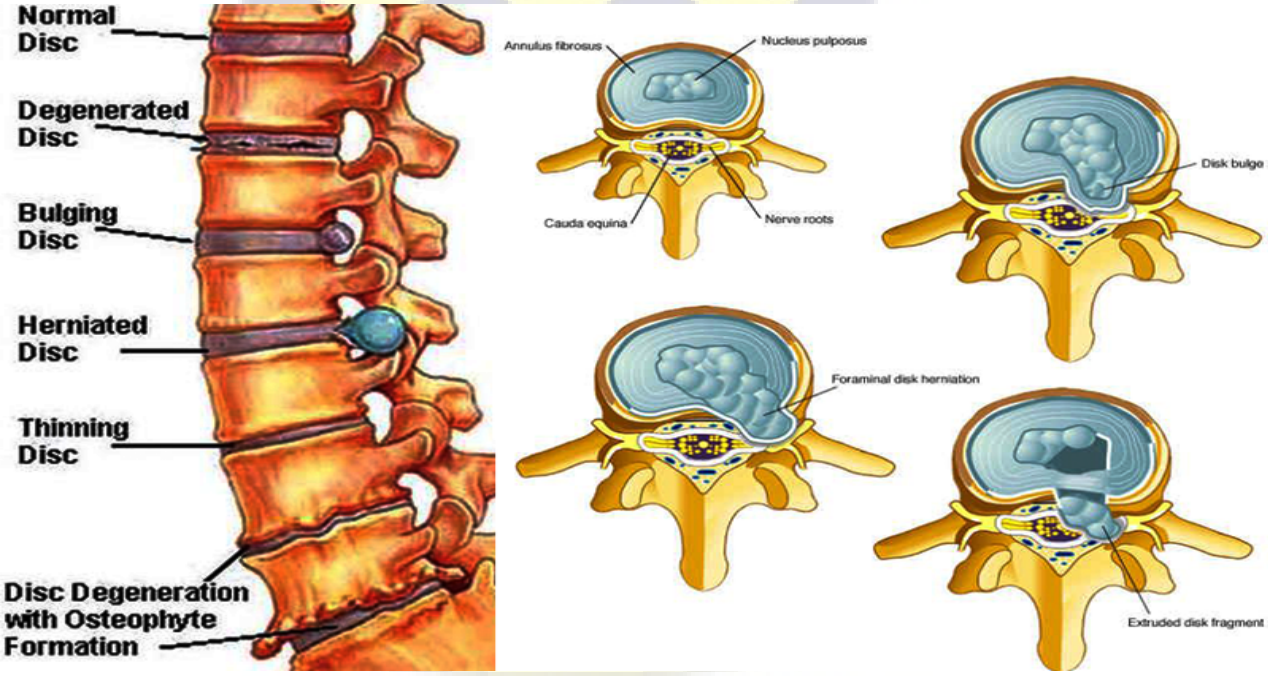

Figure 2.1: Shows examples of disc problems of low back
(Source: Adapted from Healthy Back Institute)

2.2 Epidemiology of Low Back Pain

Estimated global prevalence of low back pain is 9.4% with rates significantly higher in low- and middle-income countries with Africa recording a prevalence of 39% - 47% (Ampiah et al., 2020; Morris et al., 2018). According to reports, low back pain affects 30% of European employees each year, and in Holland, financial losses caused by low back pain amount for 1.7% of the country's annual wealth (Yong et al., 2020). According to a study of 113 Italian operating room nurses, the prevalence of low back pain during a 12-month period was found to be 80% (Brauneis et al., 2021). Another Italian study among 133 rowers showed low back pain to be very common, with a lifetime and one year prevalence of 64.7% and 40.6% respectively, with 40% of the rowers reporting some limitation in daily living activities (Maselli et al., 2015). Low back pain is the most popular disorder among the youth accounting for greater than hundred million lost working days annually in the United Kingdom (Vos et al., 2010). A study in India reported low back injuries or pain as a major musculoskeletal disorder that affect about 75-80% of the population of India. This figure they state, increases by 0.9% every year since 1990 (Kanniappan & Palani, 2020). Low back pain was the most cited body part for musculoskeletal pain, with a meta-prevalence rate of 53%, according to a systematic analysis on the prevalence of musculoskeletal pain among professional drivers in 23 countries (Joseph et al., 2020). In a primary care mission clinic in rural South-eastern Ghana, prevalence of LBP was estimated at 15.7% among 684 adult patients (Mille et al., 2020). According to Osae (2019), 48.2 % of Ghana National Ambulance Service Emergency Medical Technicians (EMTs) in the Greater Accra Region reported having low back pain.

2.3 Factors Associated with Low Back Pain Disorder

Factors associated with LBP are individual and lifestyle factors (age, marital status, gender, educational status, body mass index, monthly income, physical activity level, smoking and alcohol use), job related factors (job type and overtime working hours), social support (attitude of co-workers, employer or supervisor), awkward posture as well as vibration from equipment.

2.3.1 Individual and Lifestyle Factors

2.3.1.1 Age

Age was discovered to be correlated with the occurrence of low back pain among metropolitan cleaners in Brazil. The study revealed that workers of older ages suffered higher physical demands and body overload leading to low back pain (Pataro & Fernandes 2014). According to a study conducted in India among male machine employees in the leather industry, the prevalence of LBP is lowest among young people between the ages of 10 to 14, peaking at age 55 to 59. Even though more common in women, pain peaks were observed at the age of 75-79 years with lowest prevalence at 10-14 years of age (Kanniappan & Palani, 2020). Awosan et al. (2017) also noted that prevalence of low back pain increased progressively and significantly across age groups emphasising that study participants in their 20s, 30s, 40s and 50s were 31.0%, 50.0%, 66.0% and 73.5% more prone to suffering low back pain respectively. An older study among heavy equipment-using underground gold miners in Ghana found a substantial link between LBP and advancing age (Bio et al., 2007). Hence, as an individual ages, the higher the occurrence of low back pain. However, a cross sectional study among 422 Ethiopian low wage workers found no significant correlation between age and low back pain (Wami et al., 2019).

2.3.1.2 Gender

Literature constantly documents low back pain to be more common among women than in men (Chiluba et al., 2019; Awosan et al., 2017; Kanniappan & Palani, 2020). This disparity, Chiluba et al. (2019) explains may be due to hormonal factors at play differing risk level in men and women. The loss of estrogen, an osteo-protective factor in women, at menopause may account for high risk in aging women (Ji & Yu, 2015). Other researchers also agree that the female gender was associated with higher prevalence of LBP compared to men (Awosan et al., 2017; Kanniappan & Palani, 2020) recording a female prevalence of 31.3% as compared to 20.9% among male study respondents (Awosan et al., 2017). Even though Morris et al. (2018) found a notable difference in point and annual low back pain prevalence between African males and females, they reported that African males suffered a higher prevalence of LBP which is contradictory to outcomes of numerous research. This they explained may be due to variation in sample characteristics such as an over-representation of males in the studies used in their review (Morris et al., 2018).

2.3.1.3 Educational Status

According to Pataro and Fernandes (2014), a link was observed between education and low back pain in their study. They reported that participants who recorded a low educational status were more likely to experience LBP compared to those of higher educational backgrounds. This they attributed to the fact that persons who had low educational background were likely to be found working under poor conditions due to a lack of qualification for employment or higher positions that may have better working conditions (Pataro & Fernandes, 2014). Findings of a systematic review investigating the association between educational level of individuals and low back pain suggest that persons with higher educational backgrounds have lower risk to low back pain compared to persons with low or medium educational backgrounds (Batista et al., 2017). They cited the possibility of persons

with higher educational backgrounds having knowledge on the importance of spine care as well as factors that may cause low back pain (Batista et al., 2017). Zadro et al. (2017) affirms these findings stating that higher levels of education decrease the risk of developing low back pain. They however noted that this influence varied in men and women, suggesting that the influence was more pronounced in women than men (Zadro et al., 2017).

2.3.1.4 Body Mass Index

A recent study by Alnaami et al. (2019) found a positive association between increasing body mass index and risk of LBP among healthcare workers. Previous studies also agree with this finding reporting a higher risk of LBP among obese and overweight persons (Jensen et al., 2012). According to Alnaami and colleagues (2019), obesity and low back pain exhibit a bidirectional or comorbid relationship – having common risk factors. Being overweight or obese exerts a mechanical burden on the spine during activity resulting in low back pain and predisposing them to accidents that may exacerbate pain. Obesity results in the release of inflammatory markers that may trigger low back pain (Alnaami et al., 2019). However, Wami et al. (2019) found no significant association observed between BMI and LBP.

2.3.1.5 Job Type and Tenure

In a much recent study, Dong and colleagues (2021) found job tenure to be positively link with LBP. They discovered that the risk of low back discomfort increased with length of employment. Participants in the study who had worked for 6 to 10 years had an increased risk of LBP than those who had worked for 1 to 5 years, while those who had worked for 16 years or longer had a elevated risk of low back pain than those who had worked for 1 to 5 years (Dong et al., 2021). Ghanaian researcher, Asangbah (2016) discovered that the duration of working experience as a heavy machine operator and the average time spent on the job per session were statistically significantly linked to the development of the condition.

