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The Prevalence of Muscle Fatigue Symptoms in Industries at Lembah Klang Malaysia

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Abstract. The purpose of this study was to investigate the prevalence of muscle fatigue symptoms and its relation to the job demands among industrial workers with repetitive light tasks. The participants were one hundred and sixty seven workers from the manufacturing and electronics industries in Lembah Klang Malaysia. The results show that the prevalence of muscle fatigue symptoms is high among industrial workers in the manufacturing and electronics sectors. The highest prevalence was for the shoulder (70.659%) and neck (65.269%). The prevalence of muscle fatigue symptoms were found to be higher for females than males. The higher prevalence of muscle fatigue symptoms are found to be related to job demand factors, particularly monotonous, attention requirement, precision, and repetitiveness.

Introduction

Muscle fatigue was defined as failure to sustain the necessary force or power [1], while other researchers described it as a reduction in the energy producing power [2]. Muscle fatigue is associated with physically monotonous or repetitive work but more recent studies also report an association between psychosocial factors at the work place and musculoskeletal disorders [3]. A high risk for muscular problems is usually triggered by time pressure, lack of influence over one's work and continuous repetitive tasks with short interval [4].

Based on an empirical review, there are many studies on muscle fatigue. Some of the studies analyzed muscle fatigue during repetitive tasks [5]. They found that time pressure, lack of influence over one's work and constant involvement in repetitive tasks of short duration often characterize jobs associated with a high risk for muscular problems. Light-assembly work is a clear example of low intensity work with elevated risks of neck and shoulder disorders [6].

In Malaysia, one of the largest employers in the country is the electronics industry [7]. The electronics and electrical products produced 72.5% of the total manufactured exports in the country [8]. A study by Chee and Rampal [9] conducted in a Malaysian electronics industry found that prevalence of pain in the neck, shoulders, arms, hand, and wrists were highly occurred in the part-assembly workers. The workers were subjected to awkward position and repetitive tasks with the hands and fingers.

In summary, repetition of tasks in modern industry has proven to be a factor in causing musculoskeletal disorders among workers. Poor design of repetitive tasks can increase a person's risk of developing injuries. Muscle fatigue could be caused by performing manual tasks repeatedly [10]. Thus, it is important to study the prevalence of muscle fatigue symptoms among industrial workers in Lembah Klang Malaysia due to repetitive tasks as studies related to occupational health and safety in Malaysian industrial workers are still lacking [9].

Methodology

Participant. Workers from the manufacturing (105 workers) and electronics industries (62 workers) in Lembah Klang Malaysia participated in this study. The criteria of the participants are full-time workers having no acute musculoskeletal problems, and full consent to participate. The main activities of their daily job are repetitive light tasks.

The participants were from industries invited to participate in the survey through invitation letters by post, telephone calls, and personal visits. Data was collected from February to June 2008. The participants consisted of 70 males and 97 females with the aged of 30±7.70 years. They were paid for their time and participation.

Survey Questionnaire. The survey used a self-administered questionnaire modified from the standardized Nordic Questionnaire [11] and Nordic Questionnaire for Psychological and Social Factors at Work. The questionnaire covers a range of topics including personal backgrounds, muscle fatigue symptoms, and job demand factors. The standardized Nordic Questionnaire [11] contains items with dichotomized response options about symptoms in nine separate body parts during last 12 months and last 7 days, and the interference of those 12-month symptoms to the normal work.

Questionnaire Analysis. The questionnaire analyses were performed using SPSS (version 19.0). The frequency data on the prevalence of muscle fatigue symptoms during last 12 months were compared between gender categorized by the Mann–Whitney U-test. Logistic regression analyses were performed to investigate associations between job demand factors and the prevalence of muscle fatigue symptoms from different body parts presented as odds ratios (ORs) with 95% Confident Interval (CI).

Results

A total of 167 completed questionnaires were returned by workers from the industry. In this study, only workers with at least 12 months experience in their current work were suitable for the study. The results of the survey are presented below.

Muscle Fatigue Section. Table 1 presents results of the muscle fatigue section of the questionnaire. The results present the prevalence of muscle fatigue symptoms in the last 12 months and the last 7 days together with the interference of the symptoms to their normal work. The results show that there were high prevalence of muscle fatigue symptoms for the shoulders (70.659%), the neck (65.269%) and the wrists/hands (47.305%) during the last 12 months. These symptoms have fairly interfered with their normal work, especially due to shoulders and neck symptoms (43.114% and 40.120%, respectively). For the seven-day prevalence of muscle fatigue symptoms, the highest rate was also found in the shoulder area (55.090%) followed by the neck (47.904%) and the wrists/hands (38.323%).

