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Assessing Ergonomic Risks of Work-related Musculoskeletal Disorders in Soap Making Industries in Nigeria

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Abstract

Introduction: Workers in manufacturing industry are frequently exposed to occupational dangers associated with work-related musculoskeletal disorders. However, few studies were available on work-related musculoskeletal disorders amidst workers in Nigeria's soap making industry.
Objective: To assesses ergonomic risk associated with work-related musculoskeletal disorders (WMSDs) in soap production.
Method: Twenty purposively selected soap baking workers from four industries; work postures were assessed. Semi-structured oral questionnaires were used to appraise body areas where participants experienced the WMSDs. Workplace inspections were done by observing soap baking workers engaged in their various tasks. The semi-structured oral questionnaires and observation data collected were analysed using descriptive statistics and the Ovako Working Posture Analysis System.
Result: The descriptive statistics revealed that the participants experienced pain/discomfort arising from their work, with the body parts most commonly affected been the lower back, wrists-hands, shoulders, and upper back (100%), respectively, elbows, and ankles/feet (75%), respectively, and neck (50%). Participants identified ergonomic risk were frequent twisting and bending during dragging of soap cake into the conveyor from cylinder cooler hopper as the prominent cause of the ache.
Conclusion: The workplace should be ergonomically redesign to reduce frequent bending and twisting during soap baking that require inclined conveyor and handling techniques, to eliminate the identified risk factors causing WMSD among the soap baking workers.
Keywords: work-related musculoskeletal disorder, discomfort, soap baking, pushing

Abstrak

***Pendahuluan**: Pekerja di industri manufaktur seringkali terpapar bahaya pekerjaan yang terkait dengan gangguan muskuloskeletal terkait pekerjaan (WMSDs). Namun, hanya sedikit penelitian yang tersedia mengenai WMSDs di antara pekerja di industri pembuatan sabun di Nigeria.*
***Tujuan**: Menilai risiko ergonomis yang terkait dengan WMSDs dalam produksi sabun.*
***Metode**: Dua puluh pekerja pembuatan sabun yang dipilih dengan sengaja dari empat industri; postur kerja dinilai. Kuesioner lisan semi-terstruktur digunakan untuk menilai area tubuh di mana peserta mengalami WMSDs. Inspeksi tempat kerja dilakukan dengan mengamati pekerja pembuatan sabun yang terlibat dalam berbagai tugas mereka. Data dari kuesioner lisan semi-terstruktur dan pengamatan yang dikumpulkan dianalisis menggunakan statistik deskriptif dan Sistem Analisis Postur Kerja Ovako.*
***Hasil**: Statistik deskriptif mengungkapkan bahwa peserta mengalami rasa sakit/ketidaknyamanan yang berasal dari pekerjaan mereka, dengan bagian tubuh yang paling umum terkena adalah punggung bawah, pergelangan tangan-tangan, bahu, dan punggung atas (100%), diikuti oleh siku, dan pergelangan kaki/kaki (75%), dan leher (50%). Peserta mengidentifikasi risiko ergonomis berupa seringnya membungkuk dan memutar saat menarik kue sabun ke dalam konveyor dari corong pendingin silinder sebagai penyebab utama rasa sakit tersebut.*
***Kesimpulan**: Tempat kerja perlu didesain ulang secara ergonomis untuk mengurangi pembungkukan dan pemutaran yang sering terjadi selama pembuatan sabun, yang memerlukan konveyor yang miring dan teknik penanganan, untuk menghilangkan faktor risiko yang diidentifikasi yang menyebabkan WMSD di antara pekerja pembuatan sabun.*
***Kata kunci**: gangguan muskuloskeletal terkait kerja, ketidaknyamanan, pembuatan sabun, mendorong*