This, according to her, was caused by the risk variables' cumulative intensity exposure as one worked more hours (Asangbah, 2016). The prevalence of low back pain advanced with the duration of service, notably after the 10 or more years of services, according to Yong et al. (2020). Additionally, they noticed that employees who perform primarily manual labour are more likely to become ill from overworking under the impact of several unfavourable circumstances. However, as their experience grows over more years of service, these professionals learn how to avoid unfavourable working postures (Yong et al., 2020). Awosan et al., (2017) discovered in a different study that the prevalence of low back pain increased gradually and significantly over time, from 40.7% among study participants who had been practicing for less than ten years to 78.6 percent among those who had been doing so for roughly three decades. Compared to participants who had worked for less than 10 years, those who had worked for 10 years or more were nearly twice as likely to have LBP. Additionally, it was discovered that as compared to permanent employees, temporary workers had higher probabilities of acquiring low back pain. The industry's provision of different benefit packages to temporary and permanent employees could be the cause. Therefore, basic safety training and the use of personal protective equipment are not widely available to temporary workers. Additionally, these types of workers are frequently pressured to complete more work out of fear of losing their jobs or to extend their employment. (Wami et al., 2019). However, permanent night shift workers in Indonesia were found to experience increase incidence of low back pain in comparison with temporary shift workers (Gómez-Galán et al., 2017).

2.3.1.6 Physical Activity Level

According to Awosan et al. (2017), there are discrepancies in the findings about how physical activity affects low back pain. However, numerous studies found that exercising regularly significantly reduced the danger of getting low back discomfort (Awosan et al.,

(2017); Shieh et al., (2016); Terzi et al., (2015). Notes by Terzi et al., (2015) show that a lack of regular physical activity results in weak or no back support and incorrect body mechanics. A meta-analysis published Shiri et al. (2017) also affirms this and suggests that moderate to high amounts of physical activity during leisure time may protect against frequent or chronic low back pain by 11–16% through posture improvement and muscle activation (Alnaami et al., 2019). In contrast, Wami et al., (2019) found no significant association physical activity level and low back pain.

2.3.1.7 Smoking and Alcohol Use

A study revealed substantial link between smoking and LBP among Indonesian miners reporting an increased occurrence of LBD among smokers compared to non-smokers (Gómez-Galán et al., 2017). Though Pataro and Fernandes (2014) did not note any relationship between the intake of alcohol and smoking on low back pain, they reported that a lot of the study participants were heavy drinkers of alcohol who indicated the stressful nature of their job as reason for alcohol intake. They however found reduced numbers who smoke compared to those who took alcohol noting that those who smoked were mainly manual workers and those who were temporarily unemployed (Pataro & Fernandes, 2014).

2.3.2 Social Support

2.3.2.1 Attitude of Co-Workers, Employer or Supervisor

Physical and social environment at work were noted to be positively linked with LBP (Pataro & Fernandes, 2014). Workers who suffered high job demands but worked in teams reported lower rates and risk for low back pain compared to those who suffered high demands but worked individually. Workers who practised group cohesion and collective competence are able perform herculean tasks with little adverse effects (Dennissen, 2020). Workers who exhibited dissatisfaction and less control over work suffered higher risk of LBP than those who had more autonomy and decision-making abilities over their work

(Wami et al., 2019; Yang et al., 2016). According to Pataro and Fernandes (2014), the relationship between physical and social work ethics and low back pain are since negative physical and social characteristics of work may increase psychological tension, muscular activity and excretion of hormones contributing to the development of low back pain.

2.3.3 Whole Body Vibration from Equipment

According to the Health and Safety Authority (2021), whole-body vibration is shock experienced when seated or standing on a vehicle or machine, or when working close to powerful machinery. Low back pain has been linked to whole body vibration exposure among heavy machinery operators over the years (HSA, 2021). There is a strong positive association between whole body vibration and the development of LBP. Prolonged period of exposure to whole body vibration from engines and vehicles can result in an early and faster degradation of the spine leading to low back pain (Asangbah, 2016). Whole body vibration affects the vertebrae, intervertebral and musculature leading to low back pain (Kadir et al., 2015). According to Norasteh (2012), exposure to whole body vibration in combination with other factors is more likely to result in low back pain compared to a lone exposure to whole body vibrations.

2.3.4 Awkward Posture

Kadir et al. (2015) noted the working posture specifically awkward posture of an individual as a risk for LBP among port crane operators. They defined awkward posture as any posture that is in an extreme angle or position from neutral or normal posture such as kneeling, stooping or squatting. In their study, crane operators needed to lean forward and look down anytime they had to lift and lower containers into the yard which prone them to low back pain. Dong et al. (2021) also documented several postural factors as influencers of developing low back pain. They noted that respondents who frequently bent their trunk sideways had a greater risk of LBP than respondents who never did, whereas respondents

who rarely bent their trunk had a higher risk of low back pain than respondents who never did. Again, individuals who regularly or occasionally maintained a bent posture for extended periods of time had a higher chance of developing LBP than individuals who never did (Dong et al., 2021).

2.3.5 Job Performance and Low Back Pain

Low back pain has been shown to be a top factor in poor job performance among numerous working populations (Ahmed et al., 2022; Nygaard et al., 2020; Rufa'i et al., 2015). A study investigating the effect of LBP among 200 professional drivers in Kano, Nigeria, revealed that low back pain influenced the performance of drivers up to 74% of drivers (Rufa'i et al., 2015). A cross-sectional study among 11,738 senior workers in Denmark demonstrates that the occurrence of low back pain significantly reduces work performance in physically demanding work areas (Nygaard et al., 2020). A comparative cross-sectional study on the effect of work-related low back pain on functional performance and physical capabilities among working men and women who visited the physiotherapy unit of the King Saud University Medical Facility, noted a drastic effect of low back pain on the performance and capabilities of both genders. They however revealed that working women suffered more drastic impact of LBP on functional performance and physical capabilities compared to working men (Ahmed et al., 2022).

2.3.6 Absenteeism and Low Back Pain

Among 735 Portuguese workers from various occupations, 69% indicated at least one episode of low back pain in the last one year. Employees in the public sector and in physically demanding jobs reported more than six episodes of low back pain accounting for more than 4% absenteeism rate in the same year (Serranheira et al., 2020). In Iran, a cross-sectional study among 771 workers of an automobile factory revealed that nearly 30% of workers with a history of absenteeism was due to low back pain (Mehrdad et al., 2020). A

systematic review and meta-analysis by Wynne-Jones et al., (2014) on the rates of absenteeism and return to work in employees with LBP recorded a pooled estimate for worker absenteeism to be 15.5% in the last six months while the pooled estimate for their rate of return to work was 68.2%, 85.6% and 93.3% at one month, one to six months and above six months respectively. In Slovenia, an analysis of causes of absenteeism among 145 public transport drivers with an average of 14.4 years' driving experience revealed low back pain as the main cause of absenteeism among the drivers (Kresal et al., 2015).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

The methodology and techniques used in this investigation are described in this chapter. It covers the study design, study location or setting, study population, sample size, sampling methods, tools for gathering data, ethical considerations, processing and analysis of that data.

3.2 Study Design

An analytical cross-sectional study design was used to concurrently identify each participant's exposures and disease outcome (LBP). The study's interest in determining the prevalence of LBPD and the potential link between operating heavy machinery (exposure) and the development of low back pain disorders made a cross-sectional study acceptable for this investigation (outcome).

3.3 Study Site

Ghana Ports and Harbours Authority (GPHA), Tema was the study area, specifically, the Freights &Logistics Department inside Tema Port.

The Provisional National Defence Council Law (PNDCL 160) of 1986 of Ghana established the Ghana Ports and Harbours Authority (GPHA) as a legal entity obligated to build, plan, develop, manage, maintain, operate and regulate all of Ghana's ports. The Authority manages and operates Ghana's seaports and several business divisions in the areas of vessel handling, stevedoring, transfer, storage, receipt and delivery of containerized and general cargo in collaboration with a variety of private service providers. Other responsibilities include safety, security and conservation services.

Before staff leave for their separate posts, the heavy equipment operators congregate in the Freights &Logistics Department of Tema Port during shift changes. There are four (4) sub-categories of heavy equipment operators including Crane operators, Reach stacker operators, Forklift drivers and Mafi drivers. Participants actual work area was also part of this study. Due to security concerns, it is a restricted area.

