International Journal of Occupational Safety and Ergonomics (*JOSE*) 2005, Vol. 11, No. 2, 171–180

Harmful Postures and Musculoskeletal Symptoms Among Sanitation Workers of a Fish Processing Factory in Ghana: A Preliminary Investigation

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This study investigated musculoskeletal symptoms among sanitation workers of a fish-processing factory. The methods used included administration of a questionnaire, walk through observation, interview, task analysis and future workshop. All 27 male participants answered and submitted their questionnaires. Of the 11 operations identified, all except one was considered safe. Bent back, bent legs, and heavy manual handling were observed to impose intolerable health risk on participants. This corresponds with questionnaire results in which musculoskeletal symptoms were mostly prevalent in the neck, the shoulder, the low back, the wrists/hands and the upper back regions. Poor psychosocial complaints were also made on the job. There was no significant correlation ($p < .05$) between musculoskeletal symptoms and age, working hours and length of service. Neither was any significant correlation observed ($p < .05$) between psychosocial work factors and musculoskeletal symptoms. Recommendations such as task redesign to eliminate high-risk elements in operations, workplace changes and worker training were suggested.

ergonomics posture fish processing industry sanitation workers Ghana

1. INTRODUCTION

Early health problems identified in the fish processing industry include fatigue, stress, insomnia, digestive problems, and aches and pains. These health problems were associated with job dissatisfaction, physical environmental stressors and high work pace [1]. In recent times musculoskeletal disorders have been a top priority in the industry. The prevalence of sick leave due to disorders of the musculoskeletal system and the intention to leave the job due to musculoskeletal injuries were reportedly higher among workers than the general population [2, 3]. Former employees were also reported to have suffered 3 to 7 times more musculoskeletal injuries than current employees and this was the reason for the former workers quitting their jobs [4]. Prevalence of the neck, shoulder, elbow and hand disorders have also been reported higher in workers of the fish processing industry than the general population [2, 5, 6]. Most recent studies have also identified musculoskeletal disorders in the neck, shoulders, upper limbs and ankles as the most prevalent diseases in the industry among female workers involved in cod trimming, working at herring fillet machines, doing different types of packing activities and among male packers [3, 4, 6, 7, 8, 9]. However, no documented study exists for the sanitation workers of the industry. This is because most of these studies were carried out in the developed countries where the sanitation task is mechanized. However, in the developing nations,

The author wishes to acknowledge the financial support from the Swedish Institute (Stockholm, Sweden) and contribution from Dr. Barbara Richardson, Dr. Eric Kwei and Professor Houshang Shahnavaz.

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where the sanitation task is manually performed, studies in the industry are scanty or non-existing.

Evidence abounds that the actual contributing factor for the development of musculoskeletal health problems in the fish industry are poor awkward postures, heavy manual handling, trunk flexion and/or twisting, pushing and pulling as well as lifting well below the ground level, poor relationship with work mates, length of employment, gender, age, anthropometry, inadequate rest period, strenuous and awkward postures and manual material handling [1, 3, 4, 8, 9, 10, 11, 12, 13, 14]. There is also evidence that the risk of musculoskeletal disorders is due to a complex interaction of psychosocial work factors, physical characteristics of the job, psychological and individual characteristics and psychological and biological reactions [3, 10, 15, 16].

Various measurement techniques exist for the assessment of postural stress. These range from direct measurement of different joint angles with the use of protractors and angle templates [17, 18], special inclinometers for the measurement of the inclination of the spine [18, 19], video imaging through image processing techniques [21] and three-dimensional measurement using two or more cameras and infrared markers. Most of these methods are laboratory-based and inappropriate for the industrial setting. But observation methods such as the Ergonomic Assessment Method for Task Analysis (AET) [22], the Rapid Upper Limb Assessment (RULA) [23] and the Ovako Working Posture Analysis (OWAS) [24] are conducive for the industrial setting when carefully and systematically carried out. For possible health risks regarding working postures, very few methods are also available. Most are very elaborate and require more effort and time, especially when dealing with several different postures (e.g., biomechanical calculations of forces at joints and energy expenditure models).

