WORK RELATED MUSCULOSKELETAL DISORDERS AND ITS ASSOCIATION WITH QUALITY OF LIFE AMONG QUARRY WORKERS IN EBONYI STATE, NIGERIA

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by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

<	Less than
>	More than
%	Percentage
#	Naira
H_A	Alternate hypothesis
E	Precision
Z	Standard normal distribution
N	Sample Size
P	Proportion

LIST OF ABBREVIATIONS

BMI	Body Mass Index
CCOSH	Canadian Centre for Occupational Safety and Health
CI	Confidence Interval
HSE	Health and Safety Executive
HBM	Health Belief Model
ILO	International Labour Organization
MLgR	Multiple Logistic Regression
NIOSH	National Institute of Occupational Safety and Health
OR	Odd Ratio
PPE	Personal Protective Equipment
QOL	Quality of life
ROC	Receiver Operating Characteristics
RULA	Rapid Upper Limb Assessment
SNOMQ	Standard Nordic Musculoskeletal Questionnaire
SD	Standard deviation
WAI	Working Ability Index
WRMSDs	Work related musculoskeletal disorders
WHOQOL	World Health Organization Quality of Life Questionnaires
WHO	World Health Organization
USM	Universiti Sains Malaysia

GANGGUAN MUSKULOSKELETAL BERKAITAN DENGAN PEKERJAAN DAN PERKAITANNYA DENGAN KUALITI KEHIDUPAN DALAM KALANGAN PEKERJA KUARI DI NEGERI EBONYI, NIGERIA

ABSTRAK

Industri kuari merupakan sumber pendapatan utama kepada lebih 20 juta pekerja dan tanggungan mereka di negara membangun. Di Nigeria misalnya, kerja kuari menyumbang kepada 9% pertumbuhan ekonomi dan 42% hasil domestik kasar. Gangguan muskuloskeletal berkaitan dengan pekerjaan (WRMSDs) telah dikenalpasti sebagai ancaman besar terhadap keselamatan pekerja kuari tetapi hanya sedikit yang dilaporkan mengenainya. Kajian ini bertujuan untuk menilai prevalens, kualiti hidup, perubahan postur ergonomik dan faktor-faktor yang berkaitan dengan WRMSD dalam kalangan pekerja kuari di negeri Ebonyi, Nigeria. Data telah dikumpulkan melalui tinjauan keratan rentas dengan menggunakan soal selidik kendiri yang merangkumi soalan daripada *Nordic Musculoskeletal Questionnaire*, *World Health Organisation Quality of Life BREF* (WHOQOL-BREF) dan *Rapid Upper Limb Assessment* (RULA). Peserta kajian dipilih melalui pensampelan rawak sistematik di antara mereka yang memenuhi kriteria kajian. Dua ratus enam puluh enam pekerja kuari (266) telah mengambil bahagian dalam kajian ini dengan kadar tindak balas sebanyak 100%. Data dianalisis menggunakan SPSS versi 26. Statistik deskriptif digunakan untuk menentukan prevalens WRMSD, jenis WRMSD dan kualiti hidup dan dibentangkan dalam frekuensi dan peratusan. Regresi logistik sederhana digunakan pada faktor-faktor yang berkaitan dengan WRMSD dan kualiti hidup dan akhirnya, keputusan yang signifikan pada nilai p <0,25 dimodelkan menggunakan analisis regresi logistik

berganda. Hasil kajian menunjukkan bahawa majoriti responden (89.8%) mengalami WRMSD dengan jenis yang paling lazim adalah sakit belakang bawah (83.1%) dan sakit siku (45.9%). Sebanyak 74.1% melaporkan ketidakpuasan terhadap kualiti hidup secara keseluruhan. Berdasarkan pemodelan regresi logistik berganda, BMI, umur dan waktu rehat dikaitkan dengan WRMSD (Adjusted OR 0.174, 95% CI 0.055.0.546, p = 0.003); (Adjusted OR 1.143, 95% CI 1.066, 1.226, p <0.001); (Diselaraskan OR 0,945, 95% CI 0,908,0,984, p = 0,006). Selain itu, WRMSD dan reka bentuk kerja yang buruk juga banyak dikaitkan dengan kualiti hidup yang tidak berpuas hati di kalangan pekerja kuari (Adjusted OR 0.236, 95% CI 0.102, 0.544, P = 0.001) dan (Adjusted OR 0.311, 95% CI 0.147.0.659, P = 0.002) masing-masing. Penilaian RULA menunjukkan bahawa 70.8% peserta mendapat skor 7, yang menunjukkan keperluan terhadap penyiasatan segera dan pelaksanaan perubahan ergonomik. Kesimpulannya, pekerja kuari di negeri Ebonyi, Nigeria mengalami kadar WRMSD yang tinggi dan mempunyai kualiti hidup yang teruk. Oleh itu, langkah-langkah ergonomik dan keperluan individu yang bersesuaian perlu dilaksanakan untuk meningkatkan keselamatan dan kesejahteraan pekerja di industri kuari negara Ebonyi, Nigeria.

WORK RELATED MUSCULOSKELETAL DISORDERS AND ITS ASSOCIATION WITH QUALITY OF LIFE AMONG QUARRY WORKERS IN EBONYI STATE, NIGERIA.