3.4 Study Population

The study population was all heavy equipment operators including Crane operators, Reach stacker operators, Forklift drivers and Mafi drivers

3.4.1 Inclusion Criteria:

1. all heavy equipment operators who gave consent to be part of the study
2. all heavy equipment operators present at work at the time of the study

3.4.2 Exclusion Criteria

1. Heavy equipment operators who have had back injury by way of accident outside their workplace ever in their lifetime.

3.5 Sample Size Calculation

Sample size determination was to estimate a proportion, so the Yamane (1967) formula was used since (N) is known $n = N/1+Ne^2$, where n is sample size required, N is total number of heavy equipment operators at the GPHA Tema port numbering 302 (Human Resource Department – Heavy Equipment Operators at Logistics list, GPHA Tema), and e is error of margin at 95% CI.

$$n = \frac{302}{1+302\ (0.05^2)} = 172$$

However, to cater for non-response rate, 10% was used to upwardly adjust the sample size. Thus, (0.1 × 172 = 17.2), which translate into (172 +17.2 = 189.2). Therefore, 189 heavy equipment operators were the respondents in this study.

3.6 Sampling Method

Enrolment of participants for this study was done systematically by following three (3) phases (i) stakeholder consultation (ii) selection and enrolment of study participants (iii) data collection.

Phase 1: stakeholder consultation: The principal investigator and research assistants entered the GPHA Tema Port and informed management about the project and secured permission to carry out the study.

Phase 2: Enrolment of study participants: Once approval was given, the study employed a stratified sampling method to recruit from all four (4) sub-categories of heavy equipment operators including [Crane (52), Reach stackers (92), Forklift (103) and Mafi (55) operators].

The overall sample size (189) was divided into four homogenous subgroup -specific samples using a population-proportionate-to-size sampling [Crane - 52/302 x 189 = (32), Reach stackers - 92/302 x 189 = (58), Forklift – 103/302 x 189 = (65) and Mafi-55/302 x 189 = (34). In each stratum or sub-category heavy equipment operators, simple random sampling was used to recruit participants into the study. This was done by obtaining the list of heavy equipment operators from the human resource department of the GHPA Tema Port and organizing the list for each sub-category in alphabetical order. Those who were selected at random make the stratum specific sample if they met the inclusion criteria and gave consent to partake in the study. However, any selected heavy equipment operator who did not meet the inclusion

criteria or refused to take part in the study was replaced by the next available person in the alphabetically ordered list of the sub-category who had not already been selected. This was done simultaneously in all sub-category until the sample size was attained.

Phase 3: Data collection: the data collection tool was a structured questionnaire. The structured questionnaire was interviewer-administered and was in English but translated where appropriate.

3.7 Data Collection Tools and Methods

To gather data from study participants, a structured questionnaire was used. There were six sections in this questionnaire. The participants' demographic characteristics and individual attributes were the primary emphasis of the questionnaire's first section which included questions 1-10, (age, marital status, gender, educational level, monthly income, Body Mass Index (BMI), smoking status, alcohol usage and physical activity). The second section elicited information on history and investigations of Low Back Pain using modified Nordic Musculoskeletal Questionnaire (NMQ) and this section included questions 11- 17, (current low back pain, any low back pain in the last 12 months, ability to carry out normal activities at work in the last 12 months, consultation with physician in the past 12months and questions about imaging investigations). The third section measured job-related factors of heavy equipment operators which included questions 18-21, (job type, overtime working hours, vibrations from equipment usage and awkward posture). The fourth section focused on social support at the workplace which also included questions 22-25 (Permission to take break from work if needed, colleagues filling in to take break, equal share of work and employers' attention to employee's health and welfare). The fifth and sixth section assessed job performance and absenteeism respectively which included questions 26-39.

Job performance was assessed using a modified version of Individual Work Performance Questionnaire (IWPQ) tool by Koopman et al., (2011) which is a multidimensional scale job performance tool which assesses individual work performance on a three main dimensions job performance including task performance, contextual performance and counterproductive work behaviour. All items have a recall period of three months on a 5 points scale of 1-seldom to 5-extreme.

Absenteeism was evaluated using a self-developed questionnaire by the help of my supervisor. The objectives of the study were explained to all participants prior to the administration of the questionnaires, ensuring that they understood the questions completely and eliminating any potential for misunderstanding, three trained research assistants assisted the primary investigator in distributing the surveys one-on-one basis. Weight (kg) and Height in (m) were measured for each participant of the study using a weighing scale and stadiometer to obtain the Body Mass Index (BMI). The questionnaire was administered in English Language for literate heavy equipment operators and translated into Twi, Ewe, or Ga for non-English literate respondents. The translation was done using semantic translation to ensure the meanings of question did not differ from participant to participant. The average time to complete each questionnaire was about 30 minutes.

3.8 Study Variables

3.8.1 Dependent Variables

Low Back Pain: Is any pain that ranges from gradual mild pain to sudden, severe, or persistent pain felt below the rib cage and above the inferior gluteal folds which can radiates to the lower limbs in the last 12months.

Job performance and Absenteeism were the other dependant variables.

3.8.2 Independent variables

Individual Factors: Age, Marital Status, Gender, Educational Status, Monthly Income, Body Mass Index (BMI), Smoking and Alcohol Use, Physical Activity Level

Job related Factors: Job Type and Tenure, working hours, Social Support, Whole body vibrations from Equipment, Awkward posture.

3.8.3 Quality control

Data was collected, sorted, and coded before being entered into Microsoft Excel. Data entry accuracy was verified, and the clean database was transformed into a Stata version 16.0 file (Stata Corporation, Texas, USA) before analysis.

3.9 Data Analysis

Socio-demographic characteristics and other exposures was summarized using proportions (categorical variables such as sex, low back pain, educational level, whole body vibration) and means[±SD]/median [IQR] (continuous variables such as age and body mass index) where appropriate. The prevalence of LBP disorders was reported as proportion with a 95% confidence interval.

Factors associated with LBP were assessed using the Chi squared test/Fisher exact, T-test or simple and logistic regression (bivariate analysis). The strength of associations was

determined by fitting a multiple logistic regression of factors identified as potential confounders with LBP. For all analyses, p-values < 0.05 was considered as statistically significant. Crude and Adjusted Odds ratios was reported with their respective confidence intervals.

3.10 Ethical Considerations

3.10.1 Noguchi Memorial Institute for Medical Research Ethical Approval

An official letter was sent to the NMIMR Review Committee to seek an ethnical approval towards the commencement of the data collection. This approach was to ensure that the laid down procedures were followed in accordance to approved protocols and good practices. I wrote to inform the NMIMR-IRB of any alterations or amendments to my proposal in event of the following:

- Any alterations to the protocols and consent form.
- Any alterations to the study participants and study areas or sites.
- Changes in the recruitment procedures including informed consent process.
- Any problems encountered that could affect the safety of participants or their willingness to continue in the research.
- Any other unforeseen changes not mentioned here.

3.10.2 Approval from the Study Area

Permission was sought from Authorities of the Ghana Ports and Harbours Authority.

Informed Consent

After explaining the benefits and risks involved in participation, written consent was obtained from eligible participants. Participants were made to understand that participation was purely voluntary hence they could opt out at any time, and no one will be upset, and

this would not affect them in any way.

3.10.3 Compensation

There was no monetary compensation given to the respondents. However, respondents were thanked for participating in the study.

3.10.4 Confidentiality

To preserve anonymity, participants were given the option of filling out the surveys at convenient locations.

No information relating to the participants' names or any other details that could link the information gathered to the participants was taken to maintain anonymity. A PC with a secure password was used to store participant data. The only person who had access to the completed questionnaires was the lead investigator.

3.10.5 Privacy

Questionnaires were answered at a place deemed convenient by the participant. Person information like name, email address, telephone numbers and other details were not requested. My email address and telephone number were provided for respondents who wish to have further correspondence to reach out to me.

3.10.6 Benefits

Participating in this study gives participants an opportunity to gain some knowledge and awareness on effect of work posturing and low back pain since each participant was educated after data collection. Also, the study helped management to formulate policies that improve overall working conditions and quality life of the workers.

3.10.7 Risks

Except for the risk of having to give information that may seem personal, there was no risk to the participant that approached actual physical harm.

3.10.8 Conflict of Interest

There was no conflict of interest.

3.10.9 Data Storage and Usage

The supervisor oversaw keeping the information gathered from the GPHA Tema Port. The questionnaire's responses were double-checked for accuracy before being secured behind a lock and key. The resources utilized for data collection and analysis were password-protected and only the supervisor and the student knew the password. For a period of five years, the supervisor's office maintained the acquired data on a CD and a pen drive for future reference.

Pre-test

The pre-test was done at the Meridian Port Services (MPS) Terminal 3 since it shares similar characteristic with GPHA. Convenience sampling was used to pick ten respondents, and then questionnaires were administered. Any unclear questions discovered were documented and taken into consideration when creating the final questionnaire. The pre-test was conducted during an approximate 7-day period.

CHAPTER FOUR

4.0 RESULTS

4.1 Socio-demographic characteristics of respondents

Table 4.1 shows the descriptive statistics of socio-demographic characteristics of respondents. The mean age of respondents was 38.3 years ± 5.7SD. Out of the 189 respondents, 62.4% were married with 16.4% being single. Majority of the respondents 92.9% (174/189) had had some form of formal education (primary, secondary and tertiary). Furthermore, 97.3% (184/189) and 66.7% (126/189) of respondents indicated that they had never smoked or took in alcohol respectively. Sixty nine percent (131/189) of respondents engaged in physical activities with 57.5% (81/131) having their physical activities once a week. The median income of respondents was GH₵ 1800 with a minimum income of GH₵ 750 and a maximum income of GH₵ 3600. Respondents BMI on average 25.1kg/m^2 ± 4.7SD.

