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ERGONOMIC RISK FACTORS AND WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG WORKERS IN THE CEMENT BLOCK MANUFACTURING COMPANIES IN TEMA

BY

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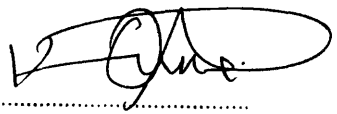
JULY, 2017

DECLARATION

I make a solemn pledge that this work is my original and first of a kind project. With the exception of other peer-reviewed articles that references were made and duly acknowledged, this work has never been produced anywhere else for an academic pursuit or any endeavour whatsoever. It is an independent research work undertaken by myself under a healthy direction of my supervisor, Dr Reginald Quansah.



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DEDICATION

This intellectual property is solely dedicated to my children, Kweku and Naana.

ACKNOWLEDGEMENT

The work could not have been accomplished without the invaluable contribution of some good people and organizations. A profound gratitude is expressed to the participants and the managers of those organizations who respectively consented to take part and also volunteered their premises for the study to be done. The unflinching support and direction from my supervisor is greatly appreciated. All other parties who contributed in diverse ways for the successful execution of this academic project are also well honoured. A special and the greatest gratitude is to no one other than the life-giver, Jehovah God for his wisdom, protection and love bestowed upon me.

ABSTRACT

Background: Work-Related Musculoskeletal Disorders (WRMSDs) has for quite a long time continued to be the world's leading health crisis among the working population. The prevalence or the disease burden among workers in the cement -block manufacturing companies in Ghana is not known. A study to determine the prevalence and the associated ergonomic risk factors of WRMDs among such working group is worth pursuing.

Objective: The study was to assess the ergonomic risk factors; mainly on awkward postures and work-related psychosocial stress factors and to determine the prevalence of work-related musculoskeletal disorders among the male workers in the cement block manufacturing companies.

Methodology: A descriptive cross- sectional study was conducted among 103 participants from the Tema Metropolis. It involved workers from 17 different Cement Block Manufacturing (CBM) companies or enterprise. A modified Standard Nordic WRMSDs and Job Content Questionnaires and Videotaping were used to solicit information on self-reported symptoms of WRMSDs and work-related psychosocial stress factors respectively. Rapid Entire Body Assessment (REBA) worksheet was used for postural evaluation.

Results: All the 103 participants have experienced the WRMSDs at different body regions within the last 7 days and 12 months' prevalence. Low back pain was the most prevailing forms of WRMDs (88.34%) among the workers.

Conclusion: WRMSDs is indeed endangering the health and safety of the workers. There is an urgent need for workers, owners of companies and the country as a whole to consider it as a national public health problem that needs an immediate remediation.

Key words: work-related musculoskeletal disorders, awkward postures, psychosocial risk factors.

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LIST OF ABBREVIATIONS

CBM:	Cement Block Manufacturing
MSD:	Musculoskeletal disorders
OSHA:	Occupational Health and Safety Administration
OWAS:	Ovako Working Posture Analysis System
PI:	Principal Investigator
RA:	Research Assistants
REBA:	Rapid Entire Body Assessment
RULA:	Rapid Upper Limb Assessment
U.S./ U.S.A:	United States of America
WRMSDS:	Work-related musculoskeletal disorders

OPERATIONAL DEFINITIONS

(1) Work related musculoskeletal disorders (WRMDS): Injury or pain to the muscles, tissues, tendons, cartilages, nerves etc. Expressions such as musculoskeletal pain or symptoms are used to represent the same concept in this study.

(2) Mortar: A mixture of fine sand or quarry dust, cement and water used for making cement block.

(3) Body regions: Parts of the human body affected by Work-related Musculoskeletal Disorders such as the neck, shoulder, knee, elbow, leg, thigh, hips, low and upper back, ankle, wrist and much more.

(4) Company or Enterprise: A business entity

(5) Chronic: Condition experienced over a long time, for instance over three months

CHAPTER ONE

INTRODUCTION

1.1: Background

Work-Related Musculoskeletal Disorders (WRMSDs) has become a major health problem among workers in both heavily-industrialised and industrially -developing countries (Nagi, Vyasi & Nagi, 2010). It is known to be the largest category of work-related illness, that represents a third or more of all registered occupational diseases in the United States of America, including Japan and the Nordic countries, according to the National Research Council (2001). A study by Hauke, Flintrop, Brun and Rugulies (2011) revealed that WRMSDs were the most frequent health complaint by European, United States and Asian Pacific workers.

WRMSDs cause considerable absenteeism with resultant low productivity at the workplace. It accounted for 44% of all the cases of work- related ill-health in the UK (Buckley, 2015). WRMSDs are very debilitating, with the potential to wreak havoc in one's daily life at work and even at home. In 2012, it was reported that WRMSDS caused 25.5 million people in the U.S. to lose an average of 11.4 working days having suffered from back and neck pain. This accumulated to a total of 290.5 million losses of working days in U.S in 2012 alone (Bixner, Bogert, Manget, & Wan, 2013).

Workers in the sub-region equally are suffering from the pangs of WRMSDs. A study by Neveen, Abdel, EL Sayyad, EL and Farag (2014) in Egypt found more than 362 out of 400 physiotherapists representing 90.7% reported of having experienced different forms of WRMSD over a 12-month period. Prevalence of low back pain,

upper back pain and neck pain among bank workers in Kumasi, Ghana, was more than 64%, 61% and 47% respectively in 2012 (Abledu & Abledu, 2012). Quansah (2005) found the prevalence of WRMSD in the following body regions among fish trimmers in Tema, Ghana: neck (70%), shoulders (70%) low back (68%), wrist/hand (64%), ankle/feet (54%) and hips/thighs (48%).

Musculoskeletal Disorders (MSDs) are injuries or discomfort affecting the musculoskeletal system (i.e. the muscles, tendons, cartilages, skeletons, disc, ligaments and the nerves (Luttmann, Jager, Griefahn & Caffier, 2003). MSDs has a larger scope including all forms of ill-health that ranges from light, transitory disorders to irreversible, disabling injuries (Luttmann et al. 2003). When Musculoskeletal Disorders (MSDs) are induced by or originated at the workplace or in an occupational setting it is referred to as Work-Related Musculoskeletal Disorders (WRMSDs), (Salik & Ozcan, 2004). Thus WRMSDs and MSDs refer to the same ill-health except that the former refers to MSDs occurring at a working environment. The two expressions or terms (i.e. WRMSD and MSD) were used interchangeably in this study to represent the same construct.

Work –related musculoskeletal disorders are usually chronic conditions naturally and mostly develops over time. The major symptoms of WRMSDs are pains or discomfort on the musculoskeletal systems (Guidotti, 1992). They are a composite of pains or discomfort around the body regions. The body regions refer to parts of the human body affected by WRMSDs such as the neck, knee, shoulder and much more. Notable examples of WRMSDs include pains in the postural muscles such as the upper and lower back, neck, shoulders, upper limbs such as the forearm and wrist, the lower extremities such as hips, thighs, knees and ankles (Hayes, Cockrell & Smith, 2009).

WRMSDs have multiple causes or risk factors including ergonomic risk factors such as heavy physical work, lifting, pushing and pulling, repetitive work, static work postures, vibration, frequent bending and twisting, psychosocial stress and much more (Andersson, 1981). The term ergonomics has its origin from Greek words "ergon" meaning work and "nomos" meaning natural laws. Ergonomics is therefore defined as the scientific study of people and their work, (Khalil, Moby, Rosomoff & Rosomoff, 1976). It is the art and science of designing work to fit the worker.

Ergonomics helps individuals to recognize their strength and limitations and to teach them how to perform safely, effectively, and comfortably within the environment (Khalil et al. 2016). Integration or implementation of ergonomic measures in job design and the workplace helps to minimise or prevent significantly the occurrence or episodes of WRMSDs among the workers (Snook, 1987).

Conversely, non-adherence to the principles of ergonomics in the designing of the workplace or the performance of job presents risk factors (i.e. ergonomic risk factors) that pave way for WRMSDs (Snook, 1987). According to Guidotti (1992), the ergonomic risk factors include but not limited to highly repetitive work, rapid change of bodily direction, forceful gripping, forceful or awkward movements, prolonged standing, static or awkward postures, insufficient rest or recovery time, heavy or frequent lifting, use of vibration tools, poor job satisfaction and so on.

The job of cement block manufacturing (CBM) involves engaging the workers to undergo the aforementioned risk factors. They are preoccupied with lifting, bending and twisting, assumption of awkward postures, pulling or pushing, carrying, exposure

to psychosocial stress factors, transporting among others,

(Godwin & Ndubueze, 2013).

1.2: The Problem Statement

Woolf and Pfleger (2003) argued that WRMSDs are the major cause of years lived with disability in all continents and economies. The World Health Organization reported in 2009 that WRMSDs contributed to more than 10% of all years lost to disability (W.H.O.,2009). It is the major cause of absenteeism from work leading to low productivity (Woolf et al., 2003). WRMSDs account for the reasons employees quit their job (Olafsdottir & Rafnsson, 1998).

The European Agency for Safety and Health at Work (EASHW), (2004) admits WRMSDs are prevalent among workers in the construction industry. The construction workers including CBM workers are at a higher risk of contracting WRMSD by virtue of their repeated exposure to awkward postures and motions such as lifting, bodily twisting and bending, arm abduction, neck flexion among others for a long period (Abdel-wahab, 2016). According to Das (2014) the prevalence of WRMSDs among brick manufacturing workers in West Bengal, India was 98%, 93%, 86%, 85%, 76% and 65% for lower back, hands, knees, wrists, shoulders and neck respectively.

