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Predictors of occupational exposure to neck and shoulder musculoskeletal disorders among sewing machine operators of garment industries in Ethiopia

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Abstract: *Background:* Occupational health problems related to upper limp musculoskeletal disorders were the major issue among sewing machine operators of garment industries in Ethiopia. The aim of this study was to assess the prevalence and associated risk factors of work related neck and shoulder musculoskeletal disorders among sewing machine operators of garment industries in Galan City, Oromia Regional State. *Methods:* A cross-sectional study was conducted from April 1 to 30, 2013. A total of 422 study subjects were included in this study. Standard Nordic Musculoskeletal Questionnaire was used to collect detailed information on musculoskeletal symptoms, socio demographic data, and factors associated with the problems through face to face interview. *Results:* From a total of 422 sewing machine operators included in the study 370 (87.7%) were females and 306 (72.5%) were in the age group of < 30 years. The prevalence of self-reported work related neck and shoulder musculoskeletal disorders was 51.7% and 45%, respectively. In multivariate analysis, those who had >16 years of service were about four times more likely to develop neck and shoulder musculoskeletal disorders than those who had short (1–5 years) year of services [AOR = 3.55, 95% CI: 1.24–10.16], medical history of systemic illness [AOR = 2.04, 95% CI: 1.02–4.08], and methods of payment [AOR = 2.04, 95% CI: 1.27–3.29], factors significantly associated with this disorders. *Conclusion:* Work related neck and shoulder musculoskeletal disorders were high among sewing machine operators in selected garment industries. Moreover, personal and environmental factors were identified as the potential risk factors related to neck and shoulder musculoskeletal disorders among the study group. Therefore, government and the owner of the garment industries should give special attention to prevent and control the problems through proper occupational health and safety policy implementation in the country.

Keywords: Garment Industries, Neck, Shoulder, Musculoskeletal and Disorders

1. Introduction

Work related musculoskeletal disorders (WRMSDs) have been considered as the potential threats of major public health problems associated with unsafe work environments. The daily hardship cost of human is the burden of poor occupational safety and health practices that can cause pain and disability in the functions of upper body musculoskeletal systems. About 6,300 people were dying every day as a result of occupational work related problems in the world [1]. The issue of safety and health conditions at workplace were different between countries, organizational sectors and social groups. For example, about 317 million accidents occur on the job annually, mostly which takes a heavy toll in

developing countries where thousands of poor and least protected people were involved in sewing machine operator in garment industries [2].

WRMSDs among sewing machine operators of garment industries were a reason for long term sick leave and disability pensions in the world [3]. World Health Organization (WHO) reported (50-70%) individuals developed WRMSDs when exposed to poor working environments during working the job [4]. A study conducted in America, Boston showed that sewing machine operators had highly affected by work related upper limb pain. Moreover, the United State Bureau of Labour Statistics Annual Survey of occupational injuries and illnesses ranked sewing machine operators of clothing industry in the country offering to upper body musculoskeletal disorders [5].

Association between UBMSDs with age, year of service and level of education studied in different countries in the world. For example, in Finland Among office employees, female workers were more likely developed neck pain than male workers [6]. Moreover, Turkey and Denmark reported the year of service was significantly associated with elbow, wrist, and shoulder and neck musculoskeletal (MS) disorders among workers in garment industries [6-8]. In Danish the prevalence of MS symptoms of the neck, shoulders, back and wrist among sewing machine operators were found to be(57%), (51%), (47%) and (26%), respectively [7].

Age and gender of sewing machine operators of shoe manufacturing industry in Iran have statistically significant association with WRMSDs of the elbow and shoulder [9]. Report on WRMSDs from Beijing reviled those female sewing machine operators who was exposed to high sustained static load and were held in more static positions developed neck and shoulder musculoskeletal disorders [10]. Long working hour, payment method through piece rate and less recovery time cycle was strongly associated with self-reporting neck and shoulder pain [11].

Harmful inflammatory diseases that can cause pain and disability in the functions of neck and shoulder experienced in the last 12 months were used as an outcome measure for this study. Therefore, prevention of WRMSDs among workforces may be a national priority in many countries. Even though, an Ethiopian labour proclamation permits working hour in all types of industries for 8 hours per day or 48 hours per week [10], there is lack of strong functioning health and safety system, particularly, among garment industries where workers involved in sewing machine operating tasks in the study area.