In this study however, the OWAS method was used for posture evaluation, with the four criteria used by OWAS reduced to the three-zone evaluation system of the European Standard for ergonomic design [25]. The modified Nordic Questionnaire [26], hierarchical task analysis (HTA) [27], the Job Content Questionnaire [28, 29], walk through observation, interview and the future workshop [30] were used with the intent to provide understanding of the interaction of the task with workers and also describe the prevalence of musculoskeletal symptoms.

The objectives of this study were as follows:

1. To describe the prevalence of musculoskeletal symptoms and to identify the most prominent ones,
2. To analyze postures adopted in sanitation tasks,
3. To identify operations presenting the highest risk for workers,
4. To identify the most problematic posture(s),
5. To identify work factors associated with sanitation tasks,
6. To provide recommendations for improving sanitation tasks.

2. RESEARCH DESIGN AND METHODS

2.1. Study Design and Population

This descriptive study was carried out in a food-processing factory in Tema (an industrialized city in Ghana), which produces canned tuna. This industry had about 1,500 work force of which the majority were females. The male population was distributed in job tasks in which manual handling of heavy materials was predominant. Some of these tasks were fish distribution (distributing fish to fish trimmers), packing and sanitation work. However, the study was limited to sanitation workers, who were few in number compared with the other work groups (i.e., 51). During the time of the study only 27 were present.

Twenty-seven workers out of the 51 sanitation workers took part in the study (of the rest, 17 were on leave and 5 were excluded from the study because they were not regularly at work during the study period). Their mean height (range), mean age (range), mean weight (range) and mean length of service (range) were 159 ± 13.8 cm (140–185), 32 ± 10.7 years (24–44), 73 ± 10.7kg (56–95), and 4 ± 2.1 years (3–6) respectively. Their level of education was as follows: 12 (44.4%) had a middle school leaving certificate, 7 (25.9%) had an ordinary (O) level certificate, 5 (18.5%) had an advanced (A) level or a high school certificate and 3 (11.1%) had certificates from tertiary institutions. All 27 subjects worked 8 hrs a day including a half-hour lunch break. Supervisors selected 3 or 6 participants at a time to take part in the study when they believed their absence would not affect the work process. Some of the results can be found in Quansah [31].

2.2. Process and Task Description

2.2.1. Sanitation task

The sanitation task was non-mechanized. Sanitation workers worked in teams of 4 or 5 with each team stationed at each of five benches at the production premises. To start with, a sanitation worker pushed an empty 150 × 145 × 150 cm waste bin (which weighed about 10 kg) under the exit of a waste conveyor. The same worker directed fish waste into the bin with a stick. When the bin was full (and weighed about 54 kg) the same worker (sometimes assisted from behind) pushed the waste bin to free space. Two workers then lifted the waste bin onto a truck. After the truck had been loaded with about four of these fully filled bins, 2 workers then pushed the truck outside the production premises and dumped the waste into large waste receptors.

2.3. Data Collection

Different data collection methods were used in this study: a questionnaire, a walk through observation, an interview and task analysis, posture evaluation and a future workshop.

2.3.1. Questionnaire administration

The prevalence of musculoskeletal symptoms was measured with a modified Nordic Questionnaire [26]. Psychological demand on the job, job control, supervisor support and co-worker support were also investigated with the Job Content Questionnaire [28, 29]. Sets of questions were also included to address employment and personal information. The questionnaires were despatched to participants in a conference room after the objective of the study had been explained to them. All subjects who finished their questionnaire were asked to write their name, their job title and the section they worked in to eliminate double participation. This allowed elimination of a questionnaire of one worker from another department who took part in the exercise. On average, it took the participants 10 min to complete the questionnaire. All 27 did so (response rate 100%).

2.3.2. Walk through observation, interview and task analysis

To start with, a walk through observation and an interview of a supervisor and a worker were carried out to understand the work process and the operations involved in the task performed by the workers, and to study various working techniques adopted by sanitation workers. Hierarchical task analysis (HTA) [27] was developed to identify various operations involved in the task performed by participants (result published in Quansah [31]). This was later discussed with supervisors and workers to ensure inclusion of all relevant operations. Eleven operations were then identified: from task analysis to posture evaluation (Table 6).

