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EDITORIAL PREFACE

This is the Second Issue of Volume Three of International Journal of Ergonomics (IJEG). The Journal is published bi-monthly, with papers being peer reviewed to high international standards. The International Journal of Ergonomics is not limited to a specific aspect of Ergonomics but it is devoted to the publication of high quality papers on all division of engineering in general. IJEG intends to disseminate knowledge in the various disciplines of the Computer Science field from theoretical, practical and analytical research to physical implications and theoretical or quantitative discussion intended for academic and industrial progress. In order to position IJEG as one of the good journal on Computer Sciences, a group of highly valuable scholars are serving on the editorial board. The International Editorial Board ensures that significant developments in Ergonomics from around the world are reflected in the Journal. Some important topics covers by journal are architectures, middleware, tools designs, Experiments, Evaluation, etc.

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The coverage of the journal includes all new theoretical and experimental findings in the fields of engineering which enhance the knowledge of scientist, industrials, researchers and all those persons who are coupled with engineering field. IJEG objective is to publish articles that are not only technically proficient but also contains information and ideas of fresh interest for International readership. IJEG aims to handle submissions courteously and promptly. IJEG objectives are to promote and extend the use of all methods in the principal disciplines of Computing.

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Assessment of Post Ergonomic Effects of Lifting Tasks Performed in Block Moulding Industries in Akure, Nigeria

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Abstract

Occupational Lifting tasks involving heavy weights have effects on both the health and productivity of the person performing the task especially if ergonomic measures are not adopted. When a person involved in manual materials handling sustains an injury in the course of performing lifting tasks, it often results in wastage of both time and material resources which in turn have multiplier effects on the profit margin of his employer. It is against this backdrop that an assessment of the post ergonomic effects of lifting tasks performed in block moulding industries in Akure, Nigeria was carried out. It was discovered that the thighs (both) are body parts susceptible to stress and discomfort whereas the mid to low back region of the body is the most stressed part of the body. This was attributed to the excessive bending of the 5^{th} lumbar and the 1^{st} sacral (L5/S1) of the spine. When asked to rate their workload, 52% of the subjects rated their occupational lifting task as Hard while 29% of them chose very hard. The average age of the 60 subjects that participated in the study is 29 years having a weight of 61Kg and a height of 169.17cm.All the subjects were male as no female was seen in all the industries visited which confirmed that the lifting task was actually a hard one involving a weight of 28Kg.

Keywords: Ergonomics, Lifting, Low Back Pain, Block Molding.

1. INTRODUCTION

Ergonomics, also known as human engineering or human factors engineering, is the science of designing machines, products, and systems to maximize the safety, comfort, and efficiency of the people who use them. Ergonomists draw on the principles of industrial engineering, psychology, anthropometry (the science of human measurement), and biomechanics (the study of muscular activity) to adapt the design of products and workplaces to people's sizes and shapes and their physical strengths and limitations [1].

Similarly, [2] defined ergonomics as the theoretical and fundamental understanding of human behavior and performance in purposeful interactions in socio-technical systems, and the application of that interaction in the context of real settings. According to [3], the objectives of ergonomics are those of achieving functional effectiveness of whatever physical equipment or facilities people use and of maintaining or enhancing human welfare or well-being (such as health, safety and satisfaction) by appropriate design of the equipment, facilities and environments. Thus ergonomics can simply be referred to as the science of designing facilities, work place and systems to enhance the health, safety and comfort of the people using them.

Despite the growing advancement in mechanization and automation, Manual Materials Handling (MMH) activities still play an important role in the industrial and service sectors of any economy

[4]. Any job that involves heavy labour or manual material handling may be in a high-risk category. MMH entails lifting, but also usually includes climbing, pushing, pulling and pivoting, all of which pose the risk of injury to the back [5]. According to [4], a significant problem associated with such activities is the fact that they are the primary cause of overexertion injuries. The moral and economic consequences that result from pain and injury made it necessary to study and, therefore, attempt to solve such a problem. To prevent pain and injuries, [4] suggested that the MMH tasks should be designed to take into account several risk factors related to the task being handled.