There exists no available information on prevalence and patterns of occurrence of WRMSDs among workers in the cement block manufacturing (CBM) companies in Ghana. Both the disease and economic burden of WRMSDs among the CBM workers in Ghana are not known. On this premise a cogent intervention or policy framework can

hardly be developed for the health and safety of these workers. The current study sought to at least fill both the knowledge and practice gaps and be a stepping stone or baseline for future development or interventions.

The study aimed to find out the prevalence of WRMSD and its associated ergonomic risk factors; especially the contribution of awkward postures and work-related psychosocial stress factors among the CBM workers and to present benchmark recommendations. The risk factors associated with WRMSDs are multi-folds, however the current study was fixated on two ergonomic risk factors: these were awkward postures and work-related psychosocial stress factors (Bridgers,2005; Luttmann et al. 2003).

1.3: Conceptual Framework

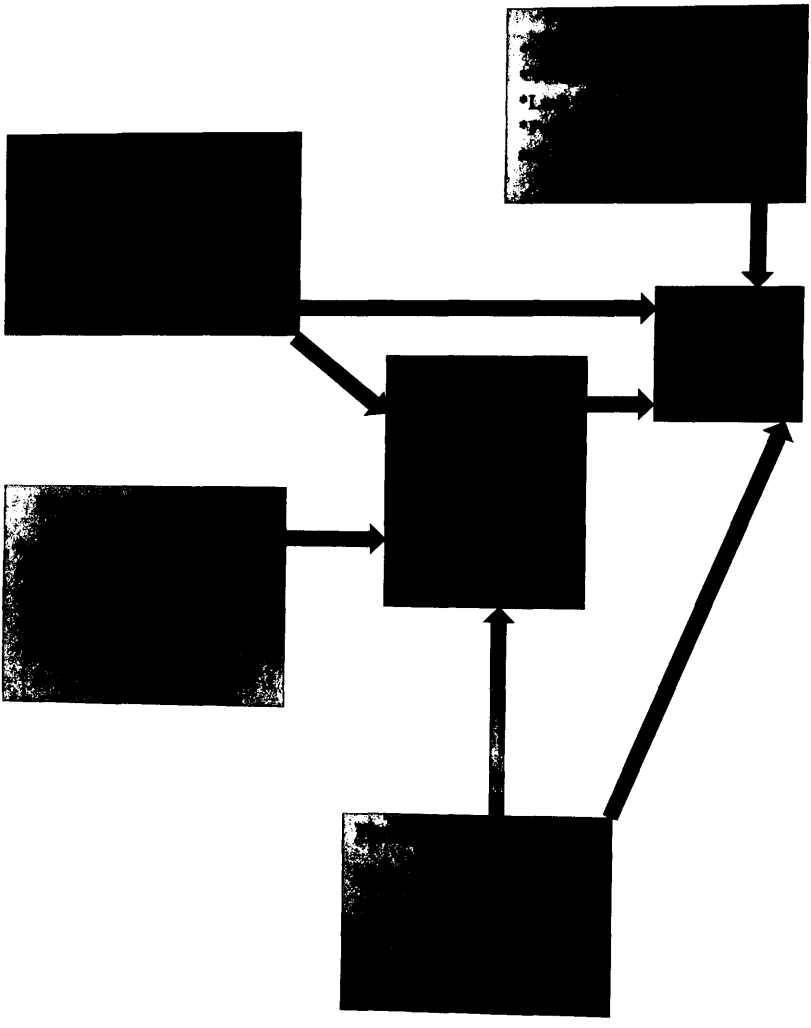


Figure 1.1: A Conceptual Framework showing ergonomic factors associated with WRMSDs

The risks of WRMSDs are multi-factorial and mutually inclusive. The study was limited to investigations into the effects of awkward postures and

work -related stress predictors of WRMSDs.

The physical workload sub- factor, awkward postures, contributes partly in WRMSD among workers. For instance, assuming a poor posture (i.e. awkward posture) when lifting or bending will lead to muscle fatigue or stoppage of blood flow which will consequently produce muscle pain or injury (Luttmann et al., 2003). Moreover, work-related stress as a result of over exertion of the body, since there is too much work demand and less control by the worker, builds up tension or pressure in the muscles and risks workers in developing WRMSDs (Karasek & Theorell, 1990).

Age and sex of the individual as cofounders indirectly aggravate the risks of developing WRMSDs. The strength of the muscles decreases with advancing age; thus the aged workers are more prone to developing WRMSDs. Moreover, males naturally have stronger muscles than females and thus the latter genetically have a higher risk for WRMSDs than the former (Luttmann et al. 2003).

1.4: Justification

WRMSDs is the leading cause of absence from occupational work and present a considerable cost for the public health system. (Luttmann et al. 2003). According to the European Agency for Safety and Health at Work, (EASH, 2004), WRMSDs are some of the most common forms of ill-health in construction industry. Though WRMSDs permeate in all job sectors, other industries such as the workers in the cement block manufacturing (CBM) enterprises or companies, are at a higher risk (Godwin et al. 2013).

Notwithstanding, no study has delved into the ergonomic risk factors and prevalence of WRMSDs among CBM workers in Ghana. The disease burden of WRMSDs among the CBM workers in Ghana is not known. It is worthy to obtain empirical information in relation to the impact of WRMSDs in CBM industry upon which intervention can be provided. Moreover, there is no direct policy framework protecting the health of workers in the CBM industry. The study intended to explore into their corridors, assessed the risks the job of CBM poses and to provide recommendations to the stakeholders. These recommendations included guidelines to minimise the ergonomic risks as well as the need for the employers to re-design the various operations at stake to ensure the health and safety of the workers.

1.5: Objectives of the study

1.5.1: General Objective

Assessing the contribution of awkward postures and work-related psychosocial risk factors on WRMSDS and its prevalence among the workers in the cement block manufacturing (CBM) companies in Tema

1.5.2: Specific Objectives

(1) To determine the prevalence or self-reported symptoms of WRMSDs

(2) To conduct postural assessment to identify the most high-risk prone WRMSDS task.

(3) To identify the most complained awkward posture(s) and high risk task(s) by the participants

(4) To identify the work-related psychosocial stress factors

CHAPTER TWO

LITERATURE REVIEW

2.1: Scope of the Review

This segment provides information in details on the theoretical bases of the two ergonomic risk factors that the study sought to assess, i.e. awkward postures and work-related psychosocial stress factors, the prevalence of WRMSDs reported in previous studies and highlights of some ergonomic assessment tools.

2.2: Ergonomic Risk Factors

The two ergonomic risk factors (i.e. Awkward postures and Work-related Psychosocial stress factors) which are the center of the study are explained in detail below.

2.2.1: Awkward Postures

Posture refers to the arrangement of the body and is limbs. An imbalance in this arrangement can result in WRMSDs. Neutral postures are range of postures where the muscles are or at near their resting length while the joint is aligned naturally (Warren & Morse, 2008). The neutral ranges of postures present the best and comfortable positions for the joints (Warren et al., 2008).

Awkward postures refer to the postures adopted when the joints are not in neutral positions (Pinzke & Kopp, 2001; Chaffin, Andersson & Martin, 2006). Examples includes when the neck is bent forward greater than 30 degrees, the elbow is raised above the shoulder, bending the back forward greater than 45 degrees, twisting the trunk, kneeling, squatting forward and backward bending, twisting, neck flexion and much more. (Washington State Department of Labour and Industries, 2008a.; OSHA, 1995)

Awkward posture also involves maintaining a posture for relatively long periods, such as prolonged standing or sitting (Warren, et.al, 2008). Muscles have greater strengths when the joints are in neutral positions therefore able to produce greater amount of force. (Chaffin et al, 2006) The reverse occurs when either awkward or static posture or both are adopted. This reduces muscle strength and with much pressure on it impedes blood flow with resultant pain (Chaffin et al., 2006). The nature of the operations in cement block manufacturing (CBM) relative to the job design compels the workers to adopt awkward postures with the risk of being afflicted with WRMSDs (Manoharan, Singh & Sanjay, 2012). The tasks are predominantly executed manually, involving prolong standing, bending the trunk at extreme angle ($> 45^0$) for lifting and dropping a block, raising the shoulder high for turning the shovels during mortar making or operating the block machine, neck stretching, repetitive movements and wrist twisting. These are also coupled with the fact that they do not have enough breaks to relax the muscles. These abnormal postures (i.e. awkward postures) strain the muscles, results in muscle fatigue and pains or discomfort (Mathiassen & Winkle, 1990; Armstrong, 1986.). It is known that extreme twisting of the trunk leads to tissues compression, which in turn increase the muscle or tissue pressure resulting in pain (Keir, Bach, Hudes, & Rempel, 2007; Mathiassen et al., 1990).

Ndivhudzannyi (2003) sought to investigate specific ergonomic risk factors associated with WRMSDs among the brick making workers in South Africa. According to the study, the subjects mentioned frequent twisting and bending of the trunk, high repetitiveness and high speed of job performance, poor handling techniques and inadequate break periods as being the leading risk factors for WRMSDs. Alehi (2007) also identified awkward postures as an ergonomic risk factor to WRMSDs.

Tawiah, Oppong-Yeboah and Bello (2015) in their study among mine workers in Ghana discovered repetitive performance of a particular task, awkward bending or twisting of the back and lifting or carrying heavy objects as ergonomic risk factors associated with WRMSDs. The aforementioned ergonomic risk factors were corroborated by Neveen et al. (2014). They identified long standing, heavy load lifting (>5kg), repetitiveness of task, awkward bending or twisting of the upper body, repetition of same body movement and working for prolong period whiles maintaining same posture as ergonomic risk factors relative to WRMSDs.