2.3.3. Posture evaluation

As participants went about their daily routine work their postures were recorded with the OWAS [24]. The postures of each participant was recorded either once or twice (depending on the availability of the participants) in the morning (between 7.30 and 9.30 a.m.) and once or twice in the afternoon after the lunch break (between 1.30 and 4.00 p.m.) when they were busy and were not aware that their postures were recorded. Seventy postures were noted in all. However, consideration was given only to postures with posture codes appearing more than once (they were assumed to be held for the greatest length of time or by most subjects) and those with higher codes (they were assumed to be the postures where the highest load was likely to occur). This reduced the number of postures to 14 (Table 6). The OWAS classification system was then reduced to the three-zone evaluation systems

TABLE 1. OWAS Classification System Converted to the Three-Zone Evaluation System Adapted From EN 614-1:1994 [25]

OWAS Classification Systems [24]			CEN Three-Zone Evaluation System [25]	
Class	Postural Load	Design Measures	Evaluation Zone	Health Risk
1	Normal	Not necessary	Green	Low
2	Increased	Necessary	Yellow	Increased but tolerable for a limited time
3	High	As soon as possible	Red	Absolutely not tolerable
4	Very high	Immediately		

Notes. OWAS—Ovako Working Posture Analysis.

of European standards for ergonomic design to classify postures according to probable health implications (Table 1) [25].

2.3.4. Future Workshop

A future workshop [30, 31, 32] was organized for 26 people (6 from the management and 24 workers, including some of the participants). The essence of the workshop was to identify work factors that existed at the work place. The contributions from the subjects were dichotomized into worker and organization factors (Table 7).

2.4. Statistical Analysis

All categorical answers for participants were entered into MS-Excel with encoded numerical values. Means and standard deviations were used to describe the demographic data such as age, level of education and marital status. The Pearson chi-square was used to indicate the differences in musculoskeletal disorders by demographic details with the significance level at $p = .05$. The Pearson correlation was also used to investigate the relationship between participants' personal profiles and musculoskeletal symptoms and the psychosocial work factors. Pearson correlation was further used to investigate the association between psychosocial stress factors and musculoskeletal symptoms. Data analyses were performed with the SPSS version 10.0.1 software.

3. RESULTS AND DISCUSSION

This study showed that musculoskeletal symptoms were widespread among sanitation workers of the fish industry. They were particularly prevalent in the low back, the shoulder, the upper back, the neck and the wrists/hands regions (Table 2). Extensive time spent in lifting or dragging loads weighing 20 or 27 or 54 kg with flexed back or flexed and twisted back possibly contributed to aches in the low back. These loads were in most cases also lifted away from the body or from the ground. It is possible that during this activity a high compressive force generated on the low back may cause aches and pains [33, 34, 35]. Most sanitation

TABLE 2. Prevalence of Musculoskeletal Symptoms in Nine Body Regions Among Sanitation Workers (*N* = 27)

Body Regions	In the Past 3 Months *n* (%)	In the Past 7 days *n* (%)	Unable to Work in the Past 3 Months *n* (%)
Neck	23 (85.2)	8 (29.6)	14 (51.9)
Shoulders	22 (81.5)	9 (33.3)	13 (48.1)
Elbows	13 (48.1)	7 (25.9)	10 (37.0)
Wrists/hands	20 (74.1)	10 (51.9)	15 (55.6)
Upper back	22 (81.5)	16 (59.3)	16 (59.3)
Low back	19 (70.4)	17 (63.0)	16 (59.3)
Hips/thighs	11 (40.7)	8 (29.6)	8 (29.6)
Knees	8 (29.6)	5 (18.5)	5 (18.5)
Ankles/feet	8 (29.6)	7 (25.9)	4 (14.8)

workers held the view that lifting heavy loads made the job look better and attractive; whereas others believed that the waist belt was capable of preventing any musculoskeletal injury on the job (Table 7). These common notions were likely to influence their lifting and working behaviour.

Furthermore, aches in the neck, the shoulder and the upper back were caused by greater force used to lift and sustain heavy loads above shoulder level. Trucks were also overloaded and that, coupled with a bad state of the tires, necessitated the use of much greater force for pushing the trucks. This could result in generation of a static load component in the neck, low and upper back region [36]. Wells et al. [37] have shown the effect of handling heavy loads on the occurrence of shoulder pain following 3-month exposure. It is obvious that those study participants who had been involved in this work for at least 3 years were more vulnerable to various aches and injuries of the musculoskeletal system.