This study was, therefore, aimed to assess the prevalence and associated risk factors of work related neck and shoulder musculoskeletal disorders among workers who were directly involved in operating sewing machine work in the selected garment industries in Galan City. Furthermore, the finding of the results were provide information on workplace illness and injuries in the garment industries and also have important public health contribution by providing information for policy makers to design strategy to keep strong functioning health and safety system for a people who become tackled by the problem.

2. Methods and Materials

2.1. Study Setting and Period

An institution based cross-sectional study was conducted in two large garment industries found in Galan City administration from April 1 to 30, 2013. Galan City is one of the industrial zones in Oromia Regional State, which is 25KMs far from Addis Ababa, the capital city of Ethiopia, in Eastern direction, where most of the foreign and domestic investors were investing in different industrial activities. Among these industrial activities, garment factories were the most common industries. Two large garment industries, owned by Ethiopians investors living outside Ethiopia were selected for this study, each having 632 and 362 sewing machine operators, respectively.

2.2. Sample Size and Sampling Procedures

A total of 994 sewing machine operators who had worked in the two garment industries for more than 12 months prior to the study period were considered as source population. The sample size was determined using single population proportion formula and to maximize the sample size, 50% assumption was used at 95% confidence interval and margin of error 5%. Therefore, including 10% non-response rate, the total sample size obtained was 422. First, sewing machine operators were stratified by its organizational structure, then after, sample size was proportionally allocated to each garment industries. Lottery method was used to recruit the actual number of study units. Administrative or supportive staffs and workers those who were absent during data collection period were excluded from the study.

2.3. Data Collection Process

Data were collected using standardized Nordic questionnaire [12].The questionnaire was translated from English into Amharic and then independently back-translated to English with adjustment of the Amharic version where problems were identified. The contents of the questionnaire included socio demographic characteristics (sex, age, marital status, educational level, monthly salary, years of service), personal factors (smoking behaviour, habit of doing physical activity, medical history of systemic illness, medical history of musculoskeletal disorder), organizational factors (payment method, work hours, employment status, break time excluding lunch and health and safety training) and working environmental factors (job satisfaction, repetitive work within less than 30 seconds, doing too much work, availability of sufficient light, availability of adjustable chair). At baseline, participants were asked about pains in the elbow/forearm and wrist/hand lasting for at least a day over the past 12 months and those who had reported pain at baseline over the past 12months were determined.

2.4. Ethical Clearance

Ethical clearance was obtained from University of Gondar and Oromia Regional Labour and Social Affairs Agency.

Formal letter of cooperation was obtained to owner of the garment industries. Verbal informed consent was obtained from each study participant after informed the objective of the study.

2.5. Data Analysis and Interpretation

The collected data were coded and entered into SPSS version 21.0 software program for analysis. Bivariate logistic regression analysis was used to determine the effect of independent variables on the dependent variables and those variables with P-value < 0.2 were exported to multiple logistic regression for further analysis [13], and the summary statistics such as mean, standard deviation and percentage were used to describe the study population in relation to outcome variables. The degree of association between independent and dependent variables were assessed using odds ratio with 95% confidence interval.

3. Results

3.1. Socio-Demographic Characteristics of Study Participants

A total of 422 sewing machine operators were included in the study and are with 100% response rate. Majority of the study subjects 370 (87.7%) were females. Most of the respondents 306 (72.5%) were in the age group of < 30 years and the mean age of the study subjects was 26.9 (±7.2 SD). Marital status, 227 (53.8%) were single and 145 (34.4%) were married, 200 (47.4%) were attended secondary school. Among the respondents, 270 (64.0%) were served from 1-5 years and 23 (5.3%) were served above 16 years and the mean year of service 5 (± 5.27 SD) with minimum and maximum value 1 and 30, respectively. Two hundred fifty two (59.7%) were paid monthly salary 700 to 900 Ethiopian birr or (35.5 to 45US dollar) and 138 (32.7%) were paid below 700 Ethiopian birr or (below 35.5 US dollar per month) (Table 1).

Table 1. *Socio-demographic characteristics of study participants and year of service in garment industries in Galan City, Oromia Regional State, Ethiopia, 2013.*

Category of variable		Frequency (n=422)	(%)
Sex	Male	52	(12.3)
	Female	370	(87.7)
Age (in years)	>30 years	306	(72.5)
	30-39 years	89	(21.1)
	40-49 years	18	(4.30)
	≥50 years	9	(2.10)
Marital Status	Married	145	(34.0)
	Divorced	29	(6.80)
	Widowed	21	(5.00)
	Single	227	(58.8)
Educational level	Illiterate	45	(10.7)
	Primary	135	(32.0)
	Secondary	200	(47.40
	Higher Education	42	(10.0)
Monthly Salary	<700 ETB (<35.5 US dollar)	138	(32.7)
	700-900 ETB (35.5-45US dollar)	252	(59.7)
	>900 ETB (>45 US dollar)	32	(7.60)
	Mean(±SD)	5(±5.2)	--
Year of service in garment	1-5 years	270	(64.0)
	6-10 years	118	(28.0)
	11-15 years	11	(2.60)
	≥ 16 years	23	(5.40)

3.2. Prevalence of Work-Related Neck and Shoulder MSDs among Sewing Machine Operators

The prevalence of WRMSDs among sewing machine operators who had experienced trouble (ache, pain and discomfort) in the last 12-month period were 45% neck disorder and 51.7% shoulder disorder. One hundred ninety (45%) of respondents developed neck MSD, of which 78 (18.5%) sewing machine operators had experienced trouble greater than 30 days but not every day and 47 (11.1%) of respondents experienced ache, pain and discomfort 8-30 days on their neck in the last 12-month. Out of the total population 218 (51.7%) developed shoulder MSD, of which 84 (19.9%) of operators had experienced ache, pain and discomfort greater than 30 days, but not every day and 56 (13.3%) of which had experienced trouble 8-30 days on their shoulder in the previous 12-month (Table 2).

Table 2. *Prevalence of neck and shoulder MSDs among Sewing Machine Operators in the Last 12 month at garment industries in Galan City, Oromia Regional state, 2013 (n= 422).*

Variables		Symptoms by anatomical body site	
		Shoulder disorder n (%)	Neck disorder n (%)
Trouble In the past 12 month	Yes	218 (51.7)	190 (45.0)
	No	204 (48.3)	232 (55.0)
Total length of MSDs trouble	1-7 days	34 (8.10)	39 (9.2)
	8-30 days	56 (13.3)	47 (11.1)
	>30 days, but not every day	84 (19.9)	78 (18.5)
	Every day	39 (9.2)	31 (7.5)

3.3. Occupational Factors Associated With WRMSDs among Sewing Machine Operators

In multivariable logistic regression analysis, variables like monthly salary, medical history of systemic illness and year of service were had protective and significant association with neck disorder. Workers those who had longer year of service (≥16 years) 3.55 times more likely develop neck disorder than had short year of service (1-5 years) and those with medical history of systemic illness were more likely to have neck disorder than without systemic illness [AOR =2.04, 95% CI=1.02-4.08] (Table 3).

Table 3. *Some variables associated with work-related Neck MSD among sewing machine operators in Galan City, Oromia Regional state,2013 (n=422).*

Category of variables	Neck disorder			
	Yes n (%)	No. n (%)	COR (95% CI)	AOR (95% CI)
Sex				
Male	32 (61.6)	20 (38.4)	1.00	-----
Female	158 (48.2)	212 (57.3)	0.46 (0.25-0.84)	
Age				
<30 years	125 (40.9)	181(59.1)	1.00	
30-39 years	46 (51.7)	43 (48.3)	1.54 (0.96-2.48)	-----
40-49 years	12 (72.7)	6 (33.3)	2.89 (1.05-7.92)	
≥ 50 years	7 (77.8)	2 (22.2)	5.0 (1.03-24.8)	
Monthly salary(Ethiopian Birr)				
<700 Birr(<35.5US dollar)	40 (29.9)	98 (71.0)	0.18 (0.08-0.42)	0.24(0.10-0.57)**
700-900 Birr(35.5-45 US dollar)	128 (50.8)	124 (49.2)	0.46 (0.21-1.03)	0.51 (0.22-1.15)
>900 Birr (45US dollar)	22 (68.8)	10 (31.2)	1.00	1.00
Year of service in garment				
1-5 years	104 (38.5)	166 (61.5)	1.00	1.00
6-10 years	60 (50.9)	58 (49.1)	1.65 (1.06-2.55)	1.35 (0.85-2.16
11-15 years	8 (72.7)	3 (27.3)	4.25 (1.10-16.40)	3.02 (0.75-12.06)
≥ 16 years	18 (78.3)	5 (21.7)	5.74 (2.07-15.94)	3.55(1.24-10.16)*
Smoking behaviour				
None	173 (43.8)	222 (56.2)	1.00	
Past smoker	7 (50.0)	7 (50.0)	1.28 (0.44-3.72)	----
Current smoker	10 (76.9)	3 (23.1)	2.04 (1.19-3.50)	
Medical history of MSD				
Yes	39 (60.0)	26 (40.0)	1.00	----
No	51 (42.3)	206 (57.7)	2.50 (1.29-4.83)	
Medical history of systemic illness≠				
Yes	28 (65.1)	15 (34.9)	1.00	2.04 (1,02-4.08)*
No	162 (42.7)	217 (57.3)	0.46 (0.25-0.84)	1.00

AOR, COR, US = Adjusted and Crude Odd Ratio, United State, respectively, 1.00= Reference, * =P-Value < 0.05, ** = P-Value < 0.001, *** =P-Value < 0.0001

3.4. Factors Associated with Occupational Exposure to Shoulder MSDs

The Variable monthly salary was protective and year of service and payment method significantly associated with work related shoulder disorders. Those who had year of service ≥16were 3 times more likely to develop shoulder disorder than had short (1-5years) years of service (AOR=2.97, 95% CI= 1.04-8.48) (Table 4).

Table 4. *Bi-variable and multi-variable analysis showing factors associated with work-related shoulder MSD among sewing machine operators in Galan City, Oromia Regional state, 2013 (n=422).*

Category of variables	Shoulder musculoskeletal disorder			
	Yes n (%)	No. n (%)	COR (95% CI)	AOR (95% CI)
Sex				
Male	34 (65.4)	18 (34.6)	1.00	------
Female	184 (49.7)	186 (50.3)	0.52 (0.28-0.96)	
Age				
<30 years	146 (47.8)	160 (52.3)	1.00	
30-39 years	53 (59.5)	36 (40.5)	1.61 (0.99-2.60)	------
40-49 years	11 (61.1)	7 (38.9)	1.72 (0.65-4.56)	
≥ 50 years	8 (88.9)	1 (11.1)	8.76 (1.08-70.9)	
Monthly salary(Ethiopian Birr)				
<700 Birr (<35.5US dollar)	47 (34.1)	91 (65.9)	0.20 (0.08-0.47)	0.27 (0.11-0.65)*
700-900 Birr (35.5-45 US dollar)	148 (58.7)	104 (41.3)	0.55 (0.24-1.25)	0.64 (0.28-1.49)
>900Birr (>45US dollar)	23 (77.9)	9 (28.1)	1.00	1.00
Year of service in garment				
1-5 years	118 (43.7)	152 (56.3)	1.00	1.00
6-10 years	73 (61.9)	45 (38.1)	2.09 (1.34-3.25)	1.64 (1.03-2.60)*
11-15 years	9 (81.8)	2 (18.2)	5.79 (1.22-27.33)	4.46 (0.91-21.83)
≥ 16 years	18 (78.3)	5 (21.7)	4.63 (1.67-12.85)	2.97 (1.04-8.48)*
Habit of doing Physical activities				
None	181 (51.1)	173 (48.9)	1.67 (0.73-3.79)	------
Once per week	21 (72.4)	8 (27.6)	4.20 (1.35-13.06)	
Two times per week	6 (46.1)	7 (53.8)	1.37 (0.35-5.27)	
≥3 times per week	10 (38.5)	16 (61.5)	1.00	
Smoking behaviour				
None	198 (50.1)	197 (49.8)	1.00	
Past smoker	9 (64.3)	5 (35.7)	1.28 (0.44-3.72)	-----
Current smoker	11 (84.6)	2 (15.4)	4.27 (1.15-15.78)	
Medical history of MSD				
Yes	42 (64.6)	23 (35.4)	2.04 (1.19-3.50)	-----
No	176 (49.3)	181 (50.7)	1.00	
Medical history of systemic illness≠				
Yes	31 (72.1)	12 (27.9)	2.50 (1.29-4.83)	-----
No	187 (49.4)	192 (50.6)	1.00	

≠ = the list of systemic illnesses or diseases includes: diabetes, low thyroid or overactive thyroid, chronic renal failure, and gout, * =P-Value <0.05, ** = P-Value <0.001, *** =P-Value < 0.0001.

4. Discussion

Work related MS disorders were common problems in garment industries, especially among sewing machine operators in the study area. In the present study, the prevalence of self-reported shoulder and neck MSDs were, 51.7% and 45%, respectively. This finding was comparable with the studies done in Sweden, Denmark, Boston, UK and Finland; where the prevalence of neck and shoulder MS disorders was reported to be from 34 to75%, [8-16]. However, a study in the Los Angeles, USA, showed that the prevalence of neck and shoulder was 25% and 16%, respectively [11]. This difference might be due to the difference of the study setting. In the USA the study was conducted on small shop sizes in which participants could mostly be the family or relatives of the shop owners and therefore they were not enforced to work for long time. However, this study was conducted on large scale industries in which workers were working for more than eight hours per day.

Employees, those who paid less than 700 Ethiopian birr (35.5 US dollar) were less likely develops neck and shoulder MS disorders than employees who had paid greater than 900 Birr (45US dollar)per month. The increment of wages of employees in the study settings of garment industries was depending on their year of service in the same industry. This shows that those who had long year of service in garment were paid high monthly salary. So the chance of having to develop occupation related neck and shoulder MSDs can be higher than those were less paid. However, employees with longer year of service (≥16 years) in garment industries were 2.97 to 3.55times more likely at risk to develop shoulder and neck MS disorder (AOR =2.97, 95% CI: 1.04-8.48), (AOR=3.55,95% CI: 1.24-10.16) than employees had short (1-5 years) year of service.

Operators with medical history of MSDs and those with a medical history of systemic illness were 2 times more likely develop neck disorder than without a history of systemic illness. This finding was higher than the results reported from USA (Boston and Los Angeles) [5, 11]. This discrepancy might be due to the fact that the practice of occupational health and safety in Ethiopia is at its infancy stage; the burden of work-related disease throughout the country is under diagnosed and under reported by clinician and other health professionals to the responsible body.

The payment method had a contribution for the occurrence of MSDs among sewing machine operators of garment

industry. Those employees, their payment method through piece rate method was more likely develop shoulder disorders than were paid via of hourly payment. This might be due to the reason that workers increase their speed of work to get more payment. This result was in agreement with the result reported in Los Angeles, USA, among sewing machine operators [5]. Workers who are working greater than 10 hours per day were 2.04 times more likely develop shoulder pain than those who work for 8 hours per day. This finding is also exceed the standard set in Ethiopian labour proclamation number 377/2003 that states as follows; *"The time during which a worker actually performs work or avails herself/himself for work in accordance with law, collective agreement or work rules shall not exceed 8 hours per day "* [17].

The limitation of this study was ergonomics tools were not used, lack of using measurement for independent variables like: job satisfaction, doing too much work and habit of smoking behaviour, biases like recall biases during data collection period might be affect the outcomes.

5. Conclusion

Generally, there is high prevalence of neck and shoulder MS disorders among sewing machine operators in the study area. The independent variables such as year of services in the garment and piece rate work, and a length of working hours per day had statistically significant association with the occurrence of work related neck and shoulder MS disorders. Therefore, promoting worker involvement in efforts to improve workplace conditions is a critical element in organization process to enhance worker motivation, added problem solving capabilities, and greater knowledge of work experiences.

Recommendation

Government and the owner of the garment industries should give special attention to prevent and control the problems through proper occupational health and safety policy implementation in the country. Moreover, Training is an essential element for any effective safety and health program to recognize workplace risk factors associated with MS disorders.

Competing Interests

The authors declare that they have no competing interests

Authors' Contribution

AT conceived the study and developed the proposal, MK and AN advising during proposal writing and WK involved in data analysis and interpretation, developed the submitted manuscript and all authors participated in the data analysis, interpretation and read and approved the final version of the manuscript.

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