Table 4.1: Socio-demographic characteristics of respondents (n = 189)

Variables	Frequency	Percentage (%)
Age of respondents (M ± SD)	38.3 years ± 5.7	
Marital status		
Single	31	16.4
Married	118	62.5
Cohabiting	8	4.2
Divorced	32	16.9
Education level		
No formal education	15	7.9
Primary	113	59.8
Secondary	51	27.0
Tertiary	10	5.3
Smoking		
Former smoker	2	1.1
Never smoker	184	97.3
Current smoker	3	1.6
Alcohol		
Former drinker	15	7.9
Never	126	66.7
Current drinker	48	25.4
Engaged in physical activities		
No	58	30.7
Yes	131	69.3
Frequency of physical activities (n = 131)		
Once a week	81	57.5
2-3 times a week	44	31.2
>3 times a week	16	11.3
Median Income Range (750, 3600)	1800	
BMI	25.1kg/m^2 ± 4.7	

4.2 Prevalence of low back pain

The prevalence of current low back pain disorders among heavy equipment operators at GPHA, Tema was found to 44.4% as shown in figure 4.2 below (95% CI = 37.2% – 51.8%).

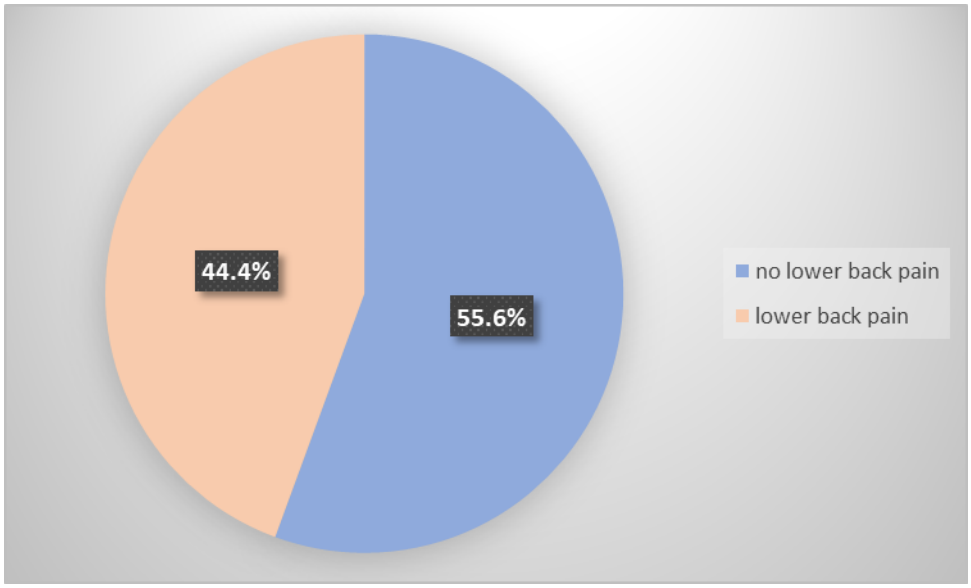

Figure 4.1: Proportion of current low back pain among heavy equipment workers

4.2.1 Participant History and Investigations of Low Back Pain Disorders

Table 4.2 below shows the factors of low back pain. More than half (54.0%) of the respondents had lower back pain within the past 12 months. Nearly fifty two percent (51.9%) of respondents indicated their "inability to carry out normal activities at work due to low back pain". Most of the respondents (60.8%) consulted a physician due to low back pain with 7.9% indicating they had an imaging investigation conducted.

Table 4.2: Participants History and Investigations of Low Back Pain Disorders

Variables	Frequency	Percentage (%)
Lower back pain within the past 12 months		
No	87	46.0
Yes	102	54.0
Inability to carry out normal activities at work due to low back pain		
No	91	48.1
Yes	98	51.9
Consulted physician due to low back pain		
No	74	39.2
Yes	115	60.8
Imaging investigation conducted		
No	174	92.1
Yes	15	7.9
Type of investigation		
X-Ray	6	40.0
CT-Scan	7	46.7
MRI	2	13.3

4.3 Individual factors associated with low back pain

Table 4.3 shows results from a chi-squared/Fischer's exact test of individual factors associated with lower back pain. It was found that the age of respondents ($p = 0.032$), educational level ($p = 0.046$) and their engagement in physical activities ($p = 0.022$) were significantly associated with lower back pain.

Table 4.3: Individual factors associated with low back pain

Variables	Low back pain		p-value
	Low back pain (n = 84)	No low back pain (n = 105)	
Age of respondents (M ± SD)	39. 3 ± 5.2	37.5 ± 6.0	**0.032***
Marital status			+0.617
Single	16(51.6)	15(48.4)	
Married	52(44.1)	66(55.9)	
Cohabiting	2(25.0)	6(75.0)	
Divorced	14(43.8)	18(56.2)	
Education level			**+0.046***
No formal education	5(33.3)	10(66.7)	
Primary	43(38.1)	70(61.9)	
Secondary	30(58.8)	21(41.2)	
Tertiary	6(60.0)	4(40.0)	
Income	1759.1 ± 518.2	1737.9 ± 444.3	0.826
BMI	25.4 ± 5.1	24.9 ± 4.3	0.477
Smoking			+0.235
Former smoker	2(100.0)	0(0.0)	
Never smoker	80(43.5)	104(56.5)	
Current smoker	2(66.7)	1(33.3)	
Alcohol			0.981
Former drinker	7(46.7)	8(53.3)	
Never	56(44.4)	70(55.6)	
Current drinker	21(43.7)	27(56.3)	
Engaged in physical activities			**0.022***
No	33(56.9)	25(43.1)	
Yes	51(38.9)	80(61.1)	

+ (fisher's exact). *(statistically significant, p≤0.05) (Age, Educational level and Engaged in physical activities)

4.4 Job related factors associated with low back pain

From table 4.4, working overtime was and awkward posture (Frequency of bending trunk sideways) were found to be significantly associated with lower back pain ($p < 0.001$) and ($p = 0.029$) respectively after a chi-squared/Fischer's exact test. However, there was no significant association between job type and lower back pain.

Table 4.4: Job related factors associated with low back pain

Variables	Low back pain		p-value
	Low back pain (n = 84)	No low back pain (n = 105)	
Job type			0.667
Crane operators	16(50.0)	16(50.0)	
Reach stackers operators	22(37.9)	36(62.1)	
Forklift drivers	30(46.1)	35(53.9)	
Mafi drivers	16(47.01)	18(52.9)	
Overtime working hours			**0.000***
No	47(35.3)	86(64.7)	
Yes	37(66.1)	19(33.9)	
Awkward posture (Frequency of bending trunk sideways)			**0.029***
Never	10(29.4)	24(70.6)	
Seldom	20(37.7)	33(62.3)	
Frequently	54(52.9)	48(47.1)	

[+] (fisher's exact). *(statistically significant, $p \leq 0.05$) (Overtime working and Awkward posture)

4.5 Social support factors associated with low back pain

In table 4.5, a chi-squared/Fischer's exact test of social support factors were not associated low back pain.

Table 4.5: Social support factors associated with low back pain

Variables	Low back pain		p-value
	Low back pain (n = 84)	No low back pain (n = 105)	
Supervisor allows break from work			+0.300
Strongly agree	5(71.4)	2(28.6)	
Agree	7(46.7)	8(53.3)	
Not sure	7(30.4)	16(69.6)	
Disagree	21(39.6)	32(60.4)	
Strongly disagree	44(48.4)	47(51.6)	
Colleagues filling in when there is break			+0.314
Strongly agree	2(20.0)	8(80.0)	
Agree	23(47.9)	25(52.1)	
Not sure	18(56.3)	14(43.7)	
Disagree	9(42.9)	12(57.1)	
Strongly disagree	32(41.0)	46(59.0)	
Work is shared equally among colleagues			+0.098
Strongly agree	4(40.0)	6(60.0)	
Agree	19(38.8)	30(61.2)	
Not sure	13(59.1)	9(40.9)	
Disagree	14(66.7)	7(33.3)	
Strongly disagree	34(39.1)	53(60.9)	
Organization pays attention to employees' health and welfare			+0.618
A great deal of attention	7(53.8)	6(46.2)	
A lot of attention	4(40.0)	6(60.0)	
A moderate amount of attention	11(57.9)	8(42.1)	
A little attention	37(44.6)	46(55.4)	
Not any attention	25(39.1)	39(60.9)	

+ (fisher's exact). *(statistically significant, p≤0.05)

4.6 Factors associated low back pain

Table 4.6 shows results of factors associated with lower back pain among heavy duty equipment workers at the GPHA from bivariate analysis (simple logistic regression). A one-year increase in age significantly increased the odds of lower back pain among heavy duty equipment workers by 6% (cOR = 1.06; 95% CI = 1.00 – 1.11; p = 0.034). However, after adjusting for all other variables (Educational level, Engaged in physical activities, Overtime working hours and Frequency of bending trunk sideways), this association was still found to be significant (aOR = 1.06; 95% CI = 1.00 – 1.12; p = 0.050).