2.2.2: Work-related Psychosocial stress factors

Psychosocial stress factors are the non-physical aspects of the job (Bakker & Demerouti, 2007). They involve both the objective demands of the work and the subjective assessment of those demands by the employee as to whether he or she has the ability to accomplish those demands (Bakker et al.2007). According to Hagberg, Silverstein, Hendrick, Smith, Wells, Carayon and Perusse (1995), work-related psychosocial stress factors are the subjective perceptions of employees on organizational factors which relates to the objective aspects of how the work is organised, managed or supervised and carried out. An employee develops stress when he or she is unable to cope with the work demands or the perceptions (Bongers, de Winter, Kompier & Hildebrandt, 1993). Occupational or workplace stress is associated with developing ill-health including WRMSDs (Sauter & Swanson, 1996; Smith & Carayon, 1996). Several researches provides theoretical perspectives underpinning how stress is associated with pain including WRMSDs. The neurotransmitter, serotonin which is released when one is under stress has been observed to potentiate the pain-mediating effects of bradykinin (Stratakis, Gold & Chrousos, 1995). The interaction of serotonin and bradykinin in the tibialis anterior muscles has been observed and concluded by Babenko,

Graven-Nielsen, Svensson, Drewes and Arendt-Nielsen (1999) to be associated with elevated pain intensity. Smith et al (1996) posit that stress results in increased muscle tension which risks pain or WRMSDs. Stress is also known to make individuals engage in abnormal or risky behaviours such as unnecessary use of excessive force and unsafe practices when at work (Macfarlane, Hunt & Silman,2000). Theorell (1996) remarked that elevated hormonal production under stress exacerbates muscle pain or WRMSDs by inhibiting repair of muscle tissue. Occupational stress has been identified to be caused by several workplace psychosocial factors, notably among them are high job demands (which include but not limited to long working hours, excessive workload, high skills, meeting targets), low job control (such as not having the autonomy to decide on the job) and little or no social support (lack of recognition, no motivation from managers and much more), (Bakker et al.,2007; Johnson & Hall, 1998). Robert Karasek (1979) developed a job Demand –Control model **(Figure 2.1 below).**

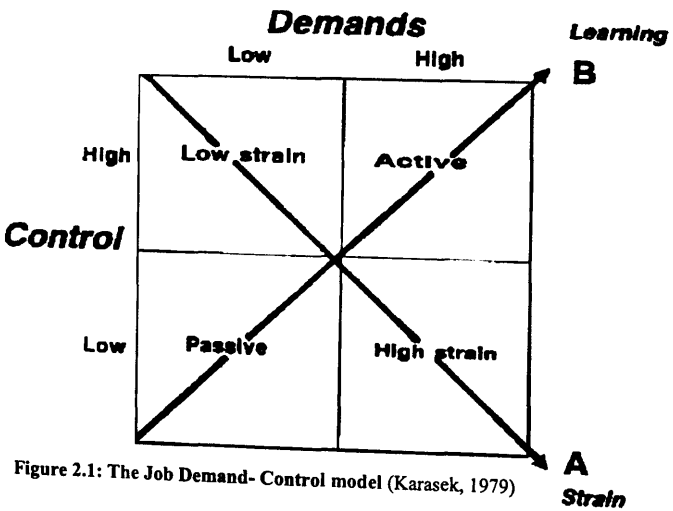


Figure 2.1: The Job Demand- Control model (Karasek, 1979)

The model explains the relationship between job demands and job control and its associated ill-health such as WRMSDs (Karasek, 1979). The job demands aspects according to Karasek (1979) encompasses elements such as skills, physical and mental strength, problem-solving, workload, working hours and the like. The job control dimension refers to decision authority, the opportunity for one to make an independent decision on the job (Karasek & Theorell, 1990). The model categorises jobs into 4 types relative to the demand-control combination. The job- type of interest to this study in following the pattern in previous studies is what Karasek referred to as 'High strain' job (Figure 2.1, quadrant A) According to Karasek et al. (1990), 'high strain' jobs are those with high job demands but low job control. An employee in this kind of job is more likely to develop high physiological arousal and ill-health that includes WRMSDs (Karasek et al.1990).

2.3: Prevalence of WRMSDs

Tawiah et al. (2015) found out that 175 mine workers out of 205 had experienced different forms of WRMSD over a 12-month period. The most affected body region was low back representing 30% prevalence, followed by the wrist (16%) and the ankle (1%). Maduagwu, Maijindadi, Duniya, Oyeyemi, Saidu and Aremu (2014) on the other hand rather found neck pain as the most prevalent among bank workers in Maiduguri, Nigeria, followed by 46.02%, and 45.13% for shoulder and low back pain respectively. The rest were knee pain; 19.91%, pain at the hips;14.16% and upper back pain 32.2%.

Abledu, Offei and Abledu (2014) also discovered the following prevalence for WRMSDs among commercial minibus drivers in Accra: low back pain 58.8%, neck

pain 25%, upper back pain22.3% shoulder pain 18.2%, knee pain14.9%, ankle 9.5%, wrist or hand 7.4%, elbow pain 4.7% and hip or thigh pain 2.7%.

2.3.1: Prevalence of WRMSDs Among Construction Workers

WRMSDs are highly prevalent and considered to be the main cause of functional impairment and disability among construction workers (LeMasters, Bhattacharya, Borton & Mayfield, 2006).

A study was conducted in Malaysia by some researchers to explore on the prevalence of WRMSDs among the construction workers (Fairus, Daud, Amdan, Aziz, & Jamal, 2014). Having a sample size of 60 construction workers, 66.7% of same reported of having experienced WRMSDs at different body regions with the low back been the most prevalent (45%) form of WRMSDs experienced by the workers. Prevalence for other body regions were shoulder (28.3%), neck (16.7%), wrist/hand (15%), upper back (13.3%), knees (13.3%), elbow (10%), hip/thigh (8.3%) and ankles/feet (5%) (Fairus et al.,2014).

2.3.2: Prevalence of WRMSDs Among Cement Block Manufacturing workers

The CBM workers have a higher prevalence of WRMSDs like other workers within the construction industry (EASHW,2004). In a case-control study by Joshi, Poudel, Dahal and Sherpa (2013) they found a higher prevalence of WRMSD among the workers in the brick manufacturing company (i.e. the case) than those not working (i.e. the control). The cases were 8 times the odds of developing WRMSD than that of the control. Prevalence of body regions among the workers were; knee (68.2%), ankle

(60.3%), low back (54.8%) upper back 54.8 (54.8%), (neck (52%), shoulder (42.5%), wrist (38.2%) and elbow (34.2%).

Ndivhudzannyi (2003) examined the prevalence of WRMSDs among workers in a brick making factory in South Africa. All the 19 subjects in the study reported of having suffered one form of the disorder over a 12-month period. Below are the breakdowns of the prevalence across the body regions: low back (36.8%), neck (26.3%), upper back (21%) shoulder and wrist (15.8% each) and the ankle (5.2%). The low and upper back pain seems to be the most form of WRMSDs affecting CBM workers. For instance, Sealetsa and Moalosi (2014) also found low and upper back pain as the most prevalent (36.1% each) forms of WRMSDs among workers in a Kiln brick factory in Botswana. Prevalence of other body regions were shoulder (34.7%), hand/wrist (22.2%), the ankle/feet had the lowest prevalence (12.5%), (Sealetsa et al., 2014).

2.4: Types of Ergonomic Assessment (Screening) Tools

There are a number of ergonomic assessment tools available for assessing level of risks of WRMSDs. Few of such tools are discussed below.

2.4.1: Rapid Entire Body Assessment (REBA)

REBA is one of the widely used ergonomic assessment tools that uses a systematic procedure to measure whole body postural WRMSDs risks associated with job tasks (Hignett & McAtamney, 2000). Detail information about REBA is provided in chapter three, section 3.4.2, (pages 25-28).

2.4.2: Rapid Upper Limb Assessment (RULA)

The second ergonomic tool, RULA is very similar to that of the REBA except that it assesses only the ergonomic risk factors associated with the upper extremities. (McAtamney & Corlett, 1993) It also has section A (arm and wrist.) and section B assessing the neck and trunk. Total score ranges from 1-7 with accompanying risk level and interpretation as shown in **Table 2.1** below. It is best for sedentary and seated tasks, however it has the disadvantage of not able to assess the lower extremities (i.e. the thigh/hips, legs, ankle and the knee).

Table 2.1: RULA score and its interpretation

RULA SCORE	LEVEL OF RISK	REMARKS
3-4	Low	Further Investigation, Change may be needed

2.4.3: Ovako Working Posture Analysis System (OWAS)

OWAS is another ergonomic assessment or screening tool developed in Finland in 1973 (Karhu, Kansi, & Kuorinka, 1977). It is used to identify the most common workplace postures for the back (4 postures), arms (3 postures) and the legs (7 postures, and the weight of load carried (3 categories). Like REBA and RULA it requires videotaping or taking photographs of workers while in the process of task performance and then later for analysis. Each body region is given a score or code, the higher the code the riskier for WRMSDs (Karhu et al. 1977). The whole of the body postures is described by these body parts with a 4-digit code. The codes are directly proportional to increasing risk for WRMSDs. For instance, total body posture with code (score) 4341 is riskier for WRMSD than a body posture with code 1211 or 2221. The 252 body postures (i.e. 4 * 3 * 7 *3) is classified into 4 action categories upon which may warrant ergonomic change as indicated in table 2.3 below.

