

Occupational Risk Factors of Low Back Pain among Ammunition Engineering Industry in West Shoa Zone, Ethiopia, 2017

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Abstract

Background: Work related back disorder is one of the most prevalent work related disease affecting working population. Estimating the burden of occupational disease among ammunition engineering industry is an important to improve the health and safety of workers. **Objective:** To identify the magnitude and factors related with occupational factors of back pain among ammunition engineering industry in West Shoa Zone, Oromia, Ethiopia. **Methods:** An institutional cross sectional study was deployed among 660 workers. Detailed information on socio-demographic conditions, organizational factors, personal factors, working environment and musculoskeletal symptoms were obtained in face-to-face interviews. Nordic Questionnaires were used to measure the outcome of interest, low back pain, as a worker experiencing self-reported musculoskeletal symptoms in the lower back were defined by aches, pain, or discomfort during the last 12 months. Both bivariate and multivariate logistic regression analysis were used to determine the degree of association by using odds ratio with 95% CI. **Results:** From the total respondents included in the study the prevalence of self-reported low back pain was 384(58.2%). Employees with no attended any training related with occupational health and safety and ergonomics were 2.5 times having the chance of developing work related low back pain than those attended the training. **Conclusion:** The study findings identified that the pre-employment medical examination (previous MSDs), load of the work and the provision of occupational health and safety training is highly a significant factors for developing of low back pain among workers engaged in ammunition engineering industry.

Keywords: Ammunition Engineering, Low back pain, musculoskeletal disorders

Introduction

Work-related musculoskeletal disorders are a leading cause of morbidity and work disability among working populations(1-5). These injuries can affect the musculoskeletal, peripheral nervous, neurovascular systems and are caused or aggravated by occupational exposures(6, 7). WMSDs are the most common work-related health problem in developed and developing countries(1, 8). Between 10% and 30% of the workforce in developed and 50% and 70% in developing countries are exposed to unergonomic working conditions(9). Low-back pain is one of the most common work-related problems in developed countries and is associated with considerable absence from work and loss in productivity, resulting in financial burdens to employers, employees and health care systems(10-12). Addressing the impact and the burden of low back pain among Homicho Ammunition Engineering industry is a key step to improving the workers' health, safety and quality of life.

Homicho Ammunition Engineering Industry (HAEI) was established in 1987 in Western Showa Zone and currently structured under Metal and Engineering Corporation (METEC). HAEI has seven factories: small and medium ammunition factory, heavy ammunition warhead factory, extrusion and forming factory, case and liner factory, explosive and propellant factory, rocket production factory and fuse and detonator factory are in the project phase. Although all formal and informal relationships have ceased to exist since the early 1990's, HAEI was originally established through cooperation between the Korea Mineral Trading General Corporation and the previous Ethiopian regime. Currently, HAEI has partners in China, India, Germany, Italy and the Czech Republic. Currently this industry has 1216 employees.

Methods and Materials

An institutional based cross-sectional study was conducted in one Ammunition Engineering industry found in West Shoa Zone, Oromia Region from December to March 2017. A total of 1216 employees who had worked more than 12 months prior to the study period were considered as source population. The sample size was determined using single population proportion formula to maximize the sample size 50% assumption was obtained at 95% confidence interval and margin of error 5%. Adding 10% non-response rate the total sample size was obtained 660. First the employees were stratified by its organizational structure then, after sample size was proportionally allocated to each sub industries; lottery method was used to recruit the actual number of study units. Prior to data collection, administrative (supportive) staffs and workers those who were absent during data collection period were excluded from the study.

In the data collection process, data were collected using standardized Nordic questionnaire(13). The questionnaire was translated from English into Afan Oromo and then independently back translated to English with adjustment of the Afan Oromo version where problems were identified. The contents of the questionnaire

included socio demographic characteristics, personal factors, organizational factors and working environment/condition. Before the actual data collection, the questionnaire was pre-tested in 33 employees working in other metal industry found in Bishoftu city near to Addis Ababa, about experiencing pains in their lower back at least a day over the past 12 months.

The data were coded and entered into SPSS software version 20.0 for further analysis. Bivariate logistic regression analysis was used to determine the association of independent and dependent variables, and those variables with P-value < 0.15 were exported to multiple logistic regressions for further analysis and to remove insignificant variables. 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.

Ethical Consideration

The study was carried out after getting permission from the ethical review board (IRB) of Ambo University. Informed consent was also obtained from Ammunition Engineering industry and from study participants to participate in the study. Confidentiality was granted for information collected from the industry and by removing the name of study participants from the questionnaires.

Results

Socio Demographic Characteristics of Homicho Ammunition Engineering Industry Workers

A total of 660 respondents were included in the study and is with 100% response rate. Majority of the study subjects 449 (68.0%) were males and the rest were females. Most of the respondents 458 (68.1%) were in the age group of less than 30 years and the mean age of the study subjects was 30.1(±8.1SD). Marital status, three hundred sixty eight (55.8%) were single, 265 (40.2%) were married, 480 (72.7%) were attended diploma and 9 (1.4%) were illiterate. Year of service in the ammunition industry, most of the respondents 332 (50.3%) were served from 1-5 years and 30 (4.5%) were served above 20 years and the mean year of service 7.0 (±6.1)) with minimum and maximum value 1 and 40 respectively (**Table1**).

Table 1: Socio-Demographic Characteristics of Homicho Ammunition Engineering Industry Workers, in West Showa Zone, West Ethiopia, March 2017.