Heavy duty equipment workers at the GPHA who engage in physical activities had a 52% significant decrease in their odds of having lower back pain as compared to those who did not engage in physical activities (cOR = 0.48; 95% CI = 0.26 – 0.90; p = 0.023). after adjusting for all other variables (Age, Educational level, Overtime working hours and Frequency in bending trunk), heavy duty equipment workers at the GPHA who engage in physical activities had a 60% significant decrease in their odds of having lower back pain as compared to those who did not engage in physical activities (aOR = 0.40; 95% CI = 0.20 – 0.80; p = 0.010).

Respondents who worked overtime were significantly 3.56 times more likely to suffer from lower back pain as compared to those who did not work overtime (cOR = 3.56; 95% CI = 1.85 – 6.88; p < 0.001). This association was still found to be significant after adjusting for all other variables (Age, Educational level, Engaged in physical activities and Frequency of bending sideways), (aOR = 3.68; 95% CI = 1.76 – 7.68; p = 0.001).

The odds of having lower back pain was significantly increased by 2.70 times among heavy duty workers who frequently bent their trunks sideways as compared to those who never bent their trunks sideways (cOR = 2.70; 95% CI = 1.17 – 6.21, p = 0.020), after adjusting

for all other variables (Age, Educational status, Overtime working and Engaged in physical activities), the odds of having lower back pain was significantly increased by 3.51 times among heavy duty workers who frequently bent their trunks sideways as compared to those who never bent their trunks sideways (aOR = 3.51; 95% CI = 1.39 – 8.84, p = 0.008).

Table 4.6: Factors found to be significantly associated low back pain

Variables	cOR(95% CI)	p-value	aOR(95% CI)	p-value
Age of respondents	**1.06(1.00 – 1.11)**	**0.034***	**1.06(1.00-1.12)**	**0.050***
Educational level				
No formal education	1.00		1.00	
Primary	1.23(0.39 - 3.84)	0.723	1.59(0.47-5.43)	0.456
Secondary	2.86(0.85 - 9.58)	0.089	2.66(0.71-10.01)	0.149
Tertiary	3.00(0.57 - 15.77)	0.194	4.26(0.68-26.61)	0.121
Engaged in physical activities				
No	1.00		1.00	
Yes	**0.48(0.26 - 0.90)**	**0.023***	**0.40(0.20-0.80)**	**0.010***
Overtime working hours				
No	1.00		1.00	
Yes	**3.56(1.85 - 6.88)**	**0.000***	**3.68(1.76-7.68)**	**0.001***
Awkward posture (Frequency of bending trunk sideways)				
Never	1.00		1.00	
Seldom	1.45(0.58 - 3.66)	0.426	2.29(0.82-6.41)	0.113
Frequently	**2.70(1.17 - 6.21)**	**0.020***	**3.51(1.39-8.84)**	**0.008***

*(statistically significant, p≤0.05) (Age, Physical activities, Overtime working and Awkward posture).

4.7 Association between low back pain and job performance, absenteeism

From table 4.7, there was no association between low back pain and job performance, absenteeism after a chi-squared/Fischer's exact test.

Table 4.7: Association between low back pain job performance, absenteeism

Variables	Low back pain		p-value
	Low back pain (n = 84)	No low back pain (n = 105)	
Hardworking			0.456
Extremely hardworking	66(43.1)	87(56.9)	
Quite hardworking	18(50.00	18(50.0)	
Work effectiveness			0.787
Extremely effective	75(44.1)	95(55.9)	
Quite effective	9(47.4)	10(52.6)	
Relating to work colleagues			0.558
Extremely well	70(45.5)	84(54.5)	
Quite well	14(40.0)	21(60.0)	
Urgency of follow-up on supervisor request			
Extremely quick	72(44.4)	90(55.6)	1.000
Quite quick	12(44.4)	15(55.6)	
Level of attention			0.091
A great deal of attention	62(41.3)	88(58.7)	
A lot of attention	22(56.4)	17(43.6)	
Handling of criticism			0.053
Extremely well	62(41.1)	89(58.9)	
Quite well	11(73.3)	4(26.7)	
Moderately well	11(47.8)	12(52.2)	
Urgency of adjusting to changing priorities			0.357
Extremely quick	66(42.9)	88(57.1)	
Quite quick	18(51.4)	17(48.6)	
Ability to meet goals set by supervisor			0.607
Extremely well	68(43.6)	88(56.4)	
Quite well	16(48.5)	17(51.5)	
Level of trust from supervisor on ability to make right decisions			0.904
A great deal of trust	67(44.7)	83(55.3)	
A lot of trust	17(43.6)	22(56.4)	
Absenteeism			0.974
No	37(44.6)	46(55.4)	
Yes	47(44.3)	59(55.7)	

CHAPTER FIVE

5.0 DISCUSSION

5.1 Prevalence of Low Back Pain

The prevalence of LBP among heavy equipment operators at GPHA, Tema, Ghana was found to 44.4% in this present study which is quite higher than the global prevalence of low back pain is estimated at 9.4% but it is not surprising the what was found in this study falls within substantially high prevalence rates in low- and middle-income countries with Africa recording a prevalence of 39% - 47% (Ampiah et al., 2020; Morris et al., 2018). Comparatively, Joseph et al. (2020) also reported a prevalence rate of 53% among professional drivers in 23 countries. In Italy, prevalence of LBP was reported to be between 40% - 80% among general population (Brauneis et al., 2021; Maselli et al., 2015) while a study in India reported low back injuries affecting 75 - 80% of the Indian population. A much lower prevalence of 30% was recorded among European workers (Yong et al., 2020). Differences in prevalence of low back pain across several populations may be due the importance attached to the implementation of occupational safety measures among workers. The prevalence of LBP at the GPHA, Tema is worrying and needs urgent intervention to curb the menace. Reports reveal that 30% of European workers suffer from low back pain annually while financial losses encountered in Holland due to low back pain accounts for 1.7% of the national wealth every year (Yong et al., 2020). The economic impact of low back pain among heavy equipment workers was not the focus of this study but as a result the prevalence recorded, further studies in this area may add significant information to literature on the subject matter. In the United Kingdom, LBP was detected to be the leading cause of disability among the youth, with greater than 100 million working days of

absenteeism recorded per year (Vos et al., 2010). A much higher prevalence was reported in a study in India that low back injuries or pain as a major musculoskeletal disorder that affect about 75-80% of the general population of India. This figure they state, increases by 0.9% annually since 1990 (Kanniappan & Palani, 2020).

5.2 Factors Associated with Low Back Pain

At the GPHA, Tema, an increase in age significantly increased the odds of lower back pain. Similarly, previous studies also found age to be a risk factor of LBP. Older workers in Brazil were found to be at higher risk of low back pain (Pataro & Fernandes 2014). Male machine workers in an Indian leather industry also noted that LBP was common at older age (Kanniappan & Palani, 2020). Awosan et al. (2017) also noted that low back pain increases gradually as one increased in age. A study among Ghanaian miners in also found a significant relationship between LBP and advancing age (Bio et al., 2007). In contrast, Wami et al., (2019) found no relationship between age and LBP in Ethiopia. Pataro and Fernandes (2014) argue that heavy equipment operators of older ages suffer higher physical demands and body overload leading to higher incidence of LBP (Pataro & Fernandes 2014). Authorities at the GPHA must put in measure to reduce the risk of LBP among workers as they age.

Heavy duty equipment workers at the GPHA who engage in physical activities had significant decrease in their odds of having lower back pain. Several studies have revealed that regular physical activity has significant protective effect against low back pain (Awosan et al., (2017); Shieh et al., (2016); Terzi et al., (2015). Terzi et al., (2015) notes that regular physical activity helps strengthen the spine offering back support and correct body posture. Results of published by Shiri et al., (2017) also recommends physical activity as a safeguard against frequent or chronic low back pain. Again, Wami et al., (2019) found no significant

association between physical activity level and low back pain. Alnaami et al., (2019) encourage regular levels of physical activity as it reduces risk of LBP by 11–16% through posture enhancement and muscle stimulation. Heavy duty equipment workers at the GPHA, Tema should be educated on the benefits of physical activity and encouraged to indulge in it regularly.