Table 2.2: OWAS score and its interpretation

CATEGORY	POSTURE RISK LEVEL	INTERPRETATION
2	**Slightly Harmful**	**Corrective action needed**
3	Distinctly Harmful	Corrective action should be taken as soon as possible
4	Extremely Harmful	Corrective action should be taken immediately

OWAS is widely used across several industries. Nonetheless it has the following limitations:

(I) It is time consuming

(II) OWAS does not consider repetition or duration of sequential postures

(III) Decision rules based on frequency distributions are arbitrary.

(IV)It is very technical and requires thorough training.

2.5: Conclusion of Literature Review

The review of existing literatures confirms the pervasive potentials of WRMSDs among workers across the globe. It also corroborates the fact that construction workers including cement block manufacturing (CBM) workers are at a higher risk of WRMSDs. The body region mostly affected with WRMSDs is the low back. A number of risk assessment tools have been detailed. REBA assessment tool was used in the current study to conduct the postural assessment. It has the advantages for covering most of the body regions significant for posture analysis in comparison to others. It has a higher accuracy rate, less technical and one of the widely used ergonomic tools (Hignett et al.2000).

CHAPTER THREE

METHODOLOGY

3.1: Study Design

A descriptive cross-sectional study was adopted to carry out the research between the months of April and May, 2017.

3.2: Study Population

The study population were 103 male workers working in seventeen (17) different Cement Block Manufacturing (CBM) companies in Tema.

3.3: Process and Task Description

The manufacturing of cement block starts with the preparation of mortar. Mortar preparation begins with pouring specified amount of fine sand or quarry dust usually on a hard surface. Bags of cements are then added to the fine sand or the quarry dust. A shovel is used to turn the sand and cement mixture several times until a homogenous mixture is attained. Specified amount of water is thereafter added to the mixture and a shovel is repeatedly used to mix the mixture till consistency is achieved. The above process is the manual process applied in most of the cement companies that were investigated. In order to increase production some companies applied semi-automated processes to prepare their mortar. In this case, the non-homogenous cement-sand (or cement-quarry dust) mixture is transferred into a cement–mixer, which will continue the mixing until consistency is achieved, (Figure 3.2). After a complete mortar is prepared, the mortar is transferred manually into the mould of a manual cement block machine, (Figure 3.4). A worker continually compacts the mould with a metal slab manually until a complete non-dried block is formed, (Figure 3.3).

However, in some companies, the process of preparing non-dried blocks is automated. The fully automated process involves just pressing a button after filling the machine with mortar, and then the machine automatically compacts the mortar into individual blocks. After the block is formed workers carry and packed them manually in an open space to dry, **(Figure 3.1).** The size of the companies ranges from 3 to 6 workers and the target per company is about 800 blocks a day.

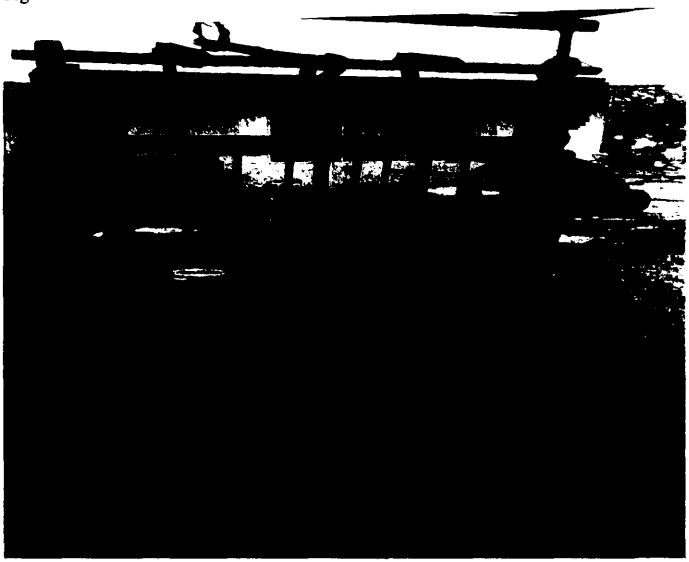
For the purpose of this study, the whole process of cement block manufacturing was categorized into 5 different sub-tasks or operations, which were christened as:
mortar preparation -semi-automated **(1),** mortar preparation-manual **(2),**
block compaction-automated **(3),** block compaction-manual **(4)** and
block packing-manual **(5).** 36 participants who were engaged in the above-named sub-tasks were videotaped while performing their duties and postural evaluation were carried out using REBA worksheet **(Table 4.3).**

Figure 3.1: Workers engaged in block packing- manual subtask

Figure 3.2: A worker operating a cement –mixer in a mortar preparation-semi-automated subtask

Figure 3.3: A worker performing block compaction –manual subtask

Figure 3.4: A manual block machine



3.4: Data collection Tools

3.4.1: Questionnaire

Questionnaires were used to solicit information from the participants. The questionnaire has 3 parts. The first part deals with participants' demographic data such as level of education, religious background, weight, height, etc. The second part deals musculoskeletal symptoms. The modified Nordic Musculoskeletal Symptom Questionnaire (NMSQ) (Kuorinka, Jonsson & Kilbom, 1987) was also adapted for this purpose. The NMSQ deals with musculoskeletal symptoms of the neck, upper back, lower back, shoulder, etc. in the last 7 days and in the last 12 months". The prevalence of WRMSDs was assessed within the last 7 days and 12 months with a purpose. It was to identify those who were recently afflicted with WRMSDs including the day of data collection (i.e. within the last 7 days) and those having experienced it for a long time (i.e. chronic WRMSDs, like within the last 12 months). Questions on severity of musculoskeletal symptoms were added which inquired participants to rate the severity of its experience on the neck, upper back, lower back, shoulders on a scale of mild severe to very severe **(Appendix 1).** The last part of the questionnaire deals with work-related psychosocial stress factors. Here, the modified version of the Job Content Questionnaire (JCQ) (Karasek and Theorell 1990) was adapted. The JCQ included questions on job demand (e.g. working excessively, working very fast, repetitive task, etc.), job control (part of decision making of one's job, having say on the job, etc.) and workplace social support (e.g. support from co-workers and support from supervisors).

3.4.2: Rapid Entire Body Assessment (REBA)

REBA is an ergonomic assessment tool used to evaluate work postures that may contribute to the risk of musculoskeletal disorders **(Figure 3.5).** It was developed by Hignett and McAtamney (2000). Relevant task for a job is selected and postures

associated with each task is evaluated and assigned an appropriate score. REBA groups the body regions into 2: group A assesses postures of the neck, trunk and the leg whereas group B evaluates postures of the wrist upper and lower arms. A posture scoring scale is assigned to each body region as well as an adjustment notes for consideration where necessary. Table A scores are scores for the Group A and Table B scores are scores for the Group B. Score A represents the sum of Table A score and load/force score whiles score B is the total score for Table B and coupling score. The load or force refers to weight of object in pounds (lbs) being handled and coupling refers the shape of the object being handled. Score A is on the row side in and score B on the column side in table C. Table C score is obtained by the intersection of score A and score B. REBA score is the sum of table C score and an activity score.

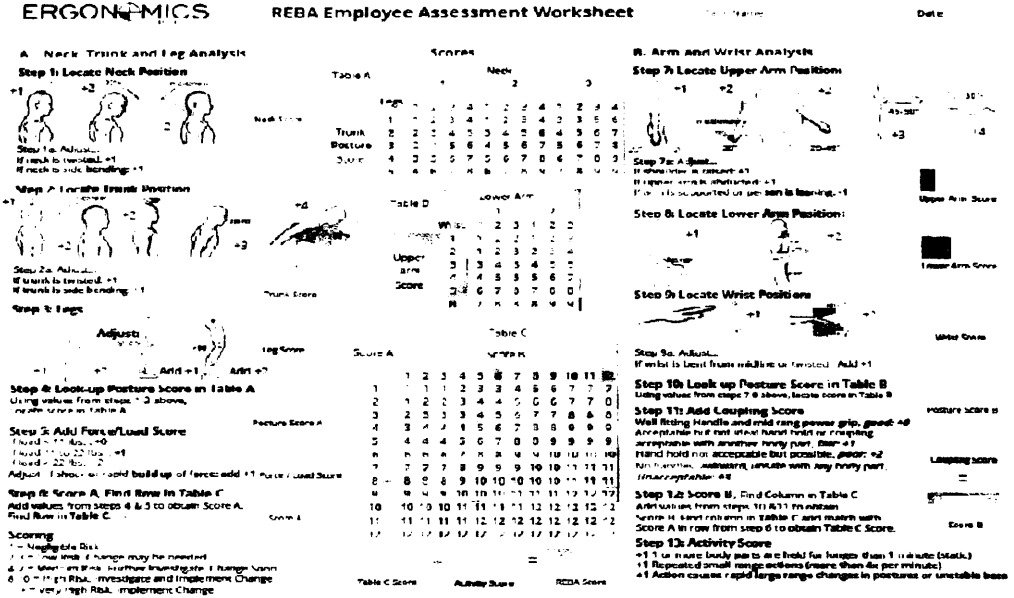


Figure 3.5: REBA assessment worksheet. Adopted from Hignett and McAtamney (2000)

REBA decision making processes

Table 3.1. REBA score and its interpretation

Score	Level of WMSD risk
1	Negligible risk, no action required
2-3	Low risk, change may be needed
4-7	Medium risk, further investigation, change soon
8-10	High risk, investigate and implement change
11+	Very high risk, implement change

Table 3.1 represent the decision score system of REBA. A score of 1, means negligible musculoskeletal risk, no action is needed for the task. Scores 2-3 up to ≥11 suggest low to high level of musculoskeletal risk.