Lifting can be described as an action that involves moving an object from one position to a higher position. It is imperative to admit that lifting results in the movement of the body members and in most cases, it is accompanied by the displacement of the entire body. Lifting tasks are performed everyday by everyone at various levels and in different places yet, most people have not identified the need for them to control the weight of the materials and objects they lift [6]. Lifting from the floor places strain on the structures in the lumber spine which can cause spinal injuries [5] and [7].

Similarly, people involved in MMH perform tasks involving lifting objects that are up to (and sometimes more than) two-third (2/3) of their total body weight by virtue of their occupation which is ergonomically unacceptable [8], [9] and [10]. It is regrettable that their ignorance of ergonomic standards for safe lifting techniques (in some cases) exposes them to the occupational health and safety hazards preordained by their profiteering employers. People often complain of body pains when performing and or after performing lifting tasks. Unfortunately, most of them cannot attribute the cause of the pain to the lifting task(s) they perform. This usually results in their frequent visit to their doctor instead of employing ergonomic measures [6].

Lower Back Pain (LBP) is the most prominent of all the injuries related to lifting tasks. It has been reported that tasks involving lifting account for 33% of all work-related causes of back pain [11]. Low back pain is an injury that can occur at the L5/S1 compression disc of the human spine when a heavy load is lifted and when bad lifting techniques are adopted while performing the task. It can also be caused by other factors such as; the posture of the person performing the task, the frequency of lift among others. According to [12], Studies and investigations need to be conducted on the occurrence of ergonomic risk factors and work organizations. Assessments need to be conducted on the risk factors of interest, feature of the measurement device, feasibility considerations, and variations, and variations at the workplace. The selection of variables should permit specific etiologic inference. The parameterization of an exposure variable should address the three principle exposure dimensions intensity, frequency and duration. Information on the numbers of persons exposed to adverse ergonomic working conditions, levels of exposure and impacts of protective and preventive ergonomic measures need to be collected.

1.1 Ergonomic Standards for Lifting Tasks

Standards have been set to “quantify” physiological limits but other aspects remain unclear like the exact link between bad posture and injuries. The established standards, however, are used to evaluate the risks associated with specific work stations or tasks. If work requirements fall below the set limits, the risk level is fairly low; conversely, the risk of injuries increases as the limits are exceeded [13]. The standards that are most widely used by ergonomist are ISO standard 11228-1, Manual Material Handling (MMH) and National Institute for Occupational Safety and Health (NIOSH) equation (Table 1). The standards determine the maximum weight that can be safely lifted by workers. According to [13], the values need to be adjusted according to five main factors affecting worker’s health and safety namely: lifting duration, lifting frequency, properties of the load, working environment and workers’ posture.

Standard*	Maximum load weight (kg)	Comments
ISO 11228-1	25	Load can be handled by 95 % of men and 70% of women.
MMH	27	Load can be handled by 90 % of men. Maximum load for women is 20 kg.
NIOSH	23	Load can be handled by 90 % of the population (men and women).

TABLE 1: Maximum Load Weight Under Optimal Conditions Source: [13].

1.2 An Overview of Block Moulding in Akure, Nigeria

The pressing need for building materials in Nigeria, particularly for low-cost housing in developing areas, has now become a major issue of concern.

There is no gainsaying in the fact that the growing population of Nigeria as the most populated black nation of the world have also spurred an increase in the need for shelter which have no doubt, made block moulding a lucrative business venture. In order to make their operations faster and meet demand, block moulding industries now make use of locally fabricated machines.

Despite the automation of the process, the blocks are still manually removed from the machine after moulding thereby making lifting an integral part of the production process. It is against this backdrop that an ergonomic assessment of the post ergonomic effects of lifting tasks performed in block moulding industries in Akure, Nigeria was conducted.