ABSTRACT

Quarry industries serve as the major sources of livelihood to over 20 million workers and their dependents in developing countries. In Nigeria, quarry account for 9% of the economic growth and 42% of the gross domestic products. Work-related musculoskeletal disorders (WRMSDs) has been recognised as a threat to the safety of the workers. This study aimed to assess the prevalence of WRMSDs, quality of life, postural changes and the factors associated with WRMSDs among the quarry workers in Ebonyi State, Nigeria. Data were collected through cross-sectional survey using self-administered questionnaires consisted of the Nordic Musculoskeletal Questionnaire, the World Health Organisation Quality of Life BREF (WHOQOL-BREF) and Rapid Upper Limb Assessment (RULA). Participants were selected through systematic random sampling among those who fulfilled the inclusion criteria. Two hundred and sixty-six quarry workers (266) participated in this study with 100% response rate. The data were analysed using SPSS version 26. Descriptive statistics was used to determine the prevalence of WRMSDs, types of WRMSDs and quality of life and presented in frequencies and percentage. Simple logistic regression was used on the factors associated with WRMSDs and the quality of life and finally, those with significant association at p-value <0.25 were modelled using multiple logistic regression analysis. The result shows that majority of the respondents (89.8%) had

WRMSDs with the most common being lower back pain (83.1%) and elbow pain (45.9%). About 74.1% reported dissatisfaction with their quality of life on the overall. Based on multiple logistic regression modelling, BMI, age and break time were significantly associated with WRMSDs (Adjusted OR 0.174, 95% CI 0.055,0.546, p=0.003); (Adjusted OR 1.143, 95% CI 1.066, 1.226, p<0.001); (Adjusted OR 0.945, 95% CI 0.908,0.984, p=0.006). Moreover, WRMSDs and poor work design were also significantly associated with poor quality of life among quarry workers (Adjusted OR 4.28, 95% CI 1.89, 9.7, P=0.001) and (Adjusted OR 3.22, 95% CI 1.52,6.82, P=0.002) respectively. The RULA assessment revealed that 70.8% of the participants scored 7, which requires immediate investigation and implementation of ergonomic changes. In conclusion, quarry workers in Ebonyi state Nigeria experienced high rate of WRMSDs and had poor quality of life. Therefore, appropriate ergonomic and personal measures need to be implemented to improve the safety and wellbeing of the workers at quarry industries Ebonyi state, Nigeria.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Work related musculoskeletal disorders (WRMDs) is defined as an inflammatory and degenerative disorders that commonly affect the major parts of the musculoskeletal system including the tendons, ligament, bones, muscles, joints, nerves and blood vessels. According to Canadian Centre for Occupational Safety (2015), WRMSDs is a complex group of painful disorders of tendon, muscles and ligaments that is caused by frequent and recurrent work activities or by awkward occupational posture. It mostly affects the soft tissues of the musculoskeletal system such as the muscle, tendon and nerves. While World Health Organisation (WHO) defined WRMSDs as a group of disorders that occur as a result of the interactions between individual factors and the work environment (WHO, 2015; Buck and David, 2012).

Furthermore, WRMSDs commonly occur in a condition of imbalance between the requirements of a work and the physique of the individual human body, depending on the visible body movement features, ergonomics and mechanical structure of job (Egwuonwu, 2013). It is equally said to occur when there is an overstretching or overexertion which occurs with repeated exposure to forceful or prolonged activities in an awkward position or unsympathetic environment (Maduegwu, 2014). According to Mody (2010), WRMSDs mainly affect muscles, joints, tendons, ligaments, nerves, bones and the localised blood vessels at different parts of the body in different degree (Mody, 2010). Accordingly, it is reported that WRMSDs occur in nine parts of the body namely: neck, shoulder, forearms, elbow, low back, waist, wrist, thighs and knee

with diverse rate across the parts of the body (Health & Safety Executive, 2017; Mohammad, 2017).

Moreover, WRMSDs have been found to exert deleterious effect on life of the workers in all fields most especially those requiring manual labour. According to Health and Safety Executive (HSE), (2017), it affects 507,000 persons per year in Great Britain and accounts for 8.9 million lost work days per year. It accounts for 34% of annual work days lost to ill health resulting in low productivity and economic backwardness of the organization (Ontario Ministry of Labour, 2009; Xu et al., 2012). A few studies also showed that WRMSDs account for 39% of all work-related health burdens on the employees leading to loss of body parts, loss of time, low productivity, change of career, handicap and total or partial dependence on the society by the affected individuals (Darragh, 2009; Egwuonwu, 2013; HSE, 2017).

It is even more worrying when several cases of death attributable to work and work-related factors had been reported across the globe through research studies. In 2014, 2.33 million persons died while in 2017, 2.78 million deaths due to WRMSDs were recorded in Great Britain (Hamalainen, Takala and Tan, 2017). Globel Burden of Diseases Study (2015) supported this as disorders associated with work accounts for 5% of all deaths in the world. Work related diseases which comprise respiratory disorders, hearing problems, WRMSDs, workplace accidents and others accounted for 86.3% of the total estimated deaths across the globe with WRMSDs accounting for 14% of the death. Asian countries (65%) had the highest contribution and constituted about two –thirds of worldwide occupation related mortality closely followed by Africa with 11.8% and Europe with 11.7% (Hamatainen, Takala and Tan, 2017).

Few studies revealed that every occupation in life is associated with a group of health problems or in some cases more specific hazards (Egwuonwu, 2013; HSE, 2017; 2018). In Netherland, the rate of WRMSDs was 346 per 100,000 annually with most cases seen amongst the construction and the quarry workers (Henk et al., 2016). High prevalence of WRMSDs was indicated in an Indian study of 231 female farmers 88% (Kalra, Arora and Pawaria, 2016), 70% among healthcare workers in Saudi Arabia (Dalia et al., 2019) and 77.3% among non-healthcare workers in Malaysia (Rajan, Martin and Emalatha, 2016). While among gold mine industry workers in Ghana, rate of WRMSDs was 85.5%, whereby 30.7% declined in efficiency of workers, 13.7% changed their specialty and 22% reported gross dissatisfaction (Andrews, Bertha and Ajediran, 2015). Whereas bankers in Nigeria had 33.8% rate of WRMSDs, physiotherapists had 84.9%, quarry and construction companies had 93.7%, and automobile workers had 76.9% (Nurhayati et al., 2014; Suleiman et al., 2015; Doaa et al., 2015; Egwuonwu et al., 2013). In Egypt, the overall prevalence of WRMSDs stood at 84.9% amongst physical therapist (Darragh et al., 2009; Doaa et al., 2015). All these studies showed higher trend of the disorders in developing countries and occurs in various occupations and geographical locations.