3.5: Data collection Procedure

Walk through observation, interview with a structured questionnaire, videotaping and task analysis were employed.

3.5:1: Walk through observation

First a walk-through observation exercise was carried out to have an interaction with workers and also understand the work processes. Under this activity the postures that were commonly adopted and maintained by most participants for a long period in the cause of performing the tasks were noted. The following operations or subtasks mentioned earlier under sub-section 3.3 (i.e. Process and Task Description) of this dissertation were targeted for evaluation with REBA **(see Table 4.3):** mortar preparation=subtask A; block compaction=subtask B and block packing-manual=subtask C. Subtask A was further subdivided into subtask 1: mortar preparation using semi-automated processes and subtask 2: mortar preparation using manual

processes. Subtask B was also subdivided into subtask 3: block compaction using automated processes and subtask 4: block compaction using manual processes. **(see Table 4.3).**

3.5.2: Questionnaire Administration

Following the walk through observation, 103 male workers were conveniently selected and interviewed with the questionnaire. The interview took place either in the morning (between 6am to 7am) before work or in the afternoon/evening (5pm to 6pm) after work. Each interview lasted for about 10 to 15 minutes.

3.5.3: Videotaping

Thirty-six workers who were performing the above subtasks **(i.e. section 3.3)** were randomly selected for the posture evaluation with REBA. To start with, a video was mounted at a hidden location in each workplace of the participants. The video was positioned to capture the sagittal plane of the worker when he was executing a subtask. At each workplace the video was positioned there for an hour. It must be emphasized that the secrete filming had earlier been consented to by the 103 participants **(Appendix 2, Informed Consent form)** involved in the entire study except that they were not aware during its execution. The video was later transferred onto a computer and the postures of each subtask evaluated with REBA **(Please see Figure 3.6, Tables 3.1 and 4.3)**

.3.6: Study Variables

3.6.1: Independent variables

The independent variables were awkward postures such as neck extension, neck flexion beyond 20-degrees, trunk position beyond 45-degrees, arm abduction, etc. Work-related psychosocial factors defined a job demand (e.g. repetitive task, working fast, etc.), job control (e.g. making decisions on the job, making decisions on what concerns you, etc.)

and workplace social support (relationship with co-workers, relationship with supervisors) (Karasek et al. 1990).

3.6.2: Dependent variable

The dependent variables of interest were self-reported musculoskeletal symptoms in the low back, upper back, neck, wrist, shoulders, elbow, knee, ankle, thigh and leg in the last 7 days and in the last 12 months; as well as severity of musculoskeletal symptoms in low back, upper back, neck, wrist, shoulders, elbow, knee, ankle, thigh and leg.

3.7: Eligibility criteria

(I): Working in the concrete block manufacturing department.

(II): Having held the current job for a minimum of a year

(III) Willingness to partake and readiness to sign a consent form

(IV) Having attained a minimum chronological (biological) age of 18 years.

3.8: Exclusion Criteria

(I) Working in a department or unit other than the CBM unit

(II) Having held the current job for less than a year

(III) Refusal to partake in the study

(IV) Being less than 18 years of age

3.9: Data processing and Analysis

The data entry was done using Microsoft Excel® 2016 version after cross-checking and correcting all inconsistencies observed. The data were then imported into a statistical analysis software Stata®, version 14 for analysis. Means and standard deviations were

computed for continuous variables whiles proportions were computed for categorical variables.

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3.10: Quality Control

3.10.1: Training of Research assistants (RAs)

The RAs were taken through an intensive training by the PI prior to the commencement of the study. This was done a month earlier. They were exposed to the theory of research ethics and conducts of research personnel. Demonstrations, discussions, simulations were some of the teaching aids or tools employed in the training. The training was executed to equip the RAs to be more diligent and competent in discharging their duties.

3.10.2: Pre-testing of Data Collection instrument

A pilot study was conducted for 5 different CBM companies out of the 17 that were used fort the study. All challenges observed in any of the data collection tools, being the questionnaire, videotaping and others were noted and addressed.

3.11: Data Entry

Each member of the research team will independently enter the data onto a Microsoft excel spreadsheet and cross-check for any anomaly. After that an interrater auditing system proceeded where the team together will compare each ones' data entry and weed off any possible error.

3.12: Security of Data

The custody of the data was the preserve of the PI. The data obtained from the participants were treated with high level of confidentiality. The RAs had access to them

during data entry only, and it was under the strict supervision of the PI. The hardcopy data was secured under lock and key whiles a password was used to save the softcopy as a first security on a durable electronic storage device and there after kept under lock and key. The data will be destroyed permanently by fire and electronic deletion for both the hardcopies and softcopies respectively by the PI after the dissertation has been approved.

3.13: Ethical Issues

3.13.1: Ethical Clearance

Ethical approval was sought from the Ghana Health Service Ethics Review Committee and permission warranted by same. Approval was also gained from all the 17 CBM companies who sacrificed their premises for the study.

3.13.2: Informed Consent

The details of the study, including its potential risks was dully explained to each worker who was then a prospective participant in a language or a medium that he fully understands before he took part in the study. Every participant voluntarily agreed to partake in the study and also consented to be videotaped. They were made to sign a consent form before administering a questionnaire to them **(Appendix 2)**. Under no circumstance was any participant coerced or induced to partake in the study. There were witnesses for participants who had difficulty reading the questionnaires and subsequently signed the form on behalf of the latter after having explained the details to him and the same agreed to partake in the study. Each participant had the absolute right to withdraw from the study at any point in time that he so wishes and this was politely made clear to them.

CHAPTER FOUR

RESULTS

4.1: Demographic Characteristics of Participants

Table 4.1: Demographic Characteristics of CBM workers

	Participants (N=103)`	Percentage (%)
Educational Level		
Primary/None	48	46.60
JHS/SHS	55	53.40
Religion		
Christian/Muslim	69	66.99
Traditional/None	34	33.01
Marital Status		
Married/Cohabitation	68	66.02
Single/Divorced	35	33.98
Age (In Years)		
20-29	35	33.98
30-39	47	45.63
40-49	21	20.39
Duration of Working (In Years)		
1-10	59	57.28
11-20	33	32.04
21-30	11	10.68

	Mean	SD	Range
Height(cm)	166.95	9.64	152-190
Weight(kg)	67.5	8.51	53-89

The demographic characteristics of the participants are shown in **Table 4.1** above. The majority of the participants have attained either JHS/SHS (54%). 68 (66%) of the participants were either married or divorced. A significant number, 69 (66%) were either Christians or Moslems. Majority of them, 59 (57%) have worked in the cement block manufacturing companies between 1 to 10 years. More than a quarter, 47(45.63%), were between the age bracket of 30 to 39 years. The mean height and standard deviation were

respectively 166.95cm and 9.64, and that of the weight was 67.5kg and 8.51 respectively.

4.2: Self-reported prevalence of musculoskeletal symptoms and its level of severity

The results of the participants' own experiences with musculoskeletal symptoms and their perception of the most painful or severe form of musculoskeletal symptoms are presented in **Table 4.2 below.** It clearly indicates that the workers are severely and significantly afflicted with WRMSD at different body regions. All the 103 participants admitted to having experienced the various types of WRMSDs within the last 7 days and 12 months. Most of the participants complained of having had low back pain both within the last 7 days and 12 months. 91 (88.34%) and 102 (99.03%) of the participants reported of having experienced low back pain respectively within the last 7 days and 12 months. WRMSDs was chronic among almost all the participants (99.03%). Within the last 7 days, the following prevalence were also high besides low back pain; shoulder 89 (86.40%), the knee and leg each had 87 (85.44%,) the least reported form or symptom of WRMSDs was the thigh with 19.42%.

The 103 participants (100%) attributed the musculoskeletal symptoms or WRMSDs to the nature of the job other than any extra activities they engage in.

The participants were asked about their perception on the severity of the different symptoms of WRMSDS experienced within the last twelve (12) months. All but one participant (99%) considered low back pain as the most severe form of WRMSDs. The number and percentages of the participants who rated other musculoskeletal symptoms as being more severe after low back pain are indicated below: i) Upper back pain 88 (85.44%,), shoulder 86 (83.5%), pains at the knee and neck were viewed by 79 (76.70%) workers as having the same severity of pain. The mildest pain according to the workers

was pain at the thigh, 92(89.32%) and 3(2.91%) considered it as mild and severe respectively. **(Table 4.2 below)**

Table 4.2: Self-reported prevalence and severity of musculoskeletal symptoms

???? N=103	Prevalence within the last 7 days	Prevalence within the last 12 months	Severity of WRMSDs		
			Mildly severe	Moderately severe	Very severe
???? Body regions	N (%)	N (%)	N (%)	N (%)	N (%)
???? Wrist	44 (42.72)	65 (63.11)	35 (33.98)	46 (44.66)	22 (21.36)
Low back	91 (88.34)	102 (99.03)	0 (0.00)	1(0.97)	102 (99.03)
Neck	82 (79.62)	79 (76.70)	9 (8.74)	14 (13.59)	80 (77.67)
Leg	88 (85.44)	94 (91.30)	11(10.68)	13 (12.62)	79 (76.70)
Shoulder	89 (86.40)	94 (91.30)	0 (0.00)	17 (16.50)	86 (83.50)
Elbow	81 (78.64)	79 (76.70)	3 (2.91)	25 (24.27)	75 (72.82)
Knee	88 (85.44)	92 (89.32)	6 (5.83)	18 (17.48)	79 (76.70)
Ankle	42 (40.80)	49 (47.57)	36 (34.95	42 (40.78)	25 (24.27)
Thigh	20 (19.42)	42 (40.80)	92 (89.32)	8 (7.77)	3 (2.91)
Upper back	85 (82.52)	91 (88.34)	5 (4.85)	10 (9.71)	88 (85.44)

4.3: Evaluation of subtasks with REBA

Postural evaluation (evaluation of posture) were conducted using REBA worksheet to identify the sub-task(s) with high risk of WRMSDs. The REBA assessment results are shown in Table 4.3 below.