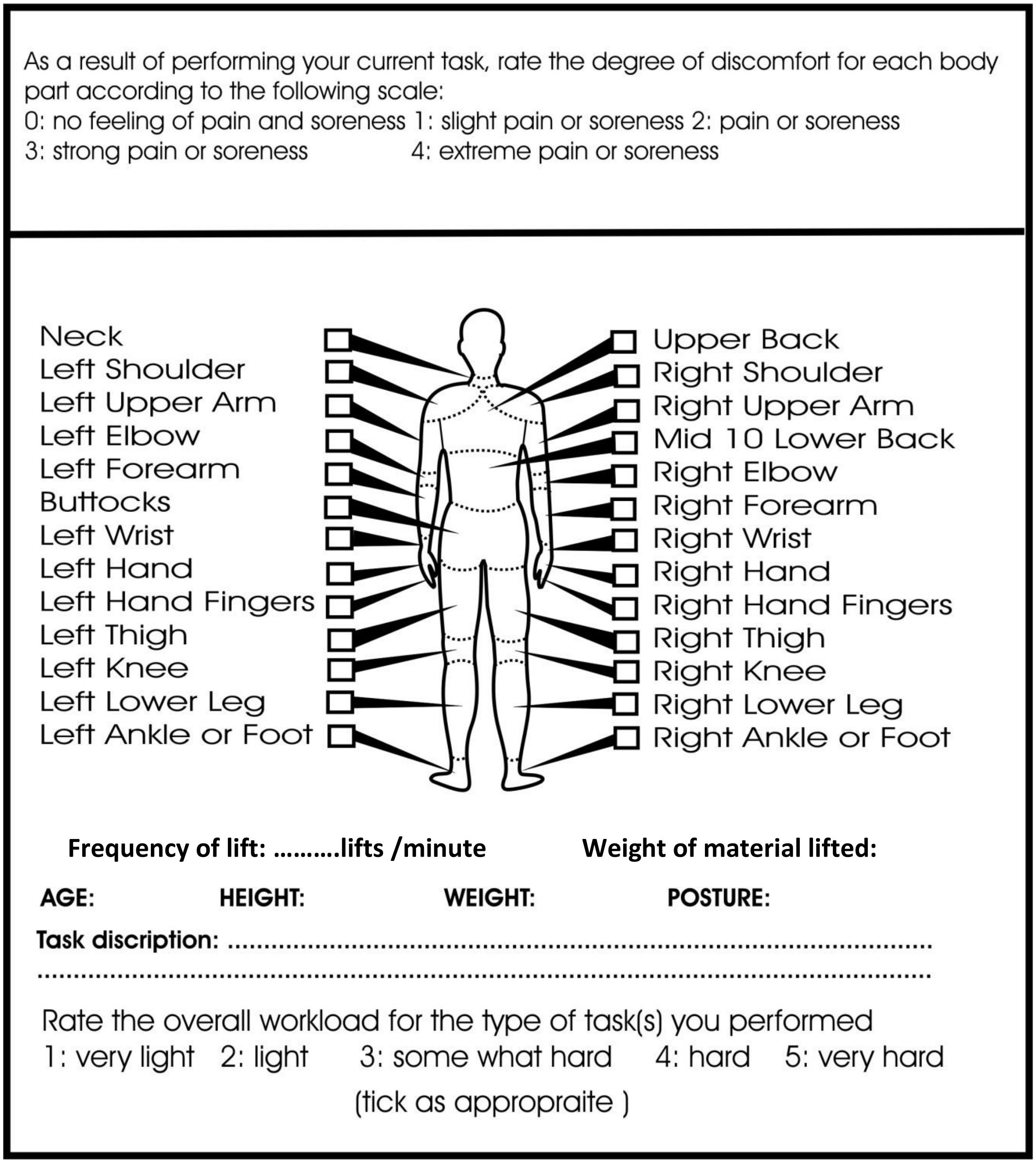
The study sought to identify body parts prone to severe discomfort prone to people performing lifting as their occupational tasks in block molding industries; assess the reaction of the participants to the workload of their occupational task; and compare the lifting tasks performed to ergonomic standards. Akure is the capital City of Ondo state and a fast developing city in Nigeria and was chosen for the study because of its availability of several block moulding industries to meet increasing building demand in the state.

2. METHODOLOGY

Sequel to the nature of the study, a field approach was employed. This involved personal visits to some block moulding industries within Akure metropolis. Thirteen locations were randomly selected and visited.

In order to assess the post ergonomic effects of performing occupational lifting tasks on the subjects, a well-structured questionnaire obtained from [6] which was earlier adapted from [10] was administered on subjects that performed lifting tasks at the various locations visited and relevant data collected.

The questionnaire contains a body discomfort chart and an overall workload assessment scale. The questionnaire was also used to obtain other basic data such as age, height, and weight. The weight of material (block) lifted and lifting posture of the subjects was also obtained. Each subject was asked to rate the degree of discomfort for each listed body part as a result of performing the type of task being studied. Illiterate workers posed a great challenge during the field trip. This was however taking care of by educating them in their local dialect.