Introduction

Work-related Musculoskeletal Disorders (WMSDs) has turned out to be critical challenge in worldwide affecting workers across various industries.[2] The WMSD have caused significant human suffering, and are challenging to manage due to high associated medical costs, also leading to reduce working capacity and decreased productivity. It has described wide range of demagogic, and disorders resulted in aches and functional injury that impart body's soft tissues, including breaking of ligaments, tendon covers and nerves that involves other body parts. Additionally, disorders include hurt in the neck and shoulders, which frequently cause work incapacity amidst workforces, which recurrently connected to long periods of ill health, and leave of absence from work. According to the National Institute of Occupational Safety and Health,[6] WMSDs arise when workforces are exposed to work circumstances that importantly contribute in nurturing the disorders in the body, however, may not act as sole basis of causation. The WMSD risk factors has been associated with several occupational engagement such as bodily work load factors like energy, posture, physical handling, dreary work and vibration, psychosocial, stressors, and personal factors. The factors can result to danger, which was caused by extended repetitive activities of forceful and awkward position devoid of requisite relaxation period. This study is assessing ergonomic factors of WMSDs in Nigeria Soap baking Industry.

Studied bakers' exposures to occupational risks and their way of dealing with the challenges by adopting a cross-sectional design, which was studied among 172 bakers in Kumasi metropolis, Ghana.[3] The bakers were observed to be exposed to occupational hazards such as physical, biological, psychosocial, chemical, and ergonomic hazards. The categories of method adopted for coping includes use of wooden and metallic peel, mosquito repellent/coil, relaxation period, and keep on hydrated. [7]observed that worker involved in administrative centre work, manufacturing, agriculture and numerous materials handling occupations have reported great incidence rates of WMSDs in the upper extremity. In research conducted in thirty workshops that were involved in producing copper utensils by measuring temperature, noise level, and formulated questionnaire distributed to evaluate well-being risks of the workers, while method of observation was adopted in evaluating working conditions at the workshops. It was reported that most workers suffered from health challenges of eyes irritation, back ache, skin hurts, respiratory difficulties, and general weakness. The use of personal protective equipment was suggested to workers to prevent risk factors.[12]

Studied musculoskeletal ailments in a brick factory that turned clay into bricks. [9] The researcher discovered that upper limb and back was area of harms, while postural position and force analysis revealed poor erect, and unaccepted wrist positions together with significant force loadings. Used cross-sectional descriptive statistics to study bodily injury that influence musculoskeletal disorders among 200 sales personnel and found that participants had aches in the hip, ankle, knee, neck, back, shoulder, and waist at 46, 20, 16.5, 9.5, 8.5, 1.5, and 0.5 %, respectively.[5] Reviewed 19 articles regarding Musculoskeletal Disorders (MSDs) and other occupational health challenges in Small Scale Industries (SSI).[10] The reviewed article covered SSI like brick (2), carpet (2), handloom (1), cotton spinning (1), garment (3), handicraft (2), food and bakery (4), footwear (2), and saw mills (2). The MSD factors identified were poor standing posture, undesirable wrist position, nerve/tendon trauma, neck, lower back, ankles, upper back, shoulders, and knee injuries. Abdullah et al. (2017) evaluated WMSDs involved in working posture in a cable support system factory, which was found that workers experienced severe WMSD resulted from awkward postures, excessive force, repetition connected with restricted working area, prolong standing, and heavy equipment lifting.

Job Hazard Analysis (JHA) was used to break cassava flake frying industry activities into its work elements, which were loading, stirring, and unloading task. Questionnaire and oral interviews were used as tool of data collection, while musculoskeletal stress was identified by Quick Ergonomic Check (QEC), and postures that were awkward was assessed through arm reach ratio.[11] The researchers reported that complain around shoulder region was 97.5% among the respondents, while pain in the region above shoulder/arm, back and wrist were identified by QEC. [8]observed health records of involved subjects in their research at a government accredited health centre as well adopted structured questionnaire and oral interview to identify occupational dangers. The identified risks were musculoskeletal disorders, bone and joint problems, skin

conditions and respiratory issues. The dust from quarry, metal, paper, minerals, wood, cereals, cement, industrial chemical fumes, extreme posture of wrist, repetitive movements, inhalation from petrol, etc were identified as cause of the occupational dangers. The researchers suggested adequate awareness of occupational health and safety through training, symposium, and use of personal protective equipment to be encouraged to minimise the risks.