The prevalence of muscle fatigue symptoms is also investigated for different gender. The results are presented in Table 2. Both males and females suffered higher prevalence in the shoulders (62.857% and 76.289%), neck (60.00% and 69.072%), and wrists/hands (42.857% and 50.515%). Females suffered relatively higher prevalence of muscle fatigue symptoms compared than males for all body parts, except for hips/thighs (28.866%) and ankles/feet (22.680%). However, those differences were not statistically significant.

Table 1. Prevalence of muscle fatigue symptoms and work interference among participated industrial-workers

Body Part	Prevalence of muscle fatigue symptoms during last 12 months		Prevalence of muscle fatigue symptoms that prevented workers from doing their normal work		Prevalence of muscle fatigue symptoms during last 7 days	
	N	%	N	%	N	%
Neck	109	65.269	67	40.120	80	47.904
Shoulders	118	70.659	72	43.114	92	55.090
Elbows	76	45.509	44	26.347	58	34.731
Wrists/Hands	79	47.305	52	31.138	64	38.323
Upper Back	64	38.323	42	25.150	49	29.341
Lower Back	67	40.120	43	25.749	54	32.335
Hips/Thighs	49	29.341	22	13.174	34	20.359
Knees	45	26.946	24	14.371	36	21.557
Ankles/Feet	40	23.952	23	13.772	25	14.970

Table 2. Prevalence of muscle fatigue symptoms during last 12 months by genders

Body Parts	Male (n = 70)		Female (n = 97)		Sig. (2-tailed)
	N	%	N	%	
Neck	42	60.000	67	69.072	0.226
Shoulders	44	62.857	74	76.289	0.061
Elbows	28	40.000	48	49.485	0.226
Wrists/Hands	30	42.857	49	50.515	0.329
Upper Back	22	31.429	42	43.299	0.121
Lower Back	26	37.143	41	42.268	0.506
Hips/Thighs	21	30.000	28	28.866	0.874
Knees	15	21.429	30	30.928	0.173
Ankles/Feet	18	25.714	22	22.680	0.651

Job Demand Section. The results of the job demands section are presented in Table 3. The workload levels and conditions of work tasks can be characterized by task difficulty, attention requirement, precision requirements, etc. The results show that in general, the levels job demands experienced by workers were above normal in a scale of 1 for never and 5 for always. The highest job demand rating was attention requirement (4.174±0.752), followed by monotonous (4.114±0.689) and social contacts (4.012±0.836).

Table 3. Mean of job demand factors for participated industrial-workers

No.	Description	Mean	SD
1	Task Difficulty	3.545	0.683
2	Attention Requirement	4.174	0.752
3	Precision Requirement	3.988	0.784
4	Monotonous	4.114	0.689
5	Repetitiveness	3.497	0.898
6	Social Contacts	4.012	0.836
7	Risk of Injury	3.024	0.828

Table 4. Job demand factors associated with prevalence of muscle fatigue symptoms (OR, 95% CI)

Body Part	Task Difficulty	Attention Requirement	Precision Requirement	Monotonous	Repetitiveness	Social Contacts	Risk of Injury
Neck	0.876 (0.536-1.431)	0.483 (0.290-0.806)**	1.216 (0.761-1.943)	0.840 (0.496 - 1.422)	1.061 (0.725 - 1.552)	0.825 (0.547 - 1.243)	1.132 (0.735 - 1.744)
Shoulders	1.009 (0.599-1.699)	0.835 (0.498-1.399)	1.363 (0.830-2.238)	0.570 (0.323 - 1.006)	1.091 (0.732 - 1.627)	0.916 (0.599 - 1.400)	0.917 (0.583 - 1.443)
Elbows	1.032 (0.652-1.634)	0.926 (0.592-1.448)	1.131 (0.734-1.743)	1.080 (0.667 - 1.748)	1.140 (0.797 - 1.630)	0.907 (0.618 - 1.331)	0.895 (0.600 - 1.335)
Wrists/Hands	0.851 (0.537-1.349)	0.967 (0.620-1.509)	0.834 (0.542-1.283)	0.997 (0.618 - 1.609)	1.051 (0.736 - 1.499)	0.880 (0.601 - 1.290)	1.082 (0.726 - 1.612)
Upper Back	1.030 (0.634-1.673)	0.844 (0.528-1.351)	1.165 (0.735-1.849)	0.621 (0.373 - 1.034)	1.592 (1.082 - 2.344)*	0.875 (0.585 - 1.307)	0.965 (0.637 - 1.464)
Lower Back	1.021 (0.633-1.647)	0.972 (0.609-1.550)	0.626 (0.395-0.992)*	0.937 (0.568 - 1.545)	1.538 (1.050 - 2.254)*	0.784 (0.526 - 1.170)	0.878 (0.580 - 1.329)
Hips/Thighs	1.388 (0.832-2.315)	0.759 (0.462-1.248)	0.918 (0.562-1.500)	0.670 (0.390 - 1.149)	1.675 (1.102 - 2.545)*	0.937 (0.611 - 1.438)	1.180 (0.761 - 1.829)
Knees	1.225 (0.717-2.091)	0.912 (0.539-1.543)	0.610 (0.359-1.037)	0.900 (0.508 - 1.594)	2.219 (1.410 - 3.490)**	0.781 (0.495 - 1.231)	0.923 (0.580 - 1.466)
Ankles/Feet	1.252 (0.723-2.170)	0.662 (0.388-1.130)	1.054 (0.623-1.784)	1.057 (0.592 - 1.886)	1.049 (0.559 - 2.554)*	0.559 (0.345 - 0.906)*	1.123 (0.692 - 1.823)