However, above all, WRMSDs is a well-known occupational health problem associated with quarrying as compared to other types of occupation. It constitutes major health challenges to the workers at quarry especially in developing countries. WRMSDs is a common problem that affect the employees in a wide variety of jobs or employment across the globe, and is the major cause of lost time from work, workers' disability, and increase in compensation claims, and health care costs (Egwuonwu, 2013).

Quarry industries in Nigeria have been recognised as one of the major sources of employment and livelihood among Nigerians in both rural and urban areas besides the main occupation such as civil service and farming. At least every state of the federation has one or two quarry sites where stones are crushed for many purposes and employs reasonable number of workers in different capacity such as drivers, blasters and lifter, most of which are literate and few illiterate men and women (Egwonwu, 2013). Quarrying work is often characterised by very risky and challenging work conditions that involve manual handling of material, lifting of heavy objects, movements and tasks that are recurrent, manual exertion of forces and possible exposure to segmental or whole-body vibration. This is due to the impact of the tool handling that predisposes workers to WRMSDs (Scharf et al., 2001, Egwuonwu et al., 2013).

Quarry industry and quarrying products are the vital sources raw materials for other secondary economic sectors in Nigeria such as civil engineering, construction companies, mining industries and cement industries. It contributes 7% -9% of the economy of Nigeria and over 42% of the fixed capital growth in the last few decades. This is said to be high despite the lack of interest by the Nigerian government in the sector owing to oil boom (Diugwu, 2012). Quarry industries are located in different parts of the world operating at different levels of technicalities with lower level of technological know-how in the developing countries like Nigeria. Hence, researchers had identified lower technology level or inappropriate methods of operation as one of the risk factors to WRMSDs in quarry industries (Health & Safety Executive, 2017).

The researcher only found one research study on the prevalence of WRMSDs among quarry workers in Nigeria despite the enormous risk of quarry work. According

to the study, WRMSDs is very common amongst the workers of quarry industry with the prevalence rate of 83.3% with low back pain being the most common type, 78.9% (Egwuonwu, 2013). However, this study did not assess the postural risk factors of the disorders among the worker. Also, so far there is no studies assessing the quality of life of the workers in Nigeria. This therefore, creates a serious gap in the knowledge which this study intends to fill in. As mentioned earlier, Nigeria is one of the developing countries of Africa with low technological advancement, most of the quarry works are done by manual labour and thereby, exposing the individuals to high risk of health problems. Hence this study on WRMSDs and its association with quality of life will be used to add in empirical evidence to convince the policy makers that something needs to be done in favour of the quarry workers.

1.2 Problem statement

WRMSDs is the most commonly self-reported occupational hazards among quarry workers globally with the high cost resulting to lost time, low productivity, and long-term disability and cost of treatment which often rest on the workers or the employers (National Research Council, 2011). It imposes outrageous financial burden on the individual, employers, families, healthcare service providers and wider society. With the increase in the legal backup for workers to claim compensation from the company due to injury and in some cases blatant refusal by the company to pay compensation to the worker. This in turn lowers their moral and subsequently lead to low productivity, loss of resources, organizational bankruptcy and economic backwardness of the society (HSE, 2017).

The quarry industries under the umbrella body of construction industries are one of the riskiest employments as long as WRMSDs and other health hazards are concerned (HSE, 2017). Quarry industry represents a strategic sector in the provision

of raw materials for building and infrastructural development. Upon these materials all the sectors of the economy depend. The workers in this sector face numerous health hazards and are more than twice at risk of WRMSDs than other occupations in the society. About 40% of workers with WRMSDs in Europe have been reported quitting their jobs (HSE, 2017). WRMSDs have also been estimated to account for loss of 2% of the European Union annual gross domestic product which stood at 400 billion dollars (Nweke, 2009). This entails reduced workers' motivation, low productivity and economic backwardness to the organization and the country at large. Hence, requires more preventive health information which would only be instituted based on research knowledge/evidence which this study intends to provide (Ajayi et al., 2015).

In Nigeria, not much significant data exist on the prevalence of WRMSDs especially as pertains to quarry works and thereby create gap in the knowledge and implementation of preventive measures, which this study intends to bridge. In spite of the increased risks of WRMSDs among quarry workers and its impacts on their lives and employers and the country at large, there is a dearth of literature on the prevalence of work-related musculoskeletal disorders among this group of workers in Nigeria. There were numbers of research studies been conducted on other occupations involved in manual material handling and physical work load in Nigeria but quarry workers appeared to have been neglected (Sanyo et al., 2005; Akinbo et al., 2008). The only existing study on the quarry workers is by (Egwuonwu 2013). However, this study involved very few respondents (n=96) and did not assess the occupational risk factors among the workers. No existing research study on this group of workers assessing their quality of life and the association with WRMSDs. This study was therefore, designed to assess the WRMSDs and its association with quality of life among quarry workers at quarry industry in Ebonyi State, Nigeria.

1.3 Research Objectives

1.3.1 General:

This study assessed the WRMSDs and its association with QOL among workers at quarry industry in Ebonyi State, Nigeria.

1.3.2 Specific Objectives:

1. To determine the prevalence of WRMSDs among quarry workers in Ebonyi state Nigeria.
2. To determine the types of WRMSDs experienced by the quarry workers in Ebonyi state, Nigeria.
3. To identify the factors (socio-demographic characteristics and workplace factors) associated with WRMSDs among the quarry workers in Ebonyi state, Nigeria
4. To determine the levels of the quarry workers' quality of life in Ebonyi state, Nigeria.
5. To identify the factors (socio- demographic and WRMSDs) associated with the quarry workers' quality of life Ebonyi state, Nigeria.
6. To assess the postural changes experienced by quarry workers in Ebonyi state, Nigeria.

1.4 Research Question(s)

1. What is the prevalence of WRMSDs among quarry workers in Ebonyi state, Nigeria?
2. What are the types of WRMSDs experienced by the quarry workers in Ebonyi state, Nigeria?