Methods

A total of twenty male workers purposively selected from four soap making industries that were involved in soap production voluntarily participated in the semi-structured oral questionnaire. Every likely participant consented that their involvement should be on company time with the normal rate of company remuneration. Therefore, the 20 subjects consented to engage in the research without payment and with understanding that the research has no link to their job position in the organisation. The participants were assured of non-disclosure of the information given during/after the study. Questionnaires were filled during lunch break and lasted approximately 10 minutes for each participant. Work place analysis was accomplished by observing employees as they were carrying out their tasks. The participants' postures were observed when their tasks were being carried out and observed postures were recorded based on Ovako Working Posture Analysis System (OWAS). The OWAS code were; the back posture four (4options), arm postures (3 options), leg postures (7 options), and load/use of force (3options) all were structure choice sentences. The participated subjects' postures were recorded for each of the four categories of OWAS for the duration of the tasks. Postures were noted according to OWAS postural categories, this was observed in the period of half or one-third of a minutes. For example, back division of tally 4 means back bent-frontward and twisted and 1 stands for upright back. Arms section (1) the two arms below shoulder level, Legs division (2) can be related to standing on two legs upright, Load/use of force section (2) means between >10<20kg and (1) stands for weight or force required is equal to or less than 10kg. Descriptive statistics were used for participants demographics and pain prevalence.

Stated below are the four body parts and sections code in Ovako Working posture Analysis Systems:

a. Back Section codes:
   1 = Upright
   2 = Bent frontward or backward
   3 = Twisted or bent sideways
   4 = Bent and twisted or bent frontward and sideways
b. Arms Section codes
   1 = the two arms below shoulder level
   2 = One arm at or above shoulder level
   3 = the two arms at or above shoulder level
c. Legs Section codes
   1 = Sitting
   2 = Staying on the two legs upright
   3 = Staying on one leg straight
   4 = Staying on the two knees bent
   5 = Staying on one knee bent
   6 = Kneeling on one or the two legs
   7 = Walking or moving
d. Load/Use of Force
   1 = Load or force needed is equal to/less than 10kg
   2 = Load or force needed greater than 10kg but is less than 20kg
   3 = Load or force needed higher than 20kg

This study has been carried out in accordance with the ethical standards by 1964 declaration of Helsinki.

Soap baking job description

Soap cakes were manually drag with the help of a rail from the cylinder cooler hopper onto the incline belt conveyor, where it is been transported into a bucket elevator, which lifted it and discharge it into a silo for temporary storage. The job was performed while bending and twisting. The method for dragging is constant from one worker to the other. Figure 1 shows one dimension representation of soap baking factory flow chart.

Results

The mean data of the twenty male participants of age (year), duration of employment (year), height (m), and weight (kg) that were involved in the present study were presented in Table 1.

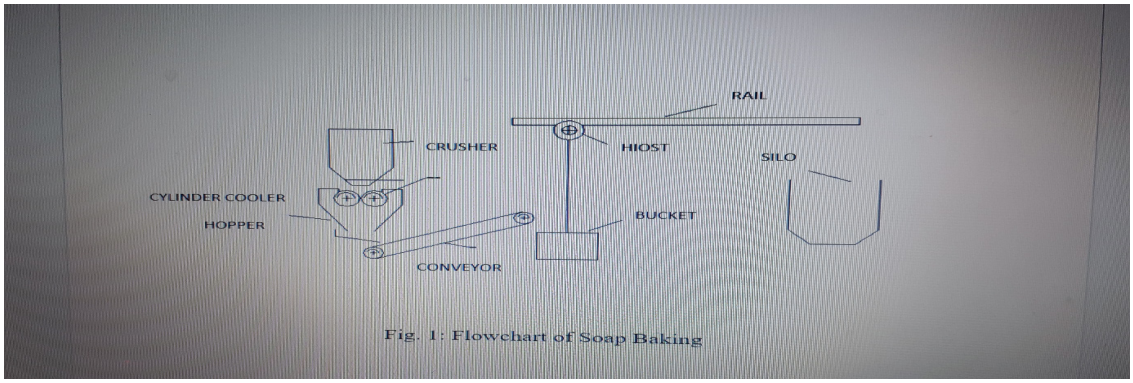

Figure 1. Soap factory flow chart

Table 1. Demographic information of the respondents

Demographic data	Mean
Age (years)	30.25
Duration of employment (years)	4.75
Height (m)	1.57
Weight (kg)	124.00