Persons who worked overtime were more likely to suffer from lower back. Likewise, Dong et al. (2021) noted that the longer a person worked, the higher the risk of low back pain. Asangbah (2016) also noted that the duration one operates a heavy-duty equipment was significantly associated with LBP. In this contemporary study, the odds of having LBP was increased among heavy duty workers who frequently bent their trunks sideways. Previous literature also documents analogous findings (Dong et al., 2021; Kadir et al., 2015) affirming that workers who frequently bent their trunk sideways had higher risk of low back pain compared to those who seldom bent their trunk (Dong et al., 2021). Asangbah (2016) argues that working overtime compounds one's risk of LBP due to increased exposure to heavy load and wrong posture. Authorities of the GPHA should develop flexible schedules to reduce overtime and its complications.

5.3 Low Back Pain and Job Performance

Job performance was discovered not to be associated with low back pain using modified version of Individual Work Performance Questionnaire (IWPQ) tool by Koopman et al., (2015) which is a multidimensional scale job performance tool. This finding is different for what is documented across some other studies. Low back pain has been a factor associated with poor job performance among numerous working populations (Ahmed et al., 2022; Nygaard et al., 2020; Rufa'i et al., 2015). A study investigating the impact of low back pain among 200 professional drivers in Kano, Nigeria, revealed that low back pain influenced

performance of up to 74% of drivers (Rufa'i et al., 2015). A cross-sectional study among 11,738 senior workers in Denmark demonstrates occurrence of LBP significantly reduces work performance in physically demanding work areas (Nygaard et al., 2020). Variations in the tool for assessing of job performance coupled with differences in sample sizes may be the reasons for the no association found in this study in comparison with other studies. A comparative cross-sectional study on the impact of work-related low back pain on functional performance and physical capabilities among working men and women who visited the physiotherapy unit of the King Saud University Medical Facility, noted a drastic effect of low back pain on the performance and capabilities of both genders. They however revealed that working women suffered more drastic effects of low back pain on functional performance and physical capabilities compared to working men (Ahmed et al., 2022). Perhaps an extended study involving a larger number of heavy equipment operators may bring out the relationship between LBP and job performance.

5.4 Absenteeism and Low Back Pain

In this study, no link was found between LBP and absenteeism. In contrast to what was found Serranheira et al., (2020) postulated that employees in the public sector and in physically demanding jobs who reported more than six episodes of low back pain accounted for more than 4% absenteeism rate in the same year (Serranheira et al., 2020). Perhaps, this study did not measure counts of LBP episodes suffered over a specified duration and that may have accounted for the difference in findings. Other studies have also found associations between low back pain and absenteeism. In Iran, a cross-sectional study among 771 workers of an automobile factory revealed that nearly 30% of workers with a history of absenteeism was due to low back pain (Mehrdad et al., 2020). A systematic review and meta-analysis by Wynne-Jones et al. (2014) on the rates of absenteeism and return to work

in employees with LBP recorded a pooled estimate for worker absenteeism to be 15.5% in the last six months while the pooled estimate for their rate of return to work was 68.2%, 85.6% and 93.3% at one month, one to six months and above six months respectively. In Slovenia, an analysis of causes of absenteeism among 145 public transport drivers with an average of 14.4 years' driving experience revealed low back pain as the main cause of absenteeism among the drivers (Kresal et al., 2015).

5.5 Limitation

Results of this current study cannot be generalised to all heavy equipment workers in Ghana since it was conducted among heavy equipment workers at the Tema Port only. Also, due to the use of analytical cross-sectional design, associations found in this study do not provide causal inference of the findings in the study though the study documented the prevalence of LBPDs among Heavy equipment operators to be high. The small sample size may account for why some variables that did not show any statistical significance in this study.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The prevalence of LBPD among heavy equipment operators at GPHA, Tema was relatively high.

A one-year increase in age increased the odds of LBP among heavy duty equipment workers.

Physical activity was found to be a protective factor against LBP. Heavy duty equipment workers who engage in physical activities had decrease odds of having LBP.

Heavy duty equipment workers who worked overtime were mostly the ones to experience LBP.

Heavy duty workers who frequently bent their trunks sideways (awkward posture) were more likely to suffer from LBP.

However, the study did not find any significant association of LBP impact on job performance and absenteeism.

6.2 Recommendation

1. Authorities at the GPHA should put in measures (ergonomics, changing task and early retirement for those at higher risk) to lower the risk of LBPD among heavy equipment workers as they age.
2. Authorities at the GPHA should educate heavy duty equipment workers on the benefits of physical activity and encourage them to indulge in it regularly.
3. Allowing for rest periods in between shifts and rotating jobs (changing tasks carried out by workers to prevent excessive exposure to the usage of the heavy equipment).

4. Management of GPHA, Tema Port, must establish an open-door policy that allows staff to freely discuss how LBPD has affected them and how it has changed their life.
5. Periodic Health Promotion and Education programs to sensitize the employees of GPHA to reduce the risk of developing LBPD.
6. Institution of policies and documentation by management outlining work related LBPD to seek early medical care to avoid debilitating complications and ergonomics measures as well.

6.3 Future Research Areas

This study can serve as the foundation to explore areas including major clinical diagnosis and the psychological aspect of low back pain disorders.

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APPENDICES

Appendix A: Application for Ethical Approval

NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH (NMIMR)
COLLEGE OF HEALTH SCIENCES, UNIVERSITY OF GHANA, LEGON

INSTITUTIONAL REVIEW BOARD

Emmanuel Mintah-Benyin
School of Public Health
Department of Biological, Environmental and Occupational Health
P.O. Box L.G 13, Legon
Accra

28/10/2021

The Chairperson
Institutional Review Board
Noguchi Memorial Institute for Medical Research
Legon

Dear Chairperson,

APPLICATION FOR ETHICAL APPROVAL

I wish to submit to you the above-named protocol and essential documents for approval by your committee

I look forward to receiving any comments that you may have in relation to the above.

Thank you.
Yours sincerely

Emmanuel Mintah-Benyin

NMIMR-IRB Form A (Students Only)
Version Date: March, 2020

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Appendix B: Letter of Introduction- Ethical Clearance

UNIVERSITY OF GHANA
DEPARTMENT OF BIOLOGICAL, ENVIRONMENTAL AND OCCUPATIONAL HEALTH
SCHOOL OF PUBLIC HEALTH

Ref. No.:.....

October 29, 2021

The Chairman
Institutional Review Board
NMIMR
Legon

Dear Chairman,

APPLICATION FOR ETHICAL CLEARANCE
EMMANUEL MINTAH-BENYIN (10325604)

I write to support the application of Emmanuel Mintah-Benyin, an MPH Student with the Department of Biological, Environmental and Occupational Health Sciences, School of Public Health, University of Ghana, Legon.

Her proposal titled **"Assessment Of Work-Related Low Back Pain Disorders among Heavy Equipment Operators at GPHA Tema Port"** has been approved and is attached for review.

I look forward to a favourable review.

Yours faithfully,

Dr. Mawuli Dzodzomenyo
(Head of Department)

COLLEGE OF HEALTH SCIENCES
P. O. Box LG 13, Legon, Accra, Ghana.
• Telephone: +233 (0) 289 109 002 • Email: sph-beohs@ug.edu.gh • Website: www.publichealth.ug.edu.gh

Appendix C: Support Letter - Ethical Clearance

University of Ghana
School of Public Health
Legon – Accra
02 November 2020

Dear Sir/Madam,

APPLICATION FOR ETHICAL CLEARANCE (DR. EMMANUEL MINTAH-BENYIN)

The above name is a student under my supervision at the school of Public Health, University of Ghana. He is applying for ethical clearance to enable him to undertake his research on the topic: ASSESSMENT OF WORK-RELATED LOW BACK DISORDERS AMONG HEAVY EQUIPMENT OPERATRS AT GPHA, TEMA PORT. I have gone through his work and approved that the proposal be submitted for ethical clearance.

Counting on your usual cooperation. Thank you

Yours faithful,

Dr Reginald Quansah
Department of Biological, Environmental and Occupational Health Sciences

THE CHAIRPERSON
THE GHANA HEALTH SERVICE REVIEW COMMITTEE
ACCRA, GHANA

Appendix D: Signatures

NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH (NMIMR)
COLLEGE OF HEALTH SCIENCES, UNIVERSITY OF GHANA, LEGON

INSTITUTIONAL REVIEW BOARD

SECTION C – SIGNATURES

I. As the **Student Investigator** on this project, my signature confirms that:

1. I will ensure that all procedures performed under the study will be conducted in accordance with all relevant policies and regulations that govern research involving human participants.
2. I understand that if there is any change from the project as originally approved I must submit an amendment to the NMIMR- IRB for review and approval prior to its implementation. Where I fail to do so, the amended aspect of the study is invalid.
3. I understand that I will report all serious adverse events associated with the study within seven days verbally and fourteen days in writing.
4. I understand that I will submit progress reports each year for review and renewal. Where I fail to do so, the NMIMR-IRB is mandated to terminate the study upon expiry.
5. I agree that I will submit a final report to the NMIMR-IRB at the end of the study.