3. What are the factors associated with WRMSDs among quarry workers in Ebonyi state, Nigeria?
4. What are the levels of quarry workers' quality of life in Ebonyi state, Nigeria?
5. What are the factors associated with quarry workers' quality of life in Ebonyi state Nigeria?
6. What are the postural changes experienced by the quarry workers in Ebonyi state, Nigeria?

1.5 Hypothesis:

1. H1A: There are significant factors (socio-demographic characteristics and workplace factors) associated with WRMSDs among the quarry workers in Ebonyi state, Nigeria.
2. H2A: There are significant factors (socio-demographic variables and WRMSDs status) associated with quarry workers' quality of life in Ebonyi state, Nigeria.

1.6 Significance of the study

This study seeks to determine the prevalence and the types of, as well as the factors associated to WRMSDs and its impact on the quarry workers' quality of life. The findings would be of great value to the quarry workers and the management. It would serve as reliable evidence upon which to base any move for initiation of preventive measures against musculoskeletal disorders in quarry and other related industries. This is because the first basic step to preventing occupational and other health problems is to determine the magnitude of the problem and the associated factors. The associated factors identified in this study would serve as the target of activities for primary and secondary prevention for WRMSDs. This action if initiated and implemented would promote the health of the workers, the industrial output and

national economic growth.

This study is the first study assessing quarry workers' quality of life to the knowledge of the researcher. Its findings would add to the few literatures on quarry workers in Nigeria and developing countries and thereby, assist future researchers in similar field. Since the workers' quality of life is linked to the quality of life of his or her dependents in terms of feeding, upkeep and others. This finding would serve as valuable research evidence that would spur the individual quarry owners and the government of Nigeria to develop interest in the sector and take drastic measures that would lead to improvement of workers' quality of life and economic growth. The quality of life of the workers also deals with their perceived satisfaction with their job in which also linked to their productivity and that of the industries. Accordingly, when the quality of life is determined by this study and the evidence acted upon to better the life of the workers, the economic output would increase leading to more gross domestic products of the countries.

Moreover, since this study seeks to determine the socio-demographic and ergonomic factors associated with the WRMSDs, the findings would be useful for health professionals (nurses, doctors and occupational health personnel) in designing health education models on WRMSDs to the quarry workers and other workers in construction industries with the intention to improve their health. The improvement of the workers' health by improving their knowledge and awareness on WRMSDs would culminate in improved community health and national health statistics of every country in which quarry exist. It would also benefit occupational health officers in developing industrial risk assessment tool for accreditation of similar companies in nearby futures. Prevention of WRMSDs through the utilization of the study findings

would also take away pressure from the health care system in that less demand would be made on them by the quarry and construction companies.

Similarly, the findings of this study will also be utilized by policy makers in Nigeria and other developing countries on quarry workers and other industries. This will enable policy makers make good policies that would benefit the workers and the employers. Such policy includes policy on work place design, criteria for industrial accreditation, demographic considerations and health status assessment of workers prior to employment as to enhance healthy workers and healthy industries. Nigerian government is currently compiling evidence to enhance the development of occupational health profile sponsored by international labour organization hence would benefit from the findings of this study.

Future researchers in related fields would also find these study findings as evidence or act as the basis of discussion for their own study outcome. This eventually will promote more research development in the field of occupational health and other related areas.

1.7 **Conceptual and Operational definitions:**

Terms	**Conceptual definition**	**Operational definition**
Work-related musculoskeletal disorders (WRMSDs)	A complex group of painful disorders of tendon, muscles and ligaments that are caused frequent and recurrent work activities or awkward occupational posture (CCOSH, 2015)	WRMSDs are seen in this study as the presence bodily pain of mild to severe degree induced or caused by the work place factors and which may or may not interfere with daily work.
Quarry Workers	Individuals that work in a sector or an industry called quarry (Collins English Dictionary,2014)	Quarry workers in this study are individuals between the age of 18 to 49 years that are employed in the quarry industries and involved in the activities of stone crushing

Pain	Pain is an abnormal sensation denoting presence of bodily abnormalities (Collins English Dictionary,2014).	Pain is seen in this study as self-reported feeling of discomfort of any degree capable of affecting performance of daily routine.
Ergonomic postures	Ergonomic postures are the recommended and ideal positions required for healthy work performance according to occupation (ILO, 2016).	Ergonomic postures in this study means the observed commonly assumed positions at work among the workers at quarry industries
Quality of Life (QoL)	Quality of Life is an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns (WHO 2018).	In this study QoL is as an individual's perception of their position in life in relation to their goals, expectations, standards and concerns.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The related literatures to this study were reviewed according to the objectives of the study and presented under the following headings: prevalence of work-related musculoskeletal disorders (WRMSDs), types, associated factors of WRMSDs, and associated factors of quarry workers' quality of life. Types of questionnaires and the selected conceptual framework that was utilised in this study are also included in this chapter.

The literature for this study were sourced from the following databases: PubMed, Scopus, ScienceDirect, and Google scholar. The literature search was done using the following mesh word: work-related AND musculoskeletal disorders OR pains AND construction companies OR quarry industries AND workers. The search was limited to journal articles published between 2010 to 2020 in order to generate most recent research evidence on the WRMSDs among quarry workers. The references of the retrieved articles were further search to identify more scholarly articles on the WRMSDs among the quarry workers. A total of four articles were further retrieved through the references. Articles published in English language were considered for inclusion.

Moreover, from the search conducted through the databases enumerated above, a total of 14,766 research articles were found (PubMed=1601, ScienceDirect=566, google scholar=11,600, Scopus=1000). After the application of filters such as year of publication, article type, accessibility and language of publication, 2166 research articles remained. Following review of the title of the 2166 research articles, a total of

46 research articles were retrieved and reviewed at abstract level. Out of the 46 articles reviewed at the abstract level, 23 research articles remained after removal of duplicates and were included in the study. The articles were assessed for quality using critical tool for cross sectional research studies (AXIS) (Downes et al., 2016). The included articles are presented below in Table 2.1.