I) **Subtask 1: Mortar preparation-semi-automated;**

Three (3) people performed this subtask at the time of the video shooting. The REBA posture scores for these participants are shown in **Table 4.3 below**. The total REBA score for this task was 10, which falls in the 'high risk' category of WRMSDs risks level according to REBA interpretation.

Table 4.3: REBA score for postures adopted for 3 subtasks

REBA Posture score	(N=36) Subtasks				
	Subtask A: Preparing mortar (n=12)		Subtask B: Block compaction (n=12)		Subtask C: Block compaction (n=12)
	Subtask 1: Semi-automated (n=3)	Subtask 2: Manual (n=9)	Subtask 3: Automated (n=2)	Subtask 4: Manual (n=10)	Subtask 5: Manual (n=12)
Neck score	2	3	1	2	3
Trunk score	4	4	2	4	5
Leg score	2	4	2	3	4
Table A score	4	9	3	7	9
Load/kg	3	3	0	2	2
Force exertion	0	0	0	1	1
Score A	7	12	3	10	12
Upper arm score	3	4	3	4	6
Lower arm score	1	2	1	1	2
Wrist score	2	2	1	3	3
Table B score	4	6	3	5	9
Coupling score	2	2	0	2	3
Score B	6	8	3	7	12
Table C score	9	12	3	11	12
Activity score	1	3	0	3	3
REBA score	10				

The score assigned to each posture represents the angle of inclination of the posture adopted by the workers. For example, the neck score for these workers was 2, this implies that they extended their neck beyond 20^0, the trunk score was 4 meaning the trunk was twisted more than 60^0 angle of inclination. The same applies to the neck score. The load score was 3, this was due to the weight of the load they were holding or carrying (i.e. weight of the shovel with mortar) while performing the task. The shovel together with the mortar weighs around 30 pounds and that 30 pounds correspond to a score of 2, but since there was a rapid build- up of force an additional 1 score was added and made the score 3, according to REBA. The same is seen for that of the upper arm, lower arm and the wrist. The upper arm score was 3 meaning it was raised or elevated between 45^0 to 90^0 angle of inclination. The wrist score was 2 implying the wrist was bent downwards as shown in the Reba figure. The coupling score represents the easiness with which an object is held. The coupling score of 2 indicates the shovels handles were not good enough to handle, they have to exert themselves before being able to hold an object. An activity score of 1 indicates some one part of the body was held together for more than a minute.

2) Subtask 2: Mortar preparation-manual

Nine (9) people were engaged in this task and their results displayed in Table 4.3 above. Their overall REBA score was 15, and it indicate a high risk of WRMSDs. The workers extended their neck, trunk, leg and their upper arm at a higher angle of inclination and thus had high posture scores for the aforementioned body regions. The scores were 3, 4,4 and 4 respectively. The activity score for the workers in this subtask was 3, and it means the following; that they held one or more of their body parts more than a minute, there was repetitiveness of the task and the action led to rapid postural changes. In view of the fact that all of the workers had a higher REBA score for undertaking this task, the

task is rated as strenuous task with high risk in WRMSDs according to REBA interpretation. The leg score of 3 indicates the leg bent and adjusted between 30 to 60 degree angle of inclination.

3) Subtask 3: Block compaction- automated

Two (2) people were engaged in this subtask during the video recording. Their total REBA score was 3 meaning low risk to WRMSDs. Their neck, trunk, leg, wrist upper and lower arms scores were 1, 2,2, 3 and 1, respectively. The low scores are indication of neutral (good) postures adopted and a lower risk of WRMSDS. The coupling score was zero meaning the switch handle was handy enough, it is held with ease, without applying too much force. Total REBA score (score 3) attained under this subtask according to REBA considers this subtask as a less strenuous or hazardous task having a lower risk to WRMSDs.

4) Subtask 4: Block compaction- manual

Ten (10) participants were involved during filming and their REBA score for the postures mainly adopted by the participants was 14, an indication of very high risk of WRMSDS. They had high scores for most of the postures. For example, the scores for the leg, trunk wrist and upper arm were high (3, 4, 3 and 4 respectively). The interpretation of their scores is same as has been explained above. The postures adopted under this subtask looks more awkward than those adopted for same task but automated. Block compaction manual subtask is thus considered as another strenuous or hazardous task per REBA interpretation.

5) Subtask 5: Block packing-manual.

Twelve (12) people performing this subtask were captured during the video recording exercise. The total REBA score was 15, an indication of very high risk of WRMSDS. It is very noteworthy that, under this particular subtask all the postures adopted recorded higher scores unlike the other subtasks. The scores were 3,5,4,6,2, and 3 respectively for the neck, trunk, leg, upper arm lower arm and the wrist. Moreover, it is evident from the Table 4.3 that the block packing-manual subtask is the task that workers had the highest posture score for the trunk (score of 5). Following this evaluation, the block packing manual is rated as the most strenuous or hazardous task above the rest by REBA interpretation.

4.4: Evaluation of strenuous task by Participants

The participants' perception of the most strenuous task(s) provided in the questionnaires were assessed and the following were their views. 97 (94%) of the participants rated the subtask 'Block packing manual' as the most hazardous or strenuous task. This was followed by 'mortar preparation- manual' subtask (76%), 'block compaction-manual' (69%) and 'mortar preparation-semi-automated' (59%). They considered the subtask 'block compaction-automated' as the task with minimum risk to WRMSDs. When they were asked to identify the most problematic posture, 97 (94.17%) considered trunk extension as the most problematic posture presenting them with frequent WRMSDS. 88(85.43%) also viewed the upper arm posture as been problematic besides the trunk extension. Prolonged standing was viewed by 86 (83.49%) as being a problematic posture.

4.5: Work-Related Psychosocial factors

Table 4.4: Work-related psychosocial stress factors

Psycho-Social Stress Factors N=103	YES N (%)	NO N (%)
JOB DEMANDS		
My job requires that I learn new things	17 (16.50)	86 (83.50)
My job involves a lot of repetitive work	103 (100%)	-
My job requires working very fast	101 (98.06)	2 (1.94)
My job requires working very hard	102 (99.03)	1(0.97)
My job requires lots of physical effort	102 (99.03)	1(0.97
I am asked to do an excessive amount of work	92 (89.32)	11(10.68)
JOB CONTROL		
My job allows me to make lots of decision on my own	16 (15.50)	87 (84.50)
I am allowed to decide how to do my work	15 (14.56)	88 (85.44)
I have a lot to say about what happens on my job	16 (15.53)	87 (84.47)
SOCIAL SUPPORT		
If work gets difficult, my colleagues will help me	100 (97.10)	3 (2.90)
My supervisor pays attention to what I am saying	13 (12.62)	80 (77.68)
I feel anxious at work	75 (72.81)	28 (27.19)
My manager is interested in my welfare	15 (14.56)	88 (85.44)
I receive help from my managers whenever am am a trouble.	2 (1.94)	101 (98.06)

The participants were asked about how psychosocial risk factors prevail in the workplace and their response are presented in Table 4.4 above. All the 103 participants agreed that their job is characterized with 'high job demand, low 'job control' and poor 'job support'. For instance, more than 92(89%) of the workers agreed that their job requires them to work at a high pace or very fast, very hard and also to do an excessive amount of work. Moreover, over 87 (84.50%) also had no or little job control. They claimed they are not involved in any decision making regarding their job. Moreover, 80 (77.68) and 101(98.06) of the workers reported respectively of not having manager's or supervisor's support or attention. 88(85.44%) were of the view that their managers were not interested in their welfare whiles 101(98.06) lamented that their mangers do not helped them when the need arises.

CHAPTER FIVE

DISCUSSION

5.1: Main Findings

Work-related musculoskeletal disorders or symptoms (WRMSDs) were found to be higher in prevalence among all the participants. All the 103(100%) participants have experienced at least two symptoms of the WRMSDs within both the last 7 days and last 12 months. Almost all the participants were suffering from chronic WRMSDs. Low back pain was found to be the most prevailing and the most severe form of WRMSDs among the workers. Other symptoms of WRMSDs with high prevalence besides low back pain were the leg, upper back, neck, knee and the shoulder. About a quarter of the workers reported of having been regularly absent from work due to recurring WRMSDs. Block packing- manual sub-task was identified to be the most strenuous and hazardous task among other subtasks. The design of the job makes the workers adopt very high risk or awkward postures such as trunk twisting, repetitive upper arm raising and prolonged standing. The workers themselves attributed the musculoskeletal symptoms to these awkward postures in addition to excessive workload as being the sources of the WRMSDs that they have been battling with at the workplace. Moreover, almost all the workers complained of having both unsafe and unhealthy psychosocial working environment. The psychosocial risk factors they complained included high job demands such as working very fast, hard, and excessively that involves exerting physical effort; no or low job control such as not involving the workers in decision making; and poor support from managers such as not having the opportunity for carrier development and also not gaining the attention of managers. Lastly both the mangers and the workers were not giving priority to occupational health and safety.

5.2: Methodological Validity

The current study is characterized with significant merits. It is a novelty or first of its kind in the Ghanaian territory among the study population. It had high response rate (94%).