As a result of performing your current task, rate the degree of discomfort for each body part according to the following scale:
0: no feeling of pain and soreness 1: slight pain or soreness 2: pain or soreness
3: strong pain or soreness 4: extreme pain or soreness

Neck
Left Shoulder
Left Upper Arm
Left Elbow
Left Forearm
Buttocks
Left Wrist
Left Hand
Left Hand Fingers
Left Thigh
Left Knee
Left Lower Leg
Left Ankle or Foot

Upper Back
Right Shoulder
Right Upper Arm
Mid 10 Lower Back
Right Elbow
Right Forearm
Right Wrist
Right Hand
Right Hand Fingers
Right Thigh
Right Knee
Right Lower Leg
Right Ankle or Foot

Frequency of lift: ……….lifts /minute **Weight of material lifted:**

AGE: **HEIGHT:** **WEIGHT:** **POSTURE:**

Task discription: ………………………………………………………………………………………
………………………………………………………………………………………………………

Rate the overall workload for the type of task(s) you performed
1: very light 2: light 3: some what hard 4: hard 5: very hard
(tick as appropraite)

FIGURE 1: The Whole Body Discomfort Questionnaire Used in the Study Source: [6].

The degree of discomfort is a five point scale going from no feeling of pain or soreness (0) to extreme pain or soreness (4). After the rating of discomfort, the subject was asked to rate the overall workload for the type of tasks being studied. The workload scale is also a five-point scale with one being very light and five being very hard. The information gotten from the questionnaires are presented in Figures 2 and 3 and the summary of the task studied is as shown in Table 2.

A standiometre was used to measure the height and weight of the subjects. The data collected was analyzed using software developed in [6] in order to determine the 5th and 95th percentile of the age, height and weight of the subjects. The body discomfort and workload ratings by the subjects were also extracted and presented in bar charts. The weight of the blocks lifted was measured using a dial spring scale procured for the purpose of the research.

ITEM	DISCRIPTION
NO. OF SUBJECTS	60 (all the subjects are male)
LIFTING POSTURE	Standing, Bending
DESCRIPTION OF LIFTING TASK	Lifting and carrying moulded blocks from machine and loading and offloading delivery trucks
FREQUENCY OF LIFT	3 Lifts Per Minute
AVERAGE WEIGHT OF THE BLOCK LIFTED	28 kg

TABLE 2: Summary of the Task Studied.

3. RESULTS AND DISCUSSIONS

Figure 2 shows that the mid to low back region of the body is the most stressed body part when performing lifting tasks in block moulding industries followed by the thighs. This can be attributed to the lifting posture (standing and bending) which over work the spinal compression disc (L5/S1) when an average load of 28Kg is lifted repeatedly during occupational operations.

The mid to low back region of the body being complemented by the shoulders as can be seen in figure are indications that people performing lifting tasks in block moulding industries are susceptible to spinal defects discussed in [14] such as spinal kyphosis (i.e. a spinal defect that reflects a weakness in the back muscles, especially the back extensor muscles that hold the upper back upright) and spinal lordosis (this is often associated with weak abdominal muscles that are not able to hold the low back and pelvis in their neutral position).

Again, the workload rating of the task by the subjects (Figure 3) show that the task is a “hard” one as the weight involved is above the ergonomic standards presented in Table 1. This further expresses why no female was seen in any of the industries visited.