However, three scholarly articles on the WRMSDs were excluded because standard tools were not used to assess the concept of WRMSDs, the target population were not specified, the article was not empirical study, full article was not accessible and the methods of data analysis were not scientific. The excluded studies include (Santos et al., 2014; Lop et al., 2017 & Crawford et al., 2020).

Table 2.1: Summary of studies on WRMSDs included in this study.

S/N	Authors	Population	Sample	Country	Findings
1	Anton & Weeks 2016	Grocery workers	254	USA	**Prevalence:** 78%. **Anatomical sites:** low back and feet
2	Rugber et al., 2016	Bus Drivers	89	South African	**Prevalence:** 22%. **Anatomical sites:** upper back (44%), lower back (42%), neck (42%), shoulder (37%), hand and wrist (31%)
3	Boschman et al., 2012	Bricklayers	267	Netherlands	**Prevalence:** 67%. **Anatomical sites:** back & elbow were commonly reported types.
4	Alghadir & Anwer 2015	Construction workers	165	Saudi Arabia	**Prevalence:**48.5% **Anatomical sites:** low back pain (50%), knee pain (20%). **Associated factors:** duration of breaktime at work, years of work experience and use of PPE.

5	Ekpenyoung et al., 2015	Construction workers	1200	Nigeria	**Prevalence**: 39.5% Iron workers: 49% Earth movement: 44% Carpentry: 42.8% Mechanicals: 36.6% Bricklayers: 36.6% Electricals: 39.7% Security: 33.3% Transporters: 34.1% **Associated factors:** Age of the worker, race, weight, BMI, educational level, and mode of employment, exposure to vibration and work experience.
6	Fairus et al., 2014	Construction workers	60	Malaysia	**Prevalence:** 66.7% **Anatomical sites**: Elbow, wrists and ankle. **Associated factors:** gender and age
7	Odebiyi et al., 2018	Call centre operators	374	Nigeria	**Prevalence:** 65.2% **Anatomical sites:** Neck, shoulder, upper back and lower back were the commonly reported.
8	Hossain et al., 2018	Garment workers	232	Bangladesh	**Prevalence:** 83.1% **Anatomical sites:** Lower back (24.7%) Neck (23.7%) Knee (13%) **Associated factors**: age, job experience, working hours and BMI
9	Egwuonwu et al., 2013	Quarry workers	114	Nigeria	**Prevalence:** 83.3% **Anatomical sites:** Lower back (78.9%) Wrist (59.6%). Upper back (8.8%) Hip (8.8%). **Associated Factors:** BMI, age and work experience
10	Egwuonwu et al., 2016	Road construction workers	100	Nigeria	**Prevalence:** 66% **Anatomical sites:** Low back (55%) Neck (45%) Thigh (8%). **Associated factors:** BMI, working hours per week and work exertion.

11	Abaraogu et al., 2015	Beverage factory workers	301	Nigeria	**Prevalence:** 91.4% **Anatomical sites:** Shoulder, Neck and upper limb were commonly affected.
12	Ahmad et al., 2017	Quarry workers	218	India	**Prevalence:** 81.2% **Anatomical sites:** Low back (61.5%) Knee (39.4%) Shoulders (28.9%)
13	Mozafari et al., 2015	Truck Drivers and office workers	346	Iran	**Prevalence:** Drivers (78.8%) and Office workers (55.5%) **Common sites:** Neck (27.2%), back region (24.3%). **Associated factors:** age, BMI, type of work and duration of work.
14	Claudia et al.,2018	Construction workers	50,218	USA	**Prevaalence:** 11.2 million cases reported in three years survey (2006, 2009 and 2014).
15	Wang et al., 2017	Construction workers	NA	USA	**The prevalence of WRMSDs** among construction workers doubled. The construction workers remained the mostly affected workers across all industries. **Anatomical site:** Lower back pain accounted for the most common type (40%).
16	da Costa & Vieira, (2010)	Construction workers	NA	Worldwide	**Associated factors** for WRMSDs were BMI, heavy lifting, overexertion, awkward posture, repetition of activities, high psychosocial work demands, smoking and other co-morbidity.
17	Labao, Faller & Bacayo, (2018)	Migrant Industrial workers	60	Malaysia	**Overall prevalence**: 73.3% **Anatomical sites/types**: lower back (60%), shoulder (60%), upper back (48.3%) & neck pain (45%)
18	Yu et al., 2012	Factory Workers	3476	China	**Overall incidence:** 119. Per 1000 workers. 8.9% prevalence of traumatic MSDs, 50% prevalence of WRMSDs among the respondents. **Associated factors**: gender, duration of work, high

					psychological stress and past injury history.
19	Madiha et al., 2020	Bricklayers	150	Pakistan	**Overall prevalence of WRMSDs:** 90% (males) and 83% (females). **Anatomical sites commonly affected:** in order high prevalence includes: neck, upper back, shoulders, lower back and hips
20	Lette et al., 2018	Building construction workers	360	Ethiopia	**Overall prevalence**: 41.4%. **Anatomical site mostly affected**: Lower back (36%). **Associated factors:** non-use of PPE, lack of training and long working hours.
21	Tawiah et al., 2015	Gold miners	205	Ghana	**Prevalence:** 85.5% **Impacts:** 30.7% reported inability to work maximally due to the WRMSDs while 13.7% reportedly changed their specialty area at work due to pains. **Associated factors:** nature of the work was significantly associated with WRMSDs.
22	Rahman et al., 2019	Sawmill workers	254	Bangladesh	**Overall prevalence:** 70.1% **Anatomical sites:** Neck (55.5%), shoulders (70.1%), upper back (62.2%), elbow (50.4%), wrist (45.75), lower back (57.9%), thigh (46.1%), knee (46.5%), ankle (49.6%). **Associated factors:** Work experience.
23	Ayub & Abbas, 2018	Industrial workers	48	Pakistan	**Prevalence:** 79% **Anatomical sites:** Upper body (86%), lower body (14%). **Associated factors**: work experience