Musculoskeletal symptoms were higher in the past 3 months than in the past 7 days, which were part of the study period. This was because the past 7 days were part of the low season (from late August to November) where the intensity of work had gone done and workers had time to relax and interact with each other to ease the tense environment they experienced in the peak season (from January to mid-August, of which the past 3 months were part). Most sanitation workers interviewed indicated they got very tired in the peak season. Most workers were also unable to work due to musculoskeletal symptoms in the past 3 months. This suggests that the nature and intensity of the workload was likely to be responsible for the development of occupational musculoskeletal symptoms. Tables 4, 5 and 6 provide additional results for the neck, wrist/hands, shoulders, and upper and low back pertaining to age, working hour/week and length of service. No statistically significant correlation was found between musculoskeletal symptoms and age, average working hours/week and length of service ($p < .05$).

The responses for 5 psychosocial concepts are shown in Figure 1. High psychological stress indicated in this study buttresses several claims that psychological stress either increases the vulnerability of the neck and the shoulders to musculoskeletal pains or increases sensitivity to pain [38, 39, 40, 41]. Psychological stress may also expose workers to inappropriate working behaviour such as the use of forceful exertion, increased awkward postures of the neck, the wrists/hands and the back as observed in this study [42, 43]. In this study, workers were observed working under stressful conditions. The high work pace also allowed no control over the job and may have put many workers under the state of high psychological stress, especially in the peak season (Figure 1).

TABLE 3. Musculoskeletal Symptoms by Age

	Age of Workers (years)		
Body Region	**18–30** ***n* (%)**	**31–40** ***n* (%)**	**41–50** ***n* (%)**
Neck	7 (70.0)	7 (58.3)	3 (60.0)^{ns}
Shoulders	9 (90.0)	7 (58.3)	3 (60.0)*
Wrists/hands	8 (80.0)	8 (66.6)	3 (60.0)*
Upper back	9 (90.0)	10 (83.3)	3 (60.0)*
Low back	7 (70.0)	7 (58.3)	5 (100)*

Notes. *—significant, $p < .05$.

TABLE 4. Musculoskeletal Symptoms by Average Working Hours/Week

	Average Working Hours/Week (hrs)		
Body Region	**40–45** ***n* (%)**	**46–50** ***n* (%)**	**≥51** ***n* (%)**
Neck	5 (55.5)	6 (54.5)	6 (85.7)^{ns}
Shoulders	7 (63.7)	5 (55.5)	7 (100)*
Wrists/hands	5 (55.5)	9 (81.2)	6 (85.7)*
Upper back	8 (88.9)	9 (81.2)	5 (71.4)*
Low back	7 (63.7)	7 (70.0)	7 (100)*

Notes. *—significant, $p < .05$.

TABLE 5. Musculoskeletal Symptoms by Length of Service

	Length of Service (years)	
Body Region	**<5** ***n* (%)**	**5–10** ***n* (%)**
Neck	7 (70.0)	10 (59.8)^{ns}
Shoulders	6 (60.0)	13 (76.4)*
Wrists/hands	7 (70.0)	12 (70.5)*
Upper back	10 (100)	12 (70.5)*
Low Back	8 (80.0)	11 (11.7)*

Notes. *—significant, $p < .05$.