The participants were recruited from 17 different CBM companies within the study area, this enhances representativeness of the sample therefore boosting the external validity of the study. Combinations of universally approved techniques were employed in soliciting data. The universally accepted and frequently used questionnaires; the standard Nordic WRMSDSs Questionnaire (Kuorinka, 1987,), REBA posture assessment tool (Hignett et al. 2000) and karasek's Job Content Questionnaire (Karasek, 1990) were used in data collection. A high standard hidden –video camera was used for the video recording. Among other quality features, the camera has high optical zoom lens and has the ability to record videos in high definition resolution.

Measures were put in place to reduce possible biases to the barest minimum. The videotaping technique allowed no room for interruption, or faking behaviour and also enhance accuracy in posture scoring. The views or self-reported claims on issues such as the most strenuous task and the most problematic postures agreed closely or were very consistent with the postural analyses using the REBA worksheet. This increase the confidence in the study. The study was approved by the various managers of all the 17 CBM companies. RAs were well trained and motivated to assist in the study. Couples of pilot studies were undertaken, and addressed challenges that emanated prior to the

main study. The findings of the current studies significantly mirror that of previous studies.

The study was however, not without challenges. Given that almost half of the participants have attained no formal education or have attained only primary education, it might be challenging for some of them to fully understand all the expressions on the questionnaire. This problem was however mitigated to a significant level by adding sketches or photographs of the human body parts to the questionnaire, reading and translating the questionnaire in language they fully understand. The videotaping captured other workers who had not consented to take part in the study and this may be an infringement to their right. It is stated categorically that these ones were never used in anyway in the study. The posture evaluations were done for only consented participants who were correctly identified in the video. This limitation of the video recording also exonerates the videotaping from any shooting biases or manipulation in the process.

5.3: Comparison with Previous Studies

The study compares favourably with existing studies. Prevalence of WRMSDs within the last 7 days and 12 months of the study had low back pain as the leading WRMSDs among the workers (88.34% and 99.03% respectively). Other body regions that recorded high prevalence or more bodily pains were the shoulder (86%), the leg (85%), the knee (85%), upper back (82%) and the elbow (78%). Das (2014) in his study among brick field workers in India had similar prevalence; low back (98%), knee (86%) and shoulder (76%). On the contrary, Das (2014) had a very high prevalence for the wrist pain (85%) ,more than twice that of the current study (42%).The current study was

consistent with findings by Ndivhudzannyi (2003) who also reported of low back pain as the most prevailing WRMSDs among the brick workers (36%). The findings again harmonize with a study by Trevelyan and Haslam (2001) who also recorded on the elbow, shoulder, upper and low back pains as the dominating WRMSDs among the participants. The prevalence of the current study corroborates that of Sealetsa et al. (2014) who in their study established that low back (36%), upper back (36%) and shoulder pain (34%) were the worst WRMSDs among the participants in their study. The low percentages in prevalence for the work of Sealetsa et al (2014) compared to the current study is because the former used small sample size (19 participants) compared to the latter. The findings of the current study reflected that of Inbaraj et al (2013), the participants in their study complained mostly of low back and knee pains. However, on the contrary, the same study by Inbaraj et al. (2013) had high prevalence for wrist pain unlike the current study. The study identified significant work-related psycho-social factors contributing to the incidence of WRMSDs among the workers. These factors included high job demands, low job control and low or no social support. The workers considered their job as being very stressful. These findings were consistent with other studies (Ndivhudzannyi, 2003;, Macfarlane et al. 2000; Nahit, Pritchard, Cherry, Silman & Macfarlane, 2001). Bongers et al. (1993) in their study concluded that high job demands like having an excessive workload coupled with lack of job control and social support are closely linked with WRMSDs. Awkward postures such as prolong standing, trunk bending or twisting, repetitively raising the upper arm, knee bending and much more contributes significantly to the workers' plight with WRMSDs according to the current study. Studies by Quansah (2005) and Travelyan et al (2000) had similar conclusion. A study by Zia-ur, Ambreen, Khan and Khan (2012) among brick moulders in Pakistan recognized that awkward postures such as trunk bending and twisting, leg bending and prolong standing promotes WRMSDs such as low back and leg pains. It

was discovered under the current study that both the workers and the managers do not prioritise on occupational health and safety and this corroborated the conclusion made by Moalosi et al (2013).

5.4: Summary of Discussion:

High prevalence of WRMSDs were found on the low back, the leg, upper back the neck and the knee. It came to light that the most problematic or awkward postures were adopted around the trunk, the leg and upper arm. The physiological or theoretical explanation of the association of awkward posture and WRMSDs are explained in detail in **chapter 3, subtitled; Awkward postures**. In brief when the trunk is extended beyond 45^0 angle of inclination and maintained for a long time, the build of load or pressure affects the low back, the neck the shoulders, and since the trunk is suspended the load or pressure trickles down to the knee and the leg and thus the surge in musculoskeletal symptoms or pains around those body regions. (Karasek et al, 1990). It was also found that subtask that were full manual operation had higher risk of WRMSDs, than those that were either semi-automated or full automation. This is due to the fact that there is excessive physical exertion in manual operation compelling the workers to adopt awkward postures with subsequent risk of WRMSD (Bakker et al.2007; Warren et al. 2008; keir et al.2007).

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1: Conclusion

The findings are reflection of the results of other published studies that investigated in same occupational health issue. WRMSDS have a significant disease burden against the workers. Ergonomic risk factors such as awkward postures and work-related psychosocial stress factors were observed to play a significant role in the symptoms of WRMSDS that the participants complained about. The study revealed that the occupational environments of the workers in the CBM companies were very unsafe and unhealthy. In view of this, it will be prudent to establish robust policy that will foster in stringent measures to ameliorate the situation with a sense of urgency.

6.2: Recommendations

The following recommendation are made with the hope that it will be implemented by the respective stakeholders.

A: To the managers:

1: Need to implement an effective job re-design. Most of the strenuous tasks like block packing-manual can be automated or mechanised. This will relieve the workers of unnecessary pressure and mitigate the risk of WRMSDS.

2: They should give priority to employees' health and safety. Hiring of occupational health and safety expert is crucial in improving the working environment in order to curtail the astronomical prevalence in WRMSDs at the workplace.

3: There should be frequent short rest or breaks for the workers to minimise exposure to excessive physical stress.

4: Management must employ job rotation system

5: Implementation of rigorous health and safety training programme. The training must include appropriate lifting techniques, correct use of Personal Protective Equipment (P.P.E) and correct posture adoption.

6: Management must provide enough and appropriate Personal Protective Equipment (P.P.E) for every worker and at no cost to the latter.

7: A clinical Psychologist may be consulted to help manage the negative effect of the prevailing work –related psychosocial factors.

8: They should involve the workers in decision making and make the working environment safer and healthier enough.

B) The workers

The workers themselves must give priority to their own health and safety. This include complying with every safety protocol at the workplace if available. They should resort to all civil approaches possible to ensure management provides a safe and healthy working environment.

C: Ministry of Employment/ Government of Ghana

The government of Ghana through the ministry of employment must improve and enforce the existing health and safety laws in the country.

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APPENDIX 1

QUESTIONNAIRE

I am a post- graduate student of the University of Ghana, pursuing Master of Science degree (MSC) in Occupational Hygiene and conducting this research. The topic for the research is: **"Ergonomic Risk Factors and Musculoskeletal Disorders among Workers in the Cement Block Manufacturing Companies in Tema".**

The research is in partial fulfilment for the award of the degree. I humbly appeal to you to fill the questionnaire and would be grateful if you would do so. Remember you are not to disclose your identity and any information you provide on this questionnaire would be treated with confidentiality. Please feel free and be honest as possible in answering the questionnaire. Please answer the questions as they apply to you. **Please complete an inform consent form attached before answering the questionnaire.**

Thank you.

SECTION A

DEMOGRAPHIC DATA

Please tick or check the appropriate answer:

1) Sex: Male [ ] Female [ ] Height [ ] Weight [ ]

2) Educational level: Primary [ ], JHS [ ], SHS [ ] Tertiary [ ] None [ ]

Others (specify).....

3) Religion: Christian [ ] Moslem [ ] Traditionalist [ ] None [ ]

Others (specify).....

4) Age (years): .....

5) Marital status: Married [ ] Single [ ] Divorced [ ] Separated [ ]

Cohabitation [ ]

6) Occupation (please specify) .....

SECTION B
JOB PROFILE

Please tick the following as they apply to you:

7) Do you work at the concrete block manufacturing section of the company?

Yes 1 [ ] No 2 [ ]

8) If yes, which of the following tasks do you perform? (You may tick **more than one** where necessary).

Mix concrete mortar **(MXCM)** [ ] Operate machine **(OP)** [ ]

carry/pack/load blocks **(CPLB)** [ ]

Others (specify).....

9) How many years have you been working in a concrete block manufacturing company? (include years from former block company).

.....

10) Do you experience bodily pains such as low back pains, neck pains, pains at the elbow or shoulder etc. after performing your duty or **later in the day?**

(DBP): YES **(1)** [ ] NO **(2)** [ ] Not Really **(3)** [ ]

11) If yes do you attribute such pains to the nature of your job? Yes 1 [ ] No 2 [ ]

12) If yes, indicate the appropriate reason (you may tick **more than one** reason):

Difficult job [ ] Long working hours [ ] Short resting period [ ]

No resting period [ ] Others (specify).....

13) Which of the tasks above **(Q2)** makes you feel pains most?.....

14) Which part of your body do you **normally feel the pains?** Wrist **1** [ ] low back **2** [ ]

Neck **3** [ ] Leg **4** [ ] Shoulder **5** [ ] Elbow **6** [ ] knee **7** [ ], ankle **8** [ ]

Thigh **9** [ ] Upper back **10** [ ] Others **11** (specify).....