2.2 The Prevalence of WRMSDs among Quarry Workers

Several research evidences have revealed that WRMSDs is among the most frequently reported work-related injuries which affect all age ranges, mostly individuals in their working ages (Oginyi, 2010; Guo et al., 2011; Egwuonwu, 2013; Dalia et al.,

2016). However, the prevalence of WRMSDs among quarry workers across the globe is varied. Current report from the European Agency for Safety and Health at Work (2015) revealed the increasing incidence of WRMSDs among quarry workers globally. Yearly millions of workers in the quarry industries develop one form of WRMSDs but with wide variation across the countries of the world (WHO, 2015). In Europe, 1/4 of adult workers in construction companies such as quarry industries developed chronic musculoskeletal disorders associated with their work which limit their ability to carry out the activities of daily living (Happiness et al., 2015). As reported by Oginyi, (2010), WRMSDs accounted for 103,000 mortalities in USA, 122,000 in European Union, 90,500 in China and 40,000 in India in 2005 but more alarming rates in the developing countries though unreported or underreported.

Furthermore, in the United States of America, recent research has reported the prevalence of WRMSDs as 860,000 and 60,300 deaths annually from workplace exposures (Oranusi, Dahunsi & Idowu, 2014). According to Dalia et al., (2016), WRMSDs in Saudi Arabia is a common health problem among quarry workers with the prevalence rate of 70%. The most common types of WRMSDs suffered by the workers in the study include lower back pain (85%) and neck (84.6%). The prevalence of WRMSDs among quarry workers in Indian stood at 93% of 63 respondents (Behzad et al, 2017). While in Malaysia, the prevalence of WRMSDs was reportedly at 77.3% among 300 respondents with more in females (78.8%) than males (74.6%) (Rajan, Martin & Emalatha, 2016) and a study in China reported prevalent rate of 97% with low back pain (80.1%) being the most common, neck (78.6%) and shoulder (70.4%)(Shua, Jingmei & Jiaqi, 2018).

African continent is evidenced by high prevalence of WRMSDs made worst by condition of work. The workers are expected to and eventually perform manually those

works that would be better done with machines. For instance, in Ghana, it was reported the prevalence rate was 85.5% of WRMSDs among stone mine workers (Andrews, Bertha & Ajediran, 2015). Egwuonwu (2013) reported 83.3% prevalence with 74% and 73% as the prevalence of low back and neck pain among stone crushers in Nigeria respectively. Whereas Omokhodion & Sanya (2003) reported 46% and 38% as the prevalence of low back pain among Northern Nigeria rural and urban quarry workers respectively. There is paucity of literature on the prevalence of WRMSDs amongst quarry workers in Ebonyi State Nigeria to the knowledge of the researcher despite their contribution to the economy.

The prevalence rate of WRMSDs has also been empirically found to vary across occupations and work expectations amongst workers. Though WRMSDs vary across all works of life, it is evidently most common among quarry workers and more in the underdeveloped than developed countries (HSE, 2017). This is due to lack of technological advancement in the performance of the work and nature of work being done (HSE, 2017). WRMSDs among quarry workers and other construction works are second only to Agricultural sector in terms of risk for occupational health problems (HSE, 2018). Researchers have reported varied cases of WRMSDs among quarry workers across countries based on the position of the individual work.

As reported by Egwuonwu et al., (2013) the prevalence of WRMSDs amongst quarry workers was 83.30% with Lower back pain being the most common (78.9%)). All the respondents reported to have suffered from WRMSDs, but 66.7%, 81.3% and 77.5% of blasters, crushers and drillers respectively also had developed WRMSDs (Egwuonwu, 2013). This further illustrates the variability of the prevalence according to the position of the worker. Figure 2.1 below shows the distribution of WRMSDs across major sectors of the economy. While Figure 2.1 revealed that agricultural sector

had the highest cases followed by construction under which lies the quarry industries (HSE, 2018).

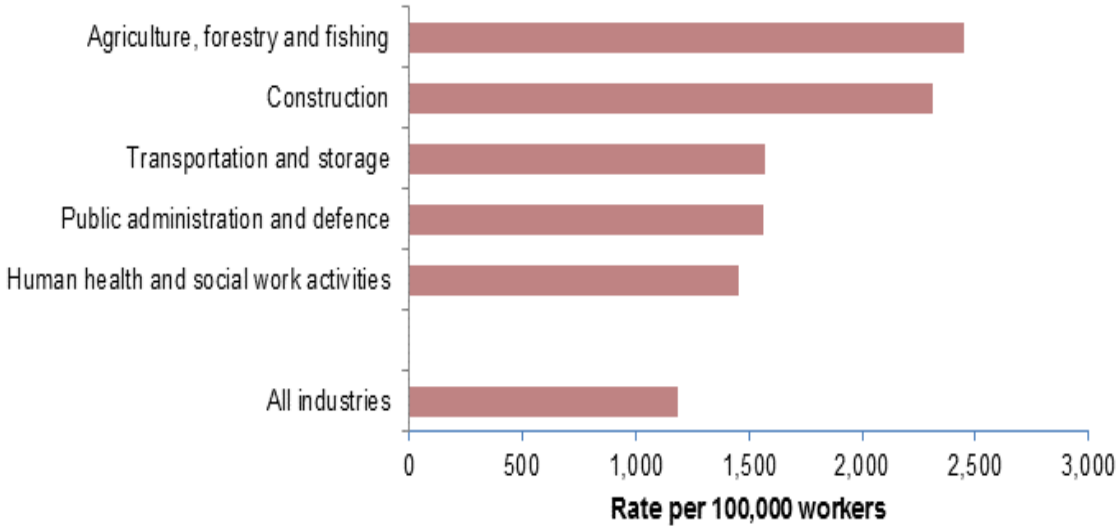

Figure 2.1: WRMSDs across occupations: Source: Health & Safety Executive 2018.