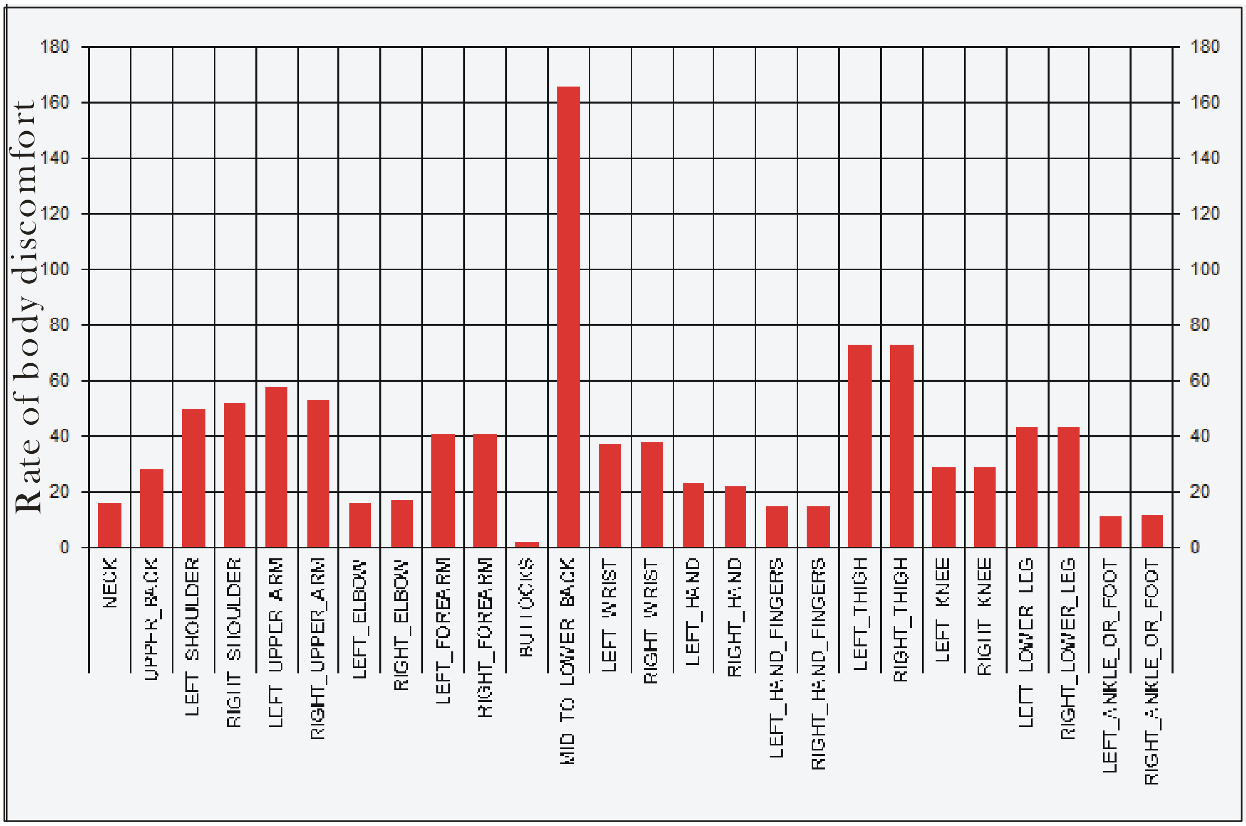


FIGURE 2: Chart showing the rate of body discomfort for lifting tasks performed in selected block moulding industries in Akure, Nigeria.