* $p < 0.05$

** $p < 0.01$

Table 4 presents the results of the logistic regression analyses of the relations between job demand factors and prevalence of muscle fatigue symptoms during the last 12 months. It shows that a number of job demand factors were significantly related to the prevalence of muscle fatigue symptoms. Attention requirement factor was significantly related to the prevalence of neck pain symptoms (OR=0.483, 95%CI=0.290-0.806). Then, precision requirement factor was significantly related to the prevalence of lower back symptoms (OR=0.626, 95%CI=0.395-0.992). Also, social contact factor ratio was significantly related to a high prevalence of ankles/feet symptoms (OR=0.559, 95%CI=0.345-0.906). Among job demand factors, repetitiveness contributes the most to the prevalence of muscle fatigue symptoms of body parts. It was significantly associated to the high prevalence of upper back (OR=1.592, 95%CI=1.082-2.344), lower back (OR=1.538, 95%CI=1.050-2.254),hips/thighs (OR=1.675, 95%CI=1.102-2.545), knees (OR=2.219, 95%CI=1.410-3.490), and ankles/feet symptoms (OR=1.049, 95%CI=0.559-2.554).

Discussion

The results from the industrial survey questionnaire provide the prevalence of muscle fatigue symptoms and job demands experienced by workers in their real workplaces. Using the standardized Nordic questionnaire, the prevalence of musculoskeletal symptoms was investigated. The findings suggest that the workers suffered a high-risk of work-related musculoskeletal disorders symptoms. In concurrence with the finding from previous study [12], this study indicates that the prevalence of muscle fatigue symptoms in the neck and upper limbs is common and often associated with disability among adults of working age. The results signify that the shoulder was the most affected area both by any symptoms in the last year (70.659%), last week (55.090%), and by those preventing workers from doing their normal work (43.114%). It is followed by symptoms in the neck, wrists/hands and elbow. However, the prevalence of muscle fatigue symptom in the lower back area was not as high as most of the results from previous study in industrial workers. The higher prevalent of muscle fatigue symptoms in the lower back area was found in the study by Ghasemkhani et al. [13] and Widanarko et al. [14].

When comparing between genders, although it was not significantly different ($p>0.05$), for most body regions, females reported more symptoms than males. This is consistent with some previous studies [1, 14, 15]. According to Widanarko et al. [14], there were four possible explanations for the gender difference in the prevalence of muscle fatigue symptoms. First, work-related exposures seem to be gender-specific which may lead to different outcomes in body regions affected and reported between males and females. Males and females may have been exposed in a different way because of gender separation in the workforce. Males tend to do more manual handling while females tend to likely perform jobs requiring more concentrated hand tasks [16].

Second, commonly females have smaller body size and dimensions and lower physical capacities than males. Therefore, females will have a higher workload when performing the same physical task with males [17]. Third, there are gender differences in pain perception due to biological mechanisms (i.e. hormonal) and finally, the attribution of sex-related stereotypes (i.e. gender role expectation) also plays a role in pain perception [18].

Results on job demands show that generally, the subjects worked in conditions that required relatively high attention and precision, monotonous, task difficulty and repetitiveness. However, social contacts with other workers were still highly possible. Therefore, these conditions contribute to some of the prevailing muscle fatigue symptoms. Among job demand factors, repetitiveness contributes the greatest effect to the muscle fatigue symptom prevalence.

Conclusion

In conclusion, this survey results has shown that the prevalence of muscle fatigue symptoms is high among industrial workers in the manufacturing and electronics sectors in Lembah Klang Malaysia. The highest prevalence was for the neck and upper limb areas. The higher prevalence of muscle fatigue symptoms are found to be related to job demand factors, particularly monotonous, attention requirement, precision, and repetitiveness.

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