There is variation in the prevalence of WRMSDs across different companies that are obviously involved in manual and mechanized handling of materials (Table 2.1). Across the construction companies, quarry industry workers recorded the high prevalence of WRMSDs across studies (Egwuonwu et al., 2013; 2016; Fairus et al., 2014; Ekpeyoung et al., 2015; Hossain et al., 2018), though there are only very few studies focusing on the quarry workers across countries despite being a high-risk work.

2.3 Sites of WRMSDs among Quarry Workers

A few studies reported various pattern of occurrence of WRMSDs amongst quarry workers depending on the nature of the work, the technological advancement and the work environments (Oginyi, 2010; Egwuonwu, et al., 2013; Dalia et al., 2016). In most of the studies, the locations of WRMSDs were also referred to as the pattern of its occurrence. The pattern of WRMSDs deals with the parts of the body involved or on which the presenting features occurred in the individual workers (HSE, 2017). There

are several parts of the body where occupational health problems especially WRMSDs affect. Figure 2.2 below illustrates the anatomical locations of this disorders with their percentages.

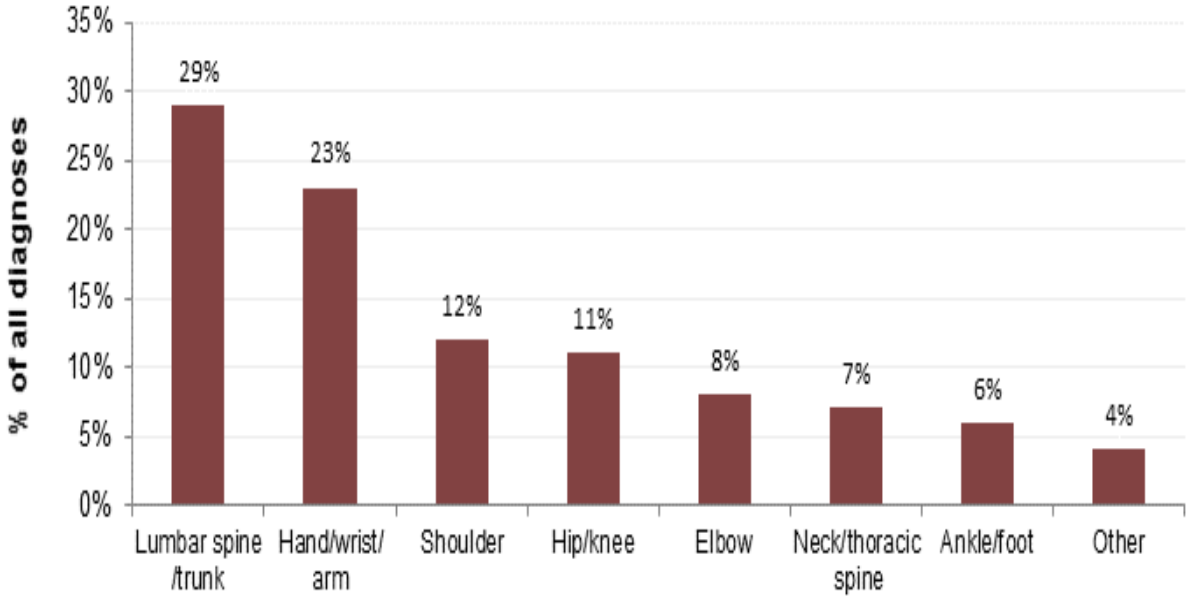

Figure2.2: WRMSDs by Anatomical site, three-years aggregate total 2013 to 2015 in Great Britain. Source: Health & Safety Executive (2017).

Researchers have consistently reported that lower back account for the highest body part with incidence of WRMSDs among quarry workers. This is followed by the wrist/ arm and the lower limbs (Egwuonwu et al., 2013, Martha et al., 2016, HSE, 2017). However, a recent study by HSE (2018) reported upper limb as the highest body parts with WRMSDs amongst construction workers (197000 cases), followed by back disorders (186000 cases) and the lower limb disorders (86000 cases). The pattern/types of WRMSDs also vary based on the nature of the job and the recurrent ergonomic conditions (physical and environmental factors) in the work place (Figure 2.2).

Akinpelu et al., (2010) reported 74% and 73% prevalence rates of low back and neck pain among computer users in Nigeria respectively. Whereas Omokhodion & Sanya, (2013) reported 46% and 38% as the prevalence of low back pain among Nigerian rural and urban hospital workers respectively. However, construction companies including quarry have more than twice, the risk of WRMSDs than any other occupation (Rwamana, 2007; Agumba, 2008; Ajayi, 2015; HSE, 2017). While in an Arabian study by Shikdar & Al-Kindi, (2007) reported that the major WRMSDs among computer users included eyestrain (58%), shoulder pain (45%), back pain (43%), forearm pain (35%), wrist pain (30%), and neck pain (30%). Moreover, a study in the United States, Baker, (2013) reported a neck pain prevalence of 57% among the same category of workers. Smith et al., (2001) reported that the highest prevalence of pain amongst workers in a nursing home was at the lower back (56.8%), followed by the neck (42.8%), upper back (38.9%) and shoulders (38.9%).

Amongst the quarry workers, the most frequently reported type of WRMSDs was lower back pain followed by the neck pain and wrist/limb pain. While for health workers, lower back disorders were more frequently reported (Egwuonwu et al., 2013; Dalia et al., 2016; Mohammad et al., 2019). This diversity was empirically linked to the ergonomic factors common in quarry industries such as manual handling of material, postural factors, prolonged standing and others (Egwuonwu et al., 2013; Hossain et al., 2018).