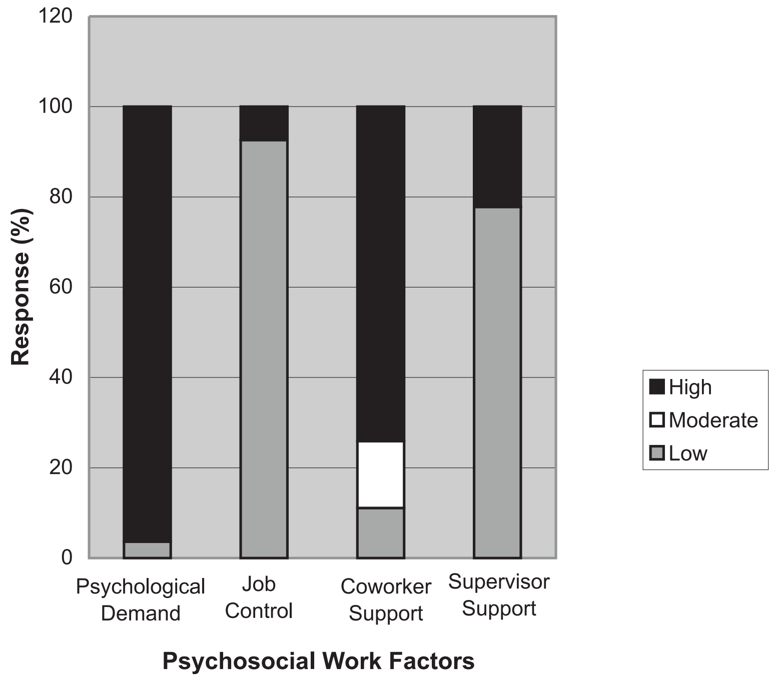

Figure 1. Response for four work place psychosocial concepts among sanitation workers in %.

Employment and personal factors had no significant ($p < .05$) association with any of the 5 psychosocial work factors. Neither was any significant association observed between the psychosocial variables and musculoskeletal symptoms.

TABLE 6. Operations Performed by Sanitation Workers (*N* = 27)

Operation No.	Operation
Op1	putting waste bin under waste carrier system
Op2	directing waste into waste bin
Op3	pushing waste bin when full to receptor height level
Op3a	by the same worker doing Op2
Op3b	drag by another worker behind
Op4	lifting waste bin when full from ground
Op4a	with 2-leg support on the ground
Op4b	with 1-leg support on the ground
Op5	waste bin raised to truck level
Op6	putting waste bin on track
Op7	pushing truck away
Op8	lift waste from truck
Op9	raise waste bin to waste free space
Op10	decanting waste
Op10a	close to waste receptor
Op10b	away from waste receptor
Op11	pushing truck back to premises

Notes. OpX—operations, OpXz—suboperations for operations.

Of the 11 operations identified, only one—operation 10(Op10:Op10a and Op10b)—was considered as a low risk operation [25] (Table 7 and Figure 2). No redesign measure was suggested for this operation.

The rest of the operations were considered to impose an intolerable health risk on the musculoskeletal system of participants because they impose high or very high postural load on participants. The most common risks associated with these operations were bent (≥60°) or twisted and bent back, and bent legs (≥60°). Those postures were due to inadequate space to lift or push waste bins, poor design of the exit of the waste conveyor and low height of trucks. Lack of training and ignorance saw most participants lifting with only one leg support on the ground. Handling or pushing or dragging heavy loads was also very frequent. These may be due to improper supervision of work tasks, overdependence on back belts, belief that lifting heavy loads makes work appear better and attractive, and competition among work teams (Table 7). From Figure 2, it was observed that the most frequently performed operations were those that imposed intolerable health risk (indicated with horizontal lines) on the

TABLE 7. Response of Participants During the Future Workshop (*N* = 26)

Worker Factor	Organizational Factor
1. Overloading of trucks and waste bin	1. Improper supervision of job tasks allowing bad habits to return or develop
2. Bad lifting habits among workers	2. Inadequate training of workers on safe working practice
3. Conservatism among workers	3. Poor supervisor-worker relationship
4. Competition among teams putting some workers under intense pressure	4. Poor state of tools and equipment (e.g., trucks)
5. A belief that lifting heavy loads makes the job look like a better job is done	5. Poor ventilation of workplace
6. Overdependence on waist belt among sanitation workers	