15) Which of the following posture do you assume **when doing your work?**

Long standing **1** [ ] Long sitting **2** [ ] Waist Bending **3** [ ]

Wrist/hand/arm Stretching/twisting **4** [ ] Neck stretching or twisting **5** [ ]

knee bending **6** [ ] Leg bending/twisting **7** [ ] Raised shoulder **8** [ ]

16) Fill the spaces with the numbers (1- 8) below to indicate the severity of pains associated with the postures, **where 1 means more severe and 8 means less severe.**

Long standing **1** [ ] Long sitting **2** [ ] Waist bending **3** [ ]

Hand/arm Stretching **4** [ ] Neck stretching or twisting **5** [ ] knee bending **6** [ ]

Leg bending/twisting **7** [ ] Raised shoulder **8** [ ]

17)How many hours do you work in a day: .....?

18)How many days do you work in a week?.....

19)Are you allowed to go for a break? Yes [ ] No [ ]

20)How many times do you go for a break in a day?.....

21)How many hours do you work before you break for rest or dinner?... .....

22)How many minutes do you stay in break before you start work again?.....

SECTION C
HEALTH AND SAFETY PROFILE

23)Are you **aware of health and safety practices** at the work place?

HSEA Yes **1** [ ] No **2** [ ]

24)Do you receive **periodic training** on health and safety practice

HSET Yes **1** [ ] No **2** [ ]

25) Are you aware that your work exposes you to **health risk:**

HRA Yes **1** [ ] No **2** [ ]

26) If yes, what are some of the health and safety risks ?

.....

.....

27) Do you know of any hazard associated with your job:

HA Yes **1** [ ] No **2** [ ]

28) If yes, what are these hazards?.....

.....

....

.....

.....

29) Are you provided with **safety gadgets**? Yes 1[ ] No **2** [ ] Not really 3 [ ]

30) Do you always use **the safety gadgets** when working?

Yes 1[ ] No **2** [ ] Not Always 3 [ ]

SECTION D

LOCATION OF PAINS

(31) Which of the following pains have you experienced within the last 7 Days?

Please you may **tick more than one** as they apply to you **(you may use the picture provided)**

WRIST PAINS	1	
LOW BACK	2	
NECK PAINS	3	
LEG PAINS	4	
SHOULDER PAINS	5	
ELBOW PAINS	6	
KNEE PAINS	7	
ANKLE PAINS	8	
THIGH PAINS	9	
UPPER BACK	10	
OTHER	11	

32)What is the cause of the pain:

PCS JOB 1 [ ] **NOT JOB 2 [ ]** Do not know 3 [ ]

33) If job/Not job, Why: .....

.....

(34) Which of the following symptoms have you experienced within the last **12 months**

Tick more than one when it applies

WRIST PAINS	1	
LOW BACK	2	
NECK PAINS	3	
LEG PAINS	4	
SHOULDER PAINS	5	
ELBOW PAINS	6	
KNEE PAINS	7	
ANKLE PAINS	8	
THIGH PAINS	9	
UPPER BACK	10	
OTHER	11	

35) What is the cause of the pain?

JOB 1 [ ] NOT JOB 2 [ ] DO NOT KNOW [ ]

36) If job/ not job, why?.....

.....

37)Please indicate with numbers the severity of the symptoms experienced

Choose from 1-3, 1 = mild , 2= moderate and 3= severe

WRIST PAINS	1	
LOW BACK	2	
NECK PAINS	3	
LEG PAINS	4	
SHOULDER PAINS	5	
ELBOW PAINS	6	
KNEE PAINS	7	
ANKLE PAINS	8	
THIGH PAINS	9	
UPPER BACK	10	
OTHER	11	

38)Please indicate which of the tasks below gives you **more bodily pains**:
Indicate with numbers 1-5 where 1 means task that is more painful and 5 less painful

Mortar making-semi-automated (A)	
Mortar making-manual (B)	
Block compaction-automated (C)	
Block compaction-manual (D)	
Block packing-manual (E)	

SECTION E

Work –related Psychosocial factors

39)Please tick where appropriate/applicable to you.

		Strongly disagree (1)	Disagree (2)	Agree (3)	Strong Agree (4)
I	My job requires that I learn new things				
II	My job involves a lot of repetitive work				
III	My job requires me to be creative				
IV	My job allows me make a lot of decision on my own				
V	My job requires a high level of skill				
VI	I am allowed to decide how to do my work				
VII	I get to do a variety of things on my job				
VIII	I have a lot to say about what happens on my job				
IX	I have an opportunity to develop my special ability				
X	My job requires working very fast				
XI	My job requires working very hard				
XII	My job requires lots of physical effort				
XIII	I am asked to do an excessive amount of work				
XIV	I have enough time to get the job done				
XV	I am free from conflicting demands others make				
XVI	If work gets difficult, my colleagues will help me				
XVII	People I work with are getting the job done				
XVIII	My supervisor pays attention to what I am saying				
XIX	I feel anxious at work				

40) STRESSFULL **1** [ ] NOT STRESSFUL **2** [ ]

SECTION F

WORKERS' REACTION TO WRMSDs

41)What do you do when you experience bodily pains due to the nature of the work? RXNMSD

I) Visit the hospital/clinic1 [ ] II) Visit the drug store/pharmacy 2 [ ]

III) Use herbal medicine 3 [ ] IV) Self Medication 4 [ ]

V) Just do nothing about it and the pain goes away with time 5 [ ]

Others, specify 6.....

APPENDIX 2

INFORMED CONSENT FORM FOR CBM WORKERS

Department of Biological, Environmental and Occupational Health, School of Public Health

University of Ghana.

Dear Prospective Participant, my name is Francis Otoo and a graduate student at the above mentioned university. I am undertaking a research project which is part of my academic requirements. The topic for the research is "**Ergonomic Risk Factors and Work-Related Musculoskeletal Disorders Among Workers in Cement Block Manufacturing Companies In Tema".** I will appreciate it if you could voluntarily answer a questionnaire. Please remember to be honest in answering the questions.

Confidentiality:

Your answers will be treated with the highest level of confidentiality; you are not even supposed to provide your name on the questionnaire to ensure anonymity. Under no circumstance will the information you provide be exposed to a third party, the information you provide will be strictly kept in confidence and destroyed permanently as soon as the study is over.

Right to partake or withdraw

You have the right to take part or otherwise in the study.

You have the right also to ask for any clarification on any of the questions and also have the right to decline to answer the questionnaire. In case you agree to answer the

questions, you still have the right to withdraw from the exercise at any time you so choose.

Risk and Benefits

I can guarantee that you have at stake no threat or risk for engaging in the study. For the purpose of the study your weight and height will be measured, these pose no risk to your health and safety. No body fluids such as blood or urine will be taken from any participant The information you provide can never be used against you in any endeavour. Your job and any entitlements to you are secured whether you participate in the study or otherwise. However, there are benefits directly or indirectly in the long term, of which you could be one of the beneficiaries. There could be national policy based on the findings to improve the health and safety of workers like you. Your management may even use the results to re-design your work for your safety.

Contact Information

You may contact me the PI on 0243 374767.

You can also contact the Ghana Health Service Ethics Review Committee Administrator on:

0243235225/0507041223

(Hannah Frimpong)

Participant/ Volunteer Agreement

I, the undersigned dully admit that the PI has informed me about the details of the study, including its potential risk, my right to willingly take or not to take part in the study, my right to withdraw from the study at any time I wish so, with no consequences against me. I have also read the questionnaire or

the questionnaire has been read to me and fully understand the contents. Moreover, I understand the study involves videotaping. Based on my own analysis of the study, I do not envisage any risk in the study against me, neither has the PI also coerced me to partake in the study, but it is by my own will that I am volunteering to partake in the study as well as the prospective secrete videotaping exercise.

....

Name of Participant Signature/Thumbprint of Participants

Investigator's Statement and Signature

I certify that the participant fully understood every item on the questionnaire before answering them and that his participation in the study was not under duress but voluntary.

APPENDIX 3

TIMELINESS

	Execution Period				
ACTIVITIES	December, 2016	January 2017	April 2017	June 2017	July 2017
Submission of proposal for ethical approval	√				
Updating Literature Review		√			
Data collection			√		
Data processing and Analysis				√	
Report writing				√	
Submission of Draft Dissertation					√
Dissertation Defence					√
Submission of Final Dissertation					√

APPENDIX 4

BUDGET

DESCRIPTION	COST (GHC)
TRAVEL AND TRANSPORT	700
HONOURARIUM FOR EACH RESEARCH ASSISTANTS	1000
HONOURARIUM FOR EACH RESEARCH PARTICIPANTS	10 (AIRTIME)
DATA COLLECTION	900
DATA ANALYSIS	2500
MEASURING DEVICES	2000
PRODUCTION OF FINAL THESIS	1200
VIDEO CAMERA	2500
REFRESHMENT FOR RESEARCH PARTICIPANTS	2000
MISCELLANEOUS	1000
TOTAL	13810

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

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Email: ghserc@gmail.com

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

MyRef. GHS/RDD/ERC/Admin/App/576
Your Ref. No.

Otoo Francis
University of Ghana
School of Public Health
Legon, Accra

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	GHS-ERC: 54/02/17
Project Title	Ergonomic Risk Factors and Work-Related Musculoskeletal Disorders among Concrete Block Manufacturing Workers in the Construction Industry
Approval Date	8th June, 2017
Expiry Date	7th June, 2018
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra