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Musculoskeletal Symptoms Among Automobile Assembly Line Workers

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Abstract: Concerns were raised about the possibility of a high prevalence of musculoskeletal symptoms among automobile assembly line workers. The aim of this study was to investigate the prevalence of musculoskeletal symptoms among this group. A cross-sectional study of 346 automobile assembly workers and office workers were carried out using a modified version of the Nordic questionnaire. Prevalence was determined by the percent of positive responses to musculoskeletal symptoms lower back tom questions. Odds ratios and 95% confidence intervals were the measures of association between prevalent musculoskeletal symptoms and demographic and were determined by logistic regression. The commonest musculoskeletal symptoms were from the feet (50.0%), low back (47.4%) and wrist/hand (30.1%), which was also the most common reason for missing work (19.4, 17.9 and 8.2%, respectively). Education status in the workers was significantly associated with MSD symptoms. Musculoskeletal symptoms are a significant problem among young automobile assembly line workers at the beginning of their careers. The work-related portion of the injuries and resulting disability is potentially preventable and it is important to identify interventions for reducing work-related musculoskeletal disorders.

Key words: Assembly line workers, low back, musculoskeletal disorders, occupational, prevalence

INTRODUCTION

Musculoskeletal Disorders (MSDs) continue to be a major source of disability and lost work time. There has been an increasing effort in recent years to investigate the causes of musculoskeletal disorders[1]. Recent reviews of priorities in occupational health research in the UK, Netherlands and the USA all concluded that musculoskeletal disorders were a major problem[2-4]. Musculoskeletal symptoms are a common occupationally related cause of ill health in the UK. The national survey of work-related illness estimated that 1.2 million men and women in 1995 believed themselves to be suffering from musculoskeletal symptoms caused or made worse by work[5]. The UK Health and Safety Executive (HSE) have estimated that 5.7 million working days (full-day equivalent) were lost in 2001/02 mainly as a result of back pain that was caused or made worse by work. Costs to employers including sickness absence, reduced productivity, staff replacement, training and compensation claims from injured workers were estimated to be at least £200 million[6]. Work-related Musculoskeletal Disorders (WMSD) comprise well over half of all reported occupational illnesses[7]. Associations between working environment and musculoskeletal symptoms have been widely reported. A number of studies have explored the relationships between automobile assembly work and musculoskeletal symptoms and have consistently shown an association between musculoskeletal symptoms and automobile assembly work. There is a high prevalence of musculoskeletal symptoms in truck assembly workers, who reported symptoms mainly affecting the low back, shoulders, neck and wrist/hand areas. Symptoms were found to be associated with age and length of service, occupational subgroup[8]. MSDs were reported to be related to force exertions in several job tasks, such as automobile assembly lines[9].

The aim of the present study was to investigate the occurrence of self-reported musculoskeletal symptoms in a group of automobile assembly line workers.

MATERIALS AND METHODS

Setting: The study was cross-sectional in design. The setting for the study was a large Iranian company that assembles automobiles. The assembly system consisted of a number of sequential steps. Work is paced, with the production lines moving on every 30 min.

Subjects: The subjects for this study were the 196 automobile assembly workers and 150 from the office workers of administrative sections (control group)

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employed by the company. They perform the main assembly process.

Procedure: All 346 assembly workers and office workers were asked to answer a self-administered questionnaire, concerning age, job type, years worked as a automobile assembly worker and occurrence of musculoskeletal symptoms in the past 12 months. The questionnaire used was a modified version of the Nordic Questionnaire (NQ) for the analysis of musculoskeletal symptoms[10]. Presence of musculoskeletal symptoms was defined as ache, pain or discomfort in one of the following body regions: neck, shoulders, upper back, elbows, low back, wrist/hands and feet. Questionnaires were coded and the code number of the questionnaires was linked to a list of employees.

Nordic questionnaire: Standardised questionnaires for the analysis of musculoskeletal symptoms in an ergonomic or occupational health context are presented. The questions are forced choice variants and may be either self-administered or used in interviews. They concentrate on symptoms most often encountered in an occupational setting. The reliability of the questionnaires has been shown to be acceptable. Specific characteristics of work strain are reflected in the frequency of responses to the questionnaires[10].

Statistical methods: The results were summarized in descriptive statistics. One-year prevalence of musculoskeletal symptoms and work absenteeism were calculated for the automobile assembly workers and control group. Statistical analysis was performed using chi-squared testing and Odds Ratio (OD) 95% Confidence Intervals (CI) were calculated by logistic regression for associations between musculoskeletal symptoms and demographic factors. The analysis was executed using SPSS (ver.9) statistical package. The level of significance was set at $p<0.05$.

RESULTS

The mean±SD age of workers and control group were 25.6±2.9 and 31.1±6.3 years, respectively and the mean period of employment was 3.9±7.2 and 6.4±5.3 years, respectively. In total 33 (16.8%) of the workers and 29 (19.3%) in controls were smokers. The highest frequency age and duration of employment of workers were <25 years group (60.2%) and <3 years group (71.4%), respectively (Table 1).

One-year prevalence of musculoskeletal symptoms by anatomic site showed differing prevalence for different anatomic sites. The feet were the area with the highest prevalence of MSD symptoms (50.0%), followed by the low back (47.4%) and wrist/hand (30.1%) in workers. Whereas, the low back was the area with the highest prevalence of MSD symptoms (21.3%) in control group. There were significant difference between the two occupational subgroups in relation to the prevalence all of MSD symptoms (Table 2).

Due to feet and low back symptoms missed work the workers, 19.4 and 17.9%, respectively. After low back symptoms, workers were more likely to miss work due to wrist/hand symptoms (8.2%) and upper back symptoms (7.7%). In the control group, the low back, feet and neck symptoms were the highest prevalence of missed work

Table 1: Demographics of the study population (N = 346)

	Workers (N = 196) N (%)	Controls (N =150) N (%)
Age (years)	25.6±2.9	31.1±6.3
< 25	118 (60.2)	18 (12.0)
25-30	59 (30.1)	68 (45.3)
> 30	19 (9.7)	64 (42.7)
Duration of employment (years)	3.9±7.2	6.4±5.3
< 3	140 (71.4)	50 (33.3)
3-10	47(24.4)	76 (50.7)
> 10	6(3.1)	24 (16.0)
Height (cm)	174.9±7.1	173.2±11.0
Weight (kg)	71.2±10.6	74.8±11.6
Body mass index (kg m^{-2})	23.84±3.0	24.66±2.8
Normal	266 (76.9)	110 (73.3)
Moderate	73 (21.1)	36 (24.0)
High	7 (2.0)	4 (2.7)
Educational status		
High school	2 (1.0)	1 (0.7)
Diploma	187 (95.4)	20 (13.3)
Diploma +	7 (3.6)	56 (37.3)
Bachelor +	0	73 (48.7)
Cigarette smoking		
Smoker	33 (16.8)	29 (19.3)
Non-smoker	163 (83.2)	121 (80.7)

Table 2: 12-month period prevalence of MSD symptoms in automobile assembly line workers and office workers by anatomic site

Anatomic site	Workers N (%)	Controls N (%)	p-value
Neck	50 (25.5)	21 (14.0)	<0.009
Shoulders	50 (25.5)	14 (9.3)	<0.0001
Upper back	53 (27.0)	23 (15.3)	<0.009
Elbow	25 (12.8)	4 (2.7)	<0.001
Low back	93 (47.4)	32 (21.3)	<0.0001
Wrist/hands	59 (30.1)	7 (4.7)	<0.0001
Feet	98 (50.0)	28 (18.7)	<0.001

Table 3: 12-month period prevalence missed work in automobile assembly line workers and office workers by MSD symptoms

Anatomic site	Workers N (%)	Controls N (%)	p-value
Neck	7 (3.6)	3 (2.0)	NS
Shoulders	14 (7.1)	2 (1.3)	<0.01
Upper back	15 (7.7)	1 (0.7)	<0.002
Elbow	5 (2.6)	1 (0.7)	NS
Low back	35 (17.9)	3 (2.0)	<0.0001
Wrist/hands	16 (8.2)	1 (0.7)	<0.001
Feet	38 (19.4)	3 (2.0)	<0.0001

NS = Not significant

Table 4: Factors associated with prevalence symptoms of MSD in assembly line workers

	Anatomic site																	
	Neck			Shoulders			Elbow			Low back			Wrist/ hands			Feet		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Age	1.06	0.54-2.07	0.86	1.04	0.53-2.04	0.90	1.09	0.44-2.65	0.84	0.90	0.50-1.61	0.73	1.23	0.65-2.35	0.51	1.20	0.68-2.14	0.52
Educational status	0.19	0.04-0.88	0.03*	2.05	1.10-3.81	0.02*	6.44	1.89-21.91	0.002*	2.36	1.38-4.03	0.001*	5.01	2.38-10.55	0.00001*	3.84	2.29-6.42	0.00001*
BMI	0.40	0.02-6.96	0.53	0.42	0.02-7.46	0.56	1.06	0.92-1.23	0.38	1.03	0.06-17.06	0.98	0.50	0.02-8.86	0.64	0.99	0.06-16.1	0.99
Cigarette smoking	1.80	0.80-4.05	0.15	2.13	0.96-4.75	0.06	2.78	1.07-7.23	0.03*	1.41	0.66-3.02	0.37	1.82	0.83-3.99	0.13	1.62	0.75-3.52	0.21

OR, Odds ratio., CI, Confidence Interval., *, Significantly different

Table 5: Prevalence of MSD symptoms by anatomic site, age and duration of employment in assembly line workers

	Anatomic site													
	Neck		Shoulders		Upper back		Elbow		Low back		Wrist/hands		Feet	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Age (years)														
< 25	31	62.0	31	62.0	35	66.1	16	64.0	55	59.1	38	64.4	61	62.3
25-30	14	28.0	13	26.0	13	24.5	5	20.0	27	29.1	14	23.7	25	25.5
> 30	5	10.0	6	12.0	5	9.4	4	16.0	11	11.8	7	11.9	12	12.2
Duration of employment (years)														
< 3	31	64.6	33	68.7	37	72.5	19	76.0	65	71.4	41	71.9	68	70.8
3-10	16	33.3	13	27.1	14	27.5	5	20.0	24	26.4	14	24.6	25	26.1
> 10	1	2.1	2	4.2	0	0	1	4.0	2	2.2	2	3.5	3	3.1

(2%). There were significant differences between the two occupational subgroups in relation to the prevalence of missed work by all of MSD symptoms, except neck and elbow symptoms (Table 3).

There were significant differences between education status and cigarette smoke with prevalence of MSD symptoms ($p<0.00001$ to 0.03). There were no significant differences between prevalence of MSD symptoms and other demographic variables. The highest odds ratio elbow symptoms were for education status (OR = 6.44; 95% CI = 1.89-21.91), followed by the wrist/hand symptoms (OR = 5.01; 95% CI = 2.38-10.55) and feet symptoms (OR = 3.84; 95% CI = 2.29-6.42) in workers (Table 4).

In general, the prevalence of MSDs among workers increased with age and duration of employment from the oldest age group to the youngest years. The prevalence rate among workers increased by age <25 years from 59.1 to 66.0% and <3 years duration of employment from 64.6 to 76.0% (Table 5).

DISCUSSION

The automobile assembly line is a major industry in Iran. Based on present results, in this study the prevalence of musculoskeletal symptoms was high in workers. It was anticipated that there would be multiple physical stressors present in automobile assembly line. Specifically, repetitive machine paced tasks, various postural stresses and forceful exertions; segmental vibration exposures, contact mechanical stresses and other exposures were considered likely to vary among jobs and plants.

The symptom survey revealed that large proportion of the workers experienced musculoskeletal symptoms in the past 12 months. Feet and low back symptoms were the most prevalent musculoskeletal disorder that resulted in high work absenteeism. In this study, the prevalence of musculoskeletal disorders among workers between 12.8 to 50%, with the feet and low back being the most frequently affected body region. Whereas in the control group was a low prevalence of MSD symptoms and missed work. Physically demanding occupations seem to be an important risk factor of MSD.

These results are consistent with Hussain[8], who found 79% of truck assembly workers had been musculoskeletal symptoms in the last 12 months. The commonest musculoskeletal symptoms were from the low back (65%). Also, Fredriksson *et al.*[11] reported that in automobile assembly in Sweden a possible explanation for the increase in musculoskeletal symptoms was the increase in perceived physical exertion. Punnet *et al.*[12] showed that back disorders of automobile assembly workers increased with exposure to multiple postures. Fransson-Hall *et al.*[13] reported that automobile assembly-line workers appear to be a high-risk group for work-related symptoms from the forearm-hand. Zetterberg and Öfverholm[14] showed that were the correlations between car assembly workers and carpal tunnel syndrome.

Low back disorder is reported as the most prevalent disorder in many occupational groups. Merlino *et al.*[15] reported that apprentice construction workers 7.3% missed work due to low back symptoms during the previous year and Goldsheyder *et al.*[16] have found that 71% of construction laborers experienced low back pain in the past year, about 14% of them missed work.

Non-occupational factors educational status and cigarette smoking were seen in odds ratio which correlated with in some MSDs. Goldberg *et al.*[17] reviewed 38 epidemiological studies on the relationship between smoking and low back pain and found that smoking seemed to be associated with the incidence and prevalence of non-specific back pain. Otani *et al.*[18] reported that found association between cigarette smoking and low back pain in Japan men. Whereas, the association between low back pain and educational was weak.

Age and BMI were not associated with musculoskeletal symptoms in this study. Age has been shown to have an inconsistent effect with low back in other studies[19]. Otani et *al.*[18] shown that the prevalence of low back pain a downward trend with age in men. Merlino *et al.*[15] reported that the construction workers were relatively young and the age range was somewhat narrow, which may have influenced the lack of association between age and musculoskeletal symptoms. Lean *et al.*[20] showed that the body mass index in men was not positively associated with low back pain. According to Leboeuf-Yde *et al.*[21], however, because the association between body mass index and low back pain was weak and there is no consistent positive linear trend in men.

The possibility of a healthy worker effect must be considered. This is evident from the finding that the prevalence of MSD symptoms was lower in age's +30 years and duration of employment +10 years than in ages <25 years and duration of employment <3 years for all locations. One exception is that the automobile assembly young workers are exposed to physical workload such as extreme working postures like stooping, kneeling, work with hands above shoulder level.

LIMITATIONS

Certain limitations should be taken into consideration when interpreting the findings of the survey. Usually self-reports of disease or disorder are considered as less accurate measurement due to possible false reporting. Moreover, musculoskeletal disorders, is a self-reported condition often without any objective clinical findings and no medical test can really refute the existence of musculoskeletal symptoms.

CONCLUSIONS

There is a high prevalence of musculoskeletal symptoms and missed work in assembly workers, who reported symptoms mainly affecting the feet, low back, wrist/hand areas compared to the office workers (control group). There were correlations between educational status and cigarette smoking and some MSDs in assembly workers. No significant relationships were identified among age, duration of employment, height, weight and BMI with 12-month prevalence of symptoms in any body region. Reducing the prevalence of work-related MSDs in the automobile assembly industry should be a primary goal for labor organizations, associations and the public health community. The supervisors should encourage workers to change postures since working in the same position for long periods was associated with musculoskeletal symptoms.

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