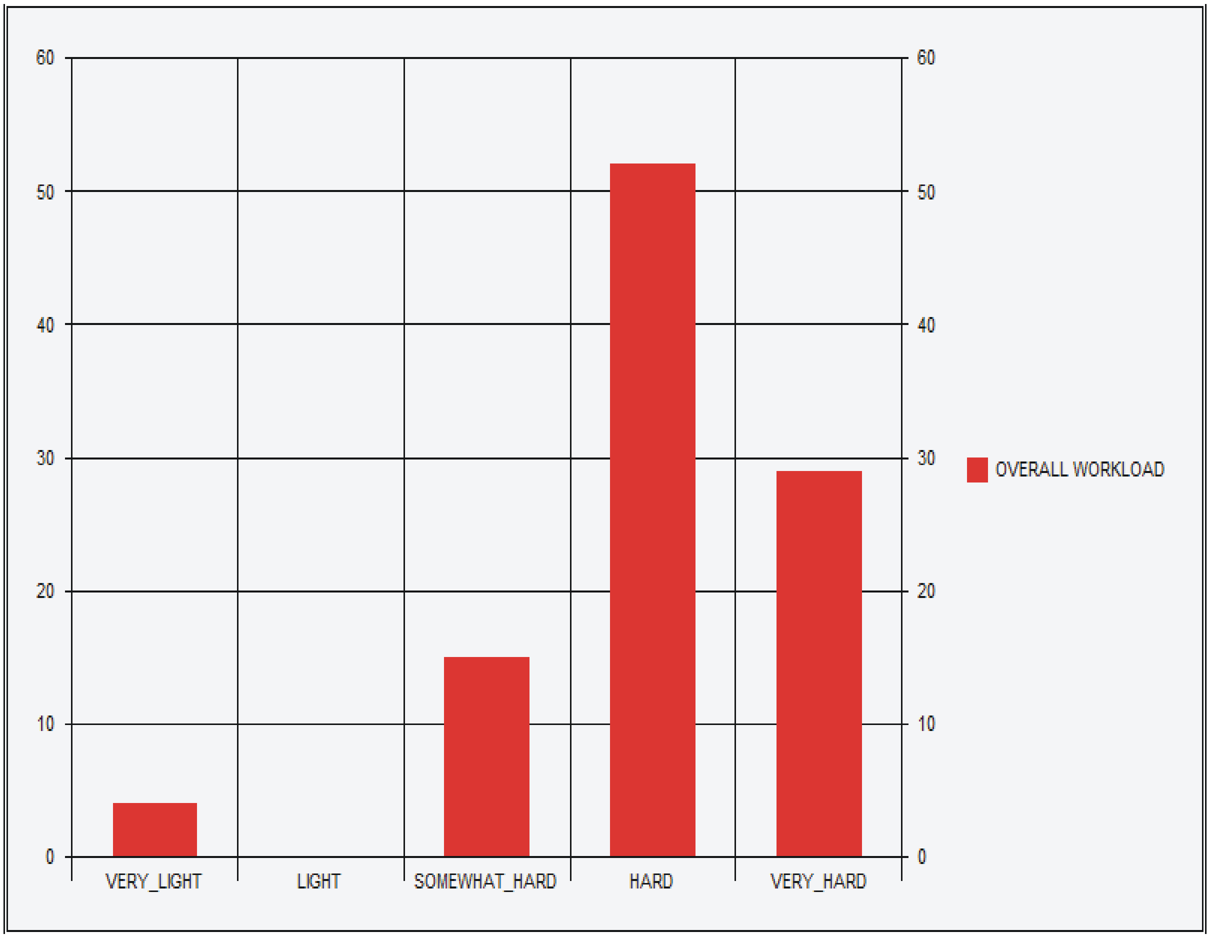


FIGURE 3: Chart showing workload rating by subjects performing lifting tasks in selected block moulding industries in Akure, Nigeria.

PARAMETER	MEAN	VARIANCE	S.D	5TH PERCENTILE	95TH PERCENTILE
AGE (YEARS)	29.5	121.57	11.03	11.36	47.64
HEIGHT (CM)	169.17	31.36	5.60	159.96	178.38
WEIGHT (KG)	61.5	205.53	14.34	37.91	85.09

TABLE 3: Anthropometric data of subjects that performed lifting tasks in selected block molding industries in Akure, Nigeria.

4. CONCLUSSIONS AND RECOMMENDATIONS

It can be concluded that lifting tasks performed in block molding industries pose a serious health risk to people performing the tasks. The low back region of the body is prone to severe body discomfort due to excessive bending when performing the occupational task as presented in [7]. This could be as a result of the automation in the process of block moulding where the person(s) removing the block from the machine will have to compete with the production rate of the machine. It is therefore necessary to employ the procedures of Job severity Index (JSI) discussed in [15] when allocating lifting tasks to employees in block moulding industries. According to [15], The JSI is defined as the time and frequency-weighted average of the maximum weight required by each task divided by the selected lifting capacity given the lifting task conditions.

However, the effect(s) of occupational stress resulting from lifting tasks performed in block moulding industries can be reduced if the recommendations presented below are adhered to.

1) Strict compliance with ergonomic lifting techniques should be enforced by the industry based supervisors.

2) Block moulding process should be redesigned to incorporate engineering controls described in [16] as efforts to reduce container size, reduce unit weight, and enhance container or unit handholds and mechanical "couplings," such as the use of handles or other features that eliminate hand grip discomfort and increase hand grip strength.

3) Enough workers should be employed to lift the blocks from the machine with respect to the production rate of the machine.

4) There should be increased downtime for workers during operational hours.

5) Further work should be conducted to include biomechanical evaluation of lifting task performed in block moulding industries using the procedures in [10].

6) Improvement studies should be conducted to incorporate block removal process in the automation of the block moulding machine.

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