The assessment scores computed for postural stress analysis in soap baking were found to be 1, 1, 2, and 2 for back (upright), arm (the two arms below shoulder level), leg (staying on the two legs upright), and load/use of force (weight or force needed greater than 10kg but is less than 20kg), respectively, for pushing of soap cake out of cylinder cooler hopper; the score of 4, 1, 2, and 1 for back (Bent and twisted or bent frontward and sideways), arm (the two arms below shoulder level), leg (staying on the two legs upright), and load/use of force (Weight or force needed is equal to/less than 10kg), respectively, were found for dragging soap cake into the inclined conveyor belt; while 1, 1, 2, and 1 for back (upright), arm (the two arms below shoulder level), leg (staying on the two legs upright), and force (Weight or force needed is equal to/less than 10kg), respectively, were found for loading/filling the bucket elevator as presented in Table 2.

The require action classes were adopted from[4] as stated below:

Action class 1: Normal postures, which do not need any special attention.

Action class 2: Postures must be considered during the subsequent regular inspection of working methods.

Action class 3: Postures need attention in not too distant future.

Action class 4: Postures need instant attention.

The tallies in Table 2 indicated require actions for sub-tasks carried out by the participants in this study. The tally 3 indicated that the subject postures need corrective measures attention in not too distant time, while tally of 4 indicated that postures correction measures should be instant, and tally 2 means that work posture must be given attention in the subsequent regular inspection. The tallies were recorded as relates to OWAS method in soap baking as shown in Table 2.

Table 2. Postural Stress analysis using OWAS

Sub-task	Back	Arms	Legs	Force	Tally
Pushing	1	1	2	2	3
Dragging	4	1	2	1	4
Loading/Filling	1	1	2	1	2

Self-reported discomfort/pain

Enquires were made from the participants as concern apparent pain experience, that persisted for not less than 24hrs. The enquiry was based on the participants experience for the past 12months. During the period of 12months, following responses were obtained as stated; 100% (20) of the participants reported lower back pain, and pain on the neck was 50% (10), 100% (20) of the participants indicated that they experienced pain on their upper back, shoulder and wrist-hand, respectively,

75% (15) subjects response revealed pain in elbows and ankles/feet. Reported that majority of the selected respondents in a brick making industries for self-reported musculoskeletal disorder study complained of pain and discomfort in different body parts, which were wrist, upper and lower back, hips/thighs, knees, and ankle/feet as reflected in this study where participants worked in a soap baking industry.[9]

Limitation

This study did not consider association risk between the workers' age, duration of employment, weight and task being carried out.

Discussion

The activities of the soap bakers in this study revealed a severe ergonomics risk that involved twisting and bending frequently. The soap making job was found to be very much repetitive. The pain experienced by the subjects on their body region in the period of 12months showed that most workers experienced pain in their lower and upper back, shoulder, wrist-hand, and elbows and ankles/feet. The findings in this study support[5,9] whose reports identified body part found in the present studies. The factors of work that contributed to the occurrence of musculoskeletal disorders were found to include workplace design; where the soap baker majorly involved in soap cake dragging and pushing. This led to majority of the soap bakers to spend time in repetitive activity during soap making. Another challenge noticed was the existing arrangement of the workplace, which requires that soap bakers should bend and turn 45^0 during dragging of soap cake to the conveyor, this demand frequent rotation and frontward bending of the workers' spine. Also soap bakers have to bend at angle 45^0 in order to reach out with their hands round to the soap cake in the cylinder cooler hopper. Simple changes to the workplace design would minimise the awkward postures during soap baking activities and reduced work-related musculoskeletal disorder experienced the workers.

Conclusion

The challenges of Work-related Musculoskeletal Disorders (WMSDs) in soap baking processes could be traced to the influence of the workplace design that imposed frequent bending and twisting on the soap bakers. Therefore, inclined conveyor should be positioned directly under the cylinder cooler hopper for direct falling of soap cake into the conveyor to avoid dragging, and implementation of continuous educational program to allow soap bakers know the relevant factors involved in work-related musculoskeletal disorders is necessary to minimise the risk of the WMSDs. If it is possible, shift of job should be allowed for tasks, especially for those workers who are much more prone to work-related musculoskeletal disorders.

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