Name of Student: EMMANUEL MINTAH-BENYIN

Signature of Student:

Date: 01 – 11 – 2021

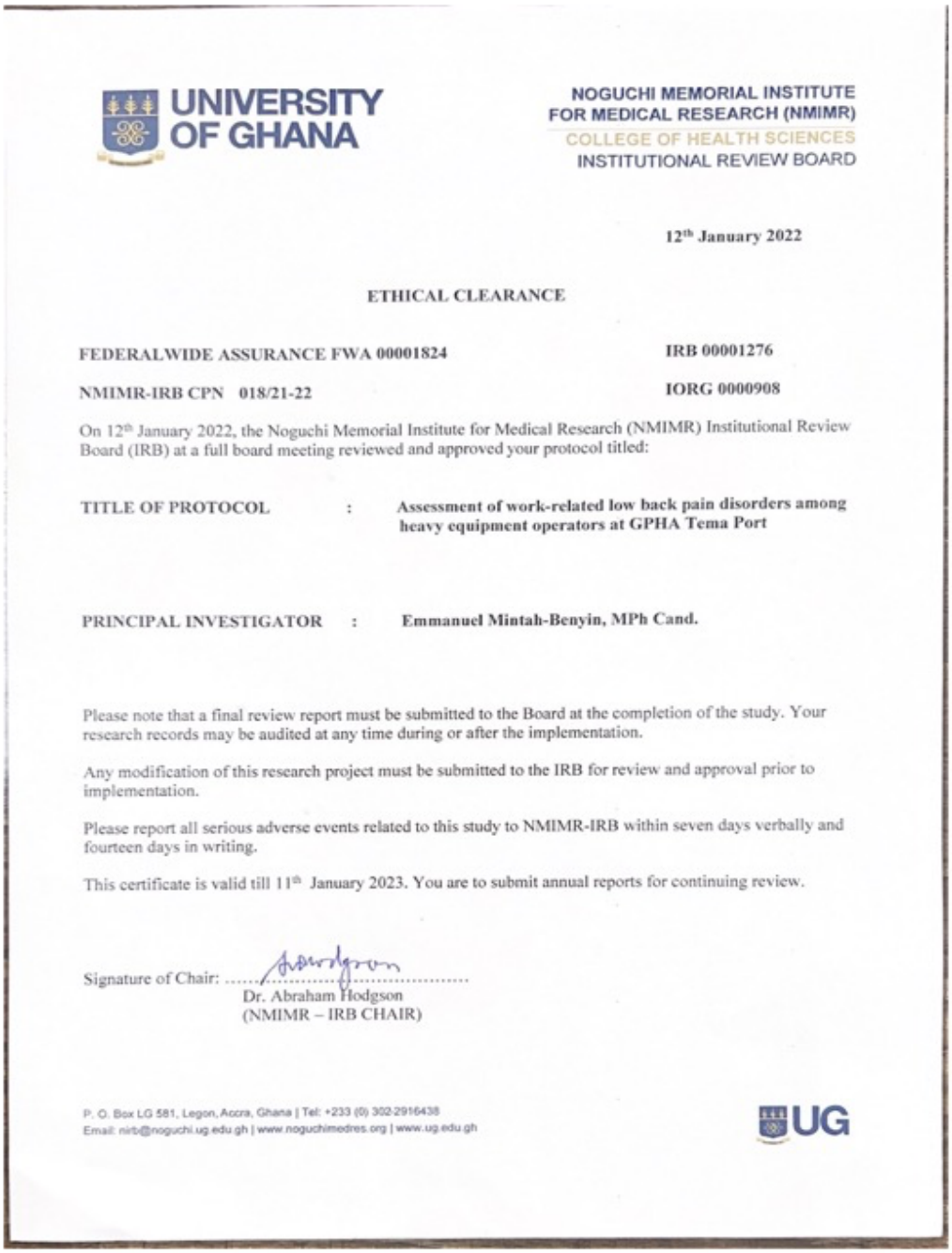
II. As the **Student Supervisor** on this project, my signature confirms that I have read the students work which has been reviewed and approved by the departmental review committee/ scientific and technical committee:

Name of Supervisor: DR. REGINALD QUANSAH

Signature of Supervisor:

Date: 02 – 11 – 2021

Appendix E: Ethical Clearance



UNIVERSITY OF GHANA

NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH (NMIMR)
COLLEGE OF HEALTH SCIENCES
INSTITUTIONAL REVIEW BOARD

12th January 2022

ETHICAL CLEARANCE

FEDERALWIDE ASSURANCE FWA 00001824 IRB 00001276

NMIMR-IRB CPN 018/21-22 IORG 0000908

On 12th January 2022, the Noguchi Memorial Institute for Medical Research (NMIMR) Institutional Review Board (IRB) at a full board meeting reviewed and approved your protocol titled:

TITLE OF PROTOCOL : **Assessment of work-related low back pain disorders among heavy equipment operators at GPHA Tema Port**

PRINCIPAL INVESTIGATOR : **Emmanuel Mintah-Benyin, MPh Cand.**

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please report all serious adverse events related to this study to NMIMR-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till 11th January 2023. You are to submit annual reports for continuing review.

Signature of Chair: .....
Dr. Abraham Hodgson
(NMIMR – IRB CHAIR)

P. O. Box LG 581, Legon, Accra, Ghana | Tel: +233 (0) 302-2916438
Email: nirb@noguchi.ug.edu.gh | www.noguchimedres.org | www.ug.edu.gh

UG

Appendix F: Letter of Introduction to GPHA

UNIVERSITY OF GHANA
DEPARTMENT OF BIOLOGICAL, ENVIRONMENTAL AND OCCUPATIONAL HEALTH
SCHOOL OF PUBLIC HEALTH

Ref. No.:.....

November 2, 2021

The Port Human Resource Manager
Ghana Ports and Harbours Authority
Tema

Dear Sir/Madam,

LETTER OF INTRODUCTION- EMMANUEL MINTAH-BENYIN (10325604)

I am pleased to introduce to you the above-named Master of Public Health student in the Department of Biological, Environmental and Occupational Health Sciences in the School of Public Health, University of Ghana, Legon.

As part of the requirement for the award of Master of Public Health Degree, He is conducting a research titled "**Assessment Of Work-Related Low Back Pain Disorders among Heavy Equipment Operators at GPHA Tema Port**"

The general objective of this study is assessment of work-related low back pain disorders among heavy equipment operators at GPHA Tema port.

It is my hope that you will give him the necessary assistance to enable him carry out the research work.

I count on your support and assistance.

Yours sincerely,

Dr. Mawuli Dzodzomenyo
(Head of Department)

COLLEGE OF HEALTH SCIENCES
• Telephone: +233 (0) 289 109 002 P. O. Box LG 13, Legon, Accra, Ghana • Email: sph-beohs@ug.edu.gh • Website: www.publichealth.ug.edu.gh

Appendix G: Participant Information Sheet

Title of Study: Assessment of Work-Related Low Back Pain Disorders Among Heavy Equipment Operators at GPHA Tema Ports.

Principal Investigator: Emmanuel Mintah-Benyin

Address: School of Public Health

University of Ghana

P.O. Box LG 13

Legon – Accra

General Information about Research

Low Back Pain (LBP) is pain, muscle tension or stiffness localized below the coastal margin and above inferior gluteal folds. LBP is very common problem amongst population and major cause of disability that affect work performances and wellbeing. LBP can be acute, subacute or chronic. Though several factors have been identified such as occupational posture, depressive moods, obesity, body height or age, the cause of the onset of low back pain remain obscure and diagnosis difficult to make.

You have been invited to complete an interviewer-administered questionnaire for my research, which seeks to assess work-related low back pain disorders among heavy equipment operators at GPHA Tema ports. The results of this study will guide in policy formulation, implementation and promotion of efficient management strategies and targeted interventions for similar future conditions.

The study is designed to interview heavy duty equipment operators at GPHA Tema port using an interviewer-administered questionnaire. You are required to help complete the survey and fill the

questionnaire as honestly as possible within an average period of 30 minutes, and do not feel inclined to fit the narrative.

Possible Risks and Discomforts

This is a minimal risk study, with no expected direct risk to you for your participation. You are free to skip providing any information you are uncomfortable disclosing, and should you feel uncomfortable and want to leave the study, you are free to do so without consequences to you. Because you are submitting anonymous data, it will not be possible to withdraw your answers after they have been submitted. Should you be unable to complete and submit your response in one sitting, you can complete it at a later time no more than two weeks from today. You are only permitted to submit one response, but you can go back and forth between pages to edit your responses prior to final submission.

Possible Benefits

There is no direct benefit to you for your participation in this study. However, information obtained from this study may be useful to guide policy formulation, improve implementation, management strategies and interventions for similar future condition. Your participation in this study may motivate you to look up more information about the work-related low back pain and how it affects job performance at work.

Confidentiality

Your name, personal identity or any details that can be traced back to you are not required in this study. The information you will provide will be coded and handled with strict confidentiality, and your confidentiality will always be protected to the maximum extent allowable by law. The data generated from your responses will be stored securely on the cloud and will be destroyed permanently after a minimum of three years as per research protocol. Apart from the researcher, research assistants, my academic supervisor and anyone examining me on my work, no one else will have access to information provided whether in part or in whole.