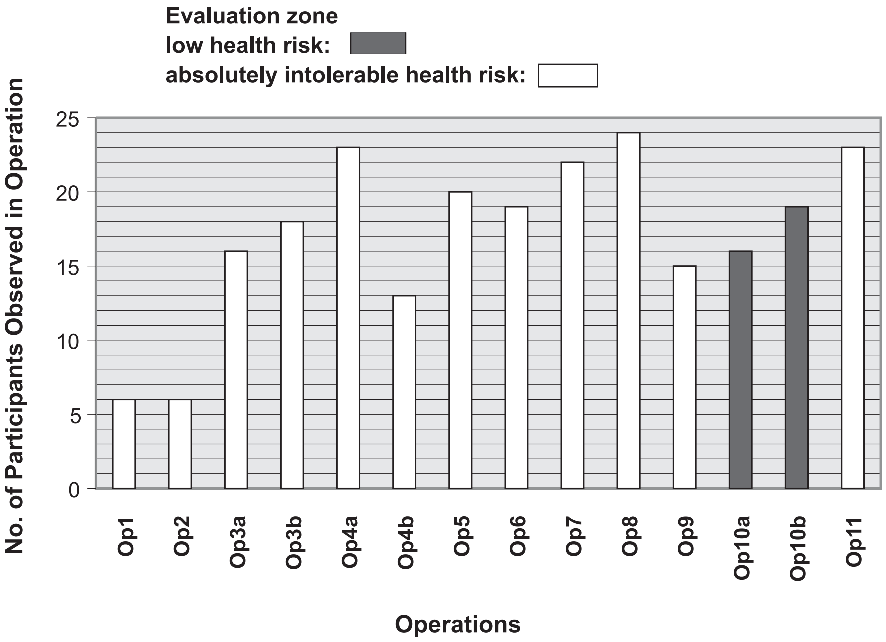

Figure 2. Showing the number of participants performing operations (Op1,...,11) and health risk as indicated by the three-zone evaluation system. *Notes*. Op(x = 1,…,11); Opxa,b = suboperations.

musculoskeletal system of workers. This confirms the widespread musculoskeletal symptoms among the participants. Kant et al. [44] have indicated that many occupational disorders were the results of poor working postures and the interaction of working postures with the work environment. It is true that improvement of working conditions through a reduction in poor working postures for sanitation work is very necessary.

The method applied in this study is appropriate for any industrial setting. It is not only relevant in increasing an understanding of how workers interact with tasks, but also in promoting ergonomic knowledge at the workplace. The use of the future workshop was necessary to promote worker and management participation in problem identification and solution seeking, which had never existed at the workplace. The use of direct observation was thought more appropriate than video technique in this study: the task was highly mobile and application of video technique might have interfered with the work. Furthermore, the observer being aware of potential observer errors, carefully followed subjects and recorded their postures when they were busy with their work and were not aware that their postures were recorded. Thus, it could be argued that observation bias was reduced to the barest minimum. Also, reducing the four-criteria system used by OWAS [24] to three-zone-evaluation of the European Standard for ergonomic design [25] provided an idea of the implication of posture on workers' health.

One source of error inherent in this study, which goes with modern complex production environments, was selection bias: (a) the subjects selected by supervisors might have represented those who were less likely to report unfavourable work situation, and (b) knowledge among subjects that the management knew about their participation in the study may have also influenced their objectivity regarding their answers in the questionnaire.

4. CONCLUSIONS AND RECOMMENDATION

Poor and awkward working posture due to poor design of workplace and workplace layout were adopted. Operations performed by the workers were suggested to impose high health risk on the workers' musculoskeletal system. Except for the relationship among workmates, workers suffered high psychosocial stress. It was therefore evident that a major ergonomic intervention was necessary to improve the work conditions. By critically examining different aspect of the work tasks and the work environment, a real improvement may require active participation of both floor workers and management. It is suggested here that active participation has not only the potential to deal with obvious problems, but also the lesser, hidden ones that have never been given consideration before. It also allows a new way of solving and dealing with problems using multi-talent and skill existing at the workplace.

Some possible improvements worth considering are the following:

- Re-schedule work to allow short breaks for muscle recovery, especially if workers sometimes engage in stretching exercises.
- Introduce pre-employment medical screening to recruit and assign appropriate tasks to workers.
- Improve ventilation system.
- Introduce appropriate and flexible training programs, which include good working techniques and their relationship with accidents and injuries at the workplace.
- Redesign trucks to fit users.
- Design waste conveyor to carry waste to reduce manual handling to the barest minimum,
- Redesign exit of waste conveyor to reduce awkward postures,
- Work teams should be autonomous in their work. Interpersonal communication and problem solving skills should be encouraged through training.

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