WRMSDs have been broadly classified into two classes which include specific disorders and non-specific disorders. The specific disorders often manifest with clear signs and symptoms. The nonspecific disorders present pain or discomfort which exists without evidence of a clear specific disorder (NIOSH, 2018). However, pain is the most

common clinical manifestation of WRMSDs, followed by muscle tightness, joint stiffness, redness and oedema of the affected area would also occur. Other than that, they might experience sensations of pins and needles, numbness, and changes in skin colour, and diminished sweating of the hands (Tinubu et al., 2010; Hamid et al., 2014). WRMSDs pain also manifest in stages ranging from early to late stage. In early stage, pain and tiredness occurs during the work hours but disappear during days off with or without reduced productivity. While in intermediate stage, body ache and weakness occur in the early hours of work and often remain till night. Work productivity is reduced in terms of capacity to perform the routine tasks. Finally, in the late stage, body pain, fatigue, and weakness occur recurrently and persistently at rest. Insomnia and inability to perform duties are common due to pain (Canadian Centre for Occupational Health & Safety, 2015). Figure 2.3 below shows the common types of WRMSDs among quarry workers. It shows the distribution of WRMSDs of the body part with the neck indicated as the highest cases of WRMSDs amongst most workers, followed by the lower part of the back.

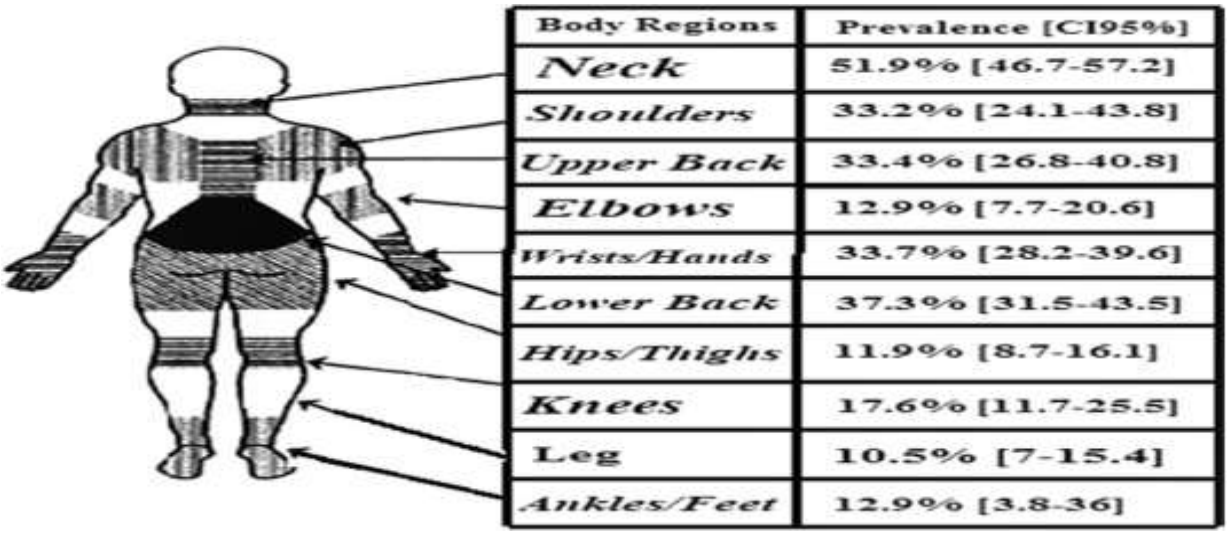

Figure2.3: Anatomical distribution of WRMSDs. Source: Mohammad Hossein (2017).

2.4 Factors Associated with WRMSDs among Quarry Workers

From the literature reviewed, thirteen studies reported the factors associated with WRMSDs among construction company workers (Ayub & Abbas, 2018; Rahman et al., 2019; Tawiah et al., 2015; Lette et al., 2018; Yu et al., 2012; da Costa & Vieira, 2010; Mozafari et al., 2015; Egwuonwu et al., 2016; Egwuonwu et al., 2013; Hossain et al., 2018; Fairus et al., 2014; Ekpenyoung et al., 2015; Alghadir & Anwer 2015).

According to empirical evidence, several factors were found as associated with development of WRMSDs among quarry workers (Egwuonwu et al., 2013; HSE, 2017). The associated factors were divided into two groups: Ergonomic factors and personal factors. Ergonomic factors which has to do with the work and its processes such as applied forces, work duration, postural requirement, repetition, exposure to vibration, break time at work, work design and working under high temperature environment. While personal factors deal with the workers' physical ability to work include: health habits, work practices, fitness and socio-demographic variables (Ahmad & Shahnawaz, 2015).

Moreover, the interaction between the two groups of factors leads the individual to WRMSDs (CCOSH, 2016; Egwuonwu et al., 2013; Absar, 2017; Mohammad et al., 2018). Socio-demographic factors such as body mass index (BMI), weight, duration of work, work experiences, position, age, and others have been significantly correlated with the development of WRMSDs among workers in construction companies like quarry (Kusmari & Yassieli, 2019; Ahmad & Shahnawaz, 2015; Behzad et al, 2017). Other associated factors with WRMSDs revealed in these studies include psychologically traumatizing factors such as work stress, time pressure, lack of

cordiality and job dissatisfaction as these precipitate psychological imbalances and disorganization at work (Mohammad et al., 2018).

Figure 2.4 shows the interaction between work environment and personal factors leading to WRMSDs. From empirical evidence, certain socio-demographic factors and workplace factors interact to create an enabling environment for occurrence of WRMSDs. These factors can independently and collectively predict the occurrence of disorders among workers (Edem, Akpan & Pepple, 2017). Ergonomic factors are those factors prevalent in the workplaces that could increase the risk for health deviation among workers. Such factors include nature of work such as repetitiveness of actions, prolonged standing, exposure to vibration, extreme temperature and others. The presence of these factors in excess creates imbalance between the normal requirement of the body and the work leading to injuries (Edem, Akpan & Pepple, 2017). The sociodemographic factors such as BMI, age, gender and others also has the tendency of making a worker more likely to develop a particular health problem compared to other workers. For instance, older workers are more likely to develop health problems than the younger ones due to less flexibility in the physiology of the body (HSE, 2016).

Furthermore, workers who have these predisposing socio-demographic factors and further exposed to hazardous work environment are more likely to develop health problems such as WRMSDs compared to those with the same socio-demographic features but work in a safe workplace. Therefore, the figure below shows that while both socio-demographic or workplace factors can lead to WRMSDs independently but they can also exist mostly with both factors coinciding.