Compensation

There will be no compensation for your participation in this study.

Voluntary Participation and Right to Leave the Research

You have the right to decline participation in this research. While fully completed surveys are most helpful, you have the right to skip or decline answering any question if you are uncomfortable or do not know have answers for them, with no resultant penalty or ill-effect to you. You can stop participation in the survey at any time with no consequences to you, and you will not lose any benefits or rights you normally have. Only participants aged 18years and above at their last birthday are eligible for this study.

Contacts for Additional Information

If you have any concerns or would like further correspondence, please contact me directly:

Emmanuel Mintah-Benyin

MPH Student of the University of Ghana, Legon.

Tel: 0243588428

Email: emintahbenyin@gmail.com

Alternatively, for any ethics-related concerns, you could contact:

The Administrator

Noguchi Memorial Institute for Medical Research Institutional Review Board (NMIMR-IRB)

P. O. Box LG581, Legon

Email: nirb@noguchi.ug.edu.gh Tel: +233 302 916438

Your rights as a Participant

This research has been reviewed and approved by the Institutional Review Board of Noguchi Memorial Institute for Medical Research (NMIMR-IRB). If you have any questions about your rights as a research participant, you can contact the IRB Office between the hours of 8am-5pm through the landline 0302916438 or email addresses: nirb@noguchi.ug.edu.gh

Appendix H: Participants' Statement of Consent

Assessment of Work-Related Low Back Pain Disorders Among Heavy Equipment Operators at GPHA Tema Port.

By ticking the "I ACCEPT" button, I am agreeing that I am at least 18 years old, that I have read the above document describing the benefits, risks and procedures for the research titled **"Assessment of Work-Related Low Back Pain Disorders Among Heavy Equipment Operators at GPHA Tema Port"**.

I fully understood the purpose and contents of the document in a language I can read and understand (English) or semantic translation into Twi, Ewe or Ga for non-English literate respondents.

I also understand that I have the right to change my mind or withdraw from the research even after consenting, and that by clicking the button below, I am voluntarily agreeing to participate in this study.

[ ] I ACCEPT

Appendix I: Low Back Pain Questionnaire

QUESTIONNAIRE ON FACTORS ASSOCIATED LOW BACK PAIN AMONG HEAVY MACHINE OPERATORS AT GPHA, TEMA PORT.
This is research on **Factors Associated Low Back Pain Among Heavy Machine Operators At GPHA, Tema Port.** The study tries to find out whether you have low back pain related to your job and take information about yourself. You are required to share your experiences by responding to the following questions.

	QUESTIONS	**CODING CATEGORIES**	**SKIP TO**	**CODES**
SECTION A. INDIVIDUAL FACTORS				
1	Age (State your last birthday age)	……		Age
2	Marital status	1. Single [ ] 2. Married [ ] 3. Cohabiting [ ] 4. Divorced [ ]		Mstat
3	Gender	1. Male [ ] 2. Female [ ]		Sex
4	Education level	1. No formal education [ ] 2. Primary level [ ] 3. Secondary [ ] 4. Tertiary [ ]		Educ
5	How much do you earn monthly from the job you do?	Please state …… …		Income
6	BMI Weight	……... …… …		Bmi

	Height	…… …		
7	Smoking status	1. Former smoker [ ] 2. Never smoked [ ] 3. Current smoker [ ]		smoking
8	Alcohol usage	1. Former drinker [ ] 2. Never [ ] 3. Current drinker [ ]		alcohol
9	Do you do any form of exercise Physical Activity?	1. No [ ] 2. Yes [ ]		physical
10	How often do you exercise?	1. Once a week [ ] 2. 2-3 times a week [ ] 3. >3 times a week [ ]		phy_freq
SECTION B. LOW BACK PAIN FACTORS				
11	Are you currently experiencing low back pain?	1. No [ ] 2. Yes [ ]		cur LBP
12	Have you at any time during the past 12 months had low back pain?	1. No [ ] 2. Yes [ ]		LBP 12mths
13	Have you been unable to carry out normal activities at work in the past 12 months because of low back pain?	1. No [ ] 2. Yes [ ]		act work
14	Have you seen a physician in the past 12 months because of low back pain?	1. No [ ] 2. Yes [ ]		phys 12mths
15	Was any imaging investigation done?	1. No [ ] 2. Yes [ ]		Imaging invgt

16	Which type of investigation was done	1. X - Ray [ ] 2. CT -Scan [ ] 3. MRI [ ] 4. USG [ ]		type invgt
17	What was the imaging investigation diagnosis?	……		Diagnosis invgt
SECTION C. JOB RELATED FACTORS				
18	Job Type	1. Crane operators [ ] 2. Reach stacker operators [ ] 3. Forklift drivers [ ] 4. Mafi drivers [ ]		job_type
19	Do you have over time working hours?	1. No [ ] 2. Yes [ ]		working hours
20	Do you experience Vibration from Equipment you use to work?	1. No [ ] 2. Yes [ ]		vibration
21	When working how frequently do you bend your trunk sideways?	1. Never [ ] 2. Seldom [ ] 3. Frequently [ ]		Postural_ Load
SECTION D. SOCIAL SUPPORT				
22	My supervisor allows me to take break from work if I need one	1. Strongly agree [ ] 2. Agree [ ] 3. Not sure [ ] 4. Disagree [ ] 5. Strongly disagree [ ]		super_sup port
23	My colleagues fill in for me when I need to take break	1. Strongly agree [ ] 2. Agree [ ] 3. Not sure [ ] 4. Disagree [ ] 5. Strongly disagree [ ]		coll_supp ort

24	Work is shared equally among colleagues, so I don't have to do too much	1. Strongly agree [ ] 2. Agree [ ] 3. Not sure [ ] 4. Disagree [ ] 5. Strongly disagree [ ]		shared_work
25	Does your organization pay attention to employees health and welfare?	1. A great deal of attention [ ] 2. A lot of attention [ ] 3. A moderate amount of attention [ ] 4. A little attention [ ] 5. Not any attention [ ]		Employees health and welfare
SECTION E. JOB PERFORMANCE				
26	How hardworking are you at work?	1. Extremely hardworking [ ] 2. Quite hardworking [ ] 3. Moderately hardworking [ ] 4. Slightly hardworking [ ] 5. Not at all hardworking [ ]		
27	How effective are you at work?	1. Extremely effective [ ] 2. Quite effective [ ] 3. Moderately effective [ ] 4. Slightly effective [ ] 5. Not at all effective [ ]		
28	How well do you work with other employees at works?	1. Extremely well [ ] 2. Quite well [ ] 3. Moderately well [ ] 4. Slightly well [ ] 5. Not at all well [ ]		
29	How quickly do follow-up on your supervisor request?	1. Extremely quickly [ ] 2. Quite quickly [ ] 3. Moderately quickly [ ] 4. Slightly quickly [ ] 5. Not at all quickly [ ]		

23	How much attention do you pay to details at work?	1. A great deal of attention [ ] 2. A lot of attention [ ] 3. A moderate amount of attention [ ] 4. A little attention [ ] 5. Not any attention [ ]		
31	How well do you handle Criticism at work?	6. Extremely well [ ] 7. Quite well [ ] 8. Moderately well [ ] 9. Slightly well [ ] 10. Not at all well [ ]		
32	How quickly do you adjust to changing priorities?	1. Extremely quickly [ ] 2. Quite quickly [ ] 3. Moderatelyquickly [ ] 4. Slightly quickly [ ] 5. Not at all quicly [ ]		
33	How well do you meet goals set by your supervisor for you during appraisal?	1. Extremely well [ ] 2. Quite well [ ] 3. Moderately well [ ] 4. Slightly well [ ] 5. Not at all well [ ]		
34	How much trust does your supervisor accord to your ability to make the right decisions?	1. A great deal of trust [ ] 2. A lot of trust [ ] 3. A moderate amount of trust [ ] 4. A little trust [ ] 5. Not any trust [ ]		
SECTION F. ABSENTEEISM				
35	How many times do you absent yourself from work in a month?	1. Never [ ] 2. 1-2 times /month [ ] 3. 3-5 times/month [ ] 4. 5-7 times/month [ ] 5. >7 times/month [ ]		absenteeism

36	What is the common reason for your absent?	1. Low back pain [ ] 2. Other health problems [ ] 3. Domestic reasons [ ] 4. Work dissatisfaction [ ] 5. Work environment [ ]		
37	Which of the following months did you absent yourself from work?	38. How often did you absent yourself from work in that month?	39. How many days did your absent eeism last?	
	Yes No 1. January [ ] [ ] 2. February [ ] [ ] 3. March [ ] [ ] 4. April [ ] [ ] 5. May [ ] [ ] 6. June [ ] [ ] 7. July [ ] [ ] 8. August [ ] [ ] 9. September [ ] [ ] 10. October [ ] [ ] 11. November [ ] [ ] 12. December [ ] [ ]	…… …… …… …… …… …… …… …… …… ……	…… …… …… …… …… …… …… …… …… ……	