Category of variable	Frequency (n=660)	Percent (%)
Sex		
Male	449	68
Female	221	32
Age		
<30 years	458	69.4
30-39 years	105	15.9
40-49 years	68	10.3
≥50 years	29	4.4
Marital Status		
Married	265	40.2
Divorced	14	2.1
Widowed	13	2.0
Single	368	55.8
Educational level		
Illiterate	9	1.4
Primary	51	7.7
Secondary	54	8.2
Diploma	480	72.7
Degree and above	66	10.0
Year of service in Ammunition		
Mean(SD)	7(±6.1)	
1-5 years	332	50.3
6-10 years	212	32.1
11-15 years	48	7.3
16-20 years	38	5.8
>20 years	30	4.5

Personal Characteristics of Homicho Ammunition Engineering Industry Workers

Four hundred twenty three (64.1%) were not practicing physical exercise, 64 (9.7%) were practice greater than three times per week. Six hundred eight (93.1%) of the respondents were none cigarette smokers, 181 (27.4%)

were with medical history of MSDs and 90(13.6%) were with systemic illness (**Table2**)

Table 2: Personal Characteristics of Homicho Ammunition Engineering Industry Workers, in West Showa Zone, West Ethiopia, March 2017.

Category of variable	Frequency(n=660)	Percent (%)
The habit of doing physical activities		
None	423	64.1
Once per week	97	14.7
Two times per week	76	11.5
≥ Three times per week	64	9.7
Smoking behaviour		
Non-smoker	608	93.1
Past smoker	31	4.7
Current smoker	21	3.2
Medical history of MSDs		
Yes	181	27.4
No	479	72.6
Medical history of systemic illness		
Yes	90	13.6
No	570	86.4

Conditions of Working Environment of Homicho Ammunition Engineering Industry Workers

Majority of the respondents 266(40.3%) were not satisfied their current job, 311(47.1%) of the respondents sometimes exposed to repetitive task repeating the same task within less than 30 seconds, 359(54.4%) of respondents feel sometimes doing too much work within working hour Four hundred forty eight (67.9%) of the respondents were had not enough sufficient light to operate sewing machine (**Table3**).

Table 3: Characteristics of Working Environment of Homicho Ammunition Engineering Industry Workers, in West Showa Zone, West Ethiopia, March 2017.

Category of variables	Frequency(n=660)	Percent (%)
Job satisfaction		
Not satisfied	266	40.3
Somewhat satisfied	155	23.5
Very satisfied	239	36.2
Repetitive work within < 30 seconds		
Never	136	20.6
Sometimes	311	47.1
Often	90	13.6
Always	123	18.6
Doing too much work		
Never	92	13.9
Sometimes	359	54.4
Often	81	12.3
Always	128	19.4
Availability of sufficient light		
Yes	212	32.1
No	448	67.9

Organizational Factors

Employment status of, 526(79.7%) of respondents were permanent and the rest are temporary workers. 523(79.7%) of the payment method were via of hourly rate and the rest was paid in piece rate method. From the total workers 610 (92.4%) of the workers work for 9-10 hours per day, 140(21.2%) of workers were not have break (excluding lunch break).Majority 511(77.4%) of the respondents never attained training on the issue of OHS and ergonomics at workplace (**Table4**).

Table 4: Organizational Characteristics of working Environment of Homicho Ammunition Engineering Industry Workers, in West Showa Zone, West Ethiopia, March 2017.

Category of variables	Frequency(n= 660)	Percent (%)
Employment status		
Temporary	134	20.3
Permanent	526	79.7
Payment method		
Hourly payment	523	79.2
Piece rate payment	137	20.8
Total working hour a day		
≤8 hours	30	4.5
9-10 hours	610	92.4
>10 hours	20	3.0
Total working break excluding lunch break		
≤15 minutes	261	39.5
>15 minutes	259	39.2
None	140	21.2
Training on issue of OHS and ergonomics		
Yes	149	22.6
No	511	77.4

Prevalence of Low Back Pain among Homicho Ammunition Engineering Industry

The prevalence of low back pain among employees who had experienced trouble (ache, pain and discomfort) in the last 12-month period were 58.2% of them developed musculoskeletal low back pain. The research conducted among Turkey ammunition engineering industry workers indicates that 42.5% of the workers developed low back pain(14). This is lower than this finding. The majority 281(73.1%) of the workers had experienced low back MSD in the last 12-month period trouble (ache, pain and discomfort) 1-7 days. From those employees developed low back pain 248(64.6%) of them were prevented from their daily work more than one day per year. This is greater than the research conducted among Norway aluminum industry workers(15).

The Associated Factors for Work-Related Low Back Pain

In Table 5 below both bivariate and multivariate analysis were displayed to show the correlation and association between the outcome variable with independent variable. The Bivariate logistic regression analysis, factors such age, marital status, previous medical history of MSDs, doing too much work, employment status, tea break and OHS training, were found to be protective and significant association with work related low back pain. Of the all covariates that exported to multiple logistic regressions; age, marital status, previous medical history of MSDs, doing too much work and OHS training were statistically significant with Low back MSD. Being age and marital status of the workers were protective for the development of low back disorders than with their respective group. Those employees who did not diagnosed previously MSDs 3.2 times develop low back pain than others [AOR =3.20, 95% CI =2.04-5.03]. A group of workers sometimes forced to do much work were 5.29 times more having the chance to develop low back pain than never forced to do much work [AOR=5.29, 95% CI = 2.78-10.07]. Workers who did not attended occupational health and safety training on job were 2.55 times to have the opportunity of developing low back pain than others[AOR =2.55, 95% CI =1.64-3.96] (Table 5).

Table 5: Association factors with Work-Related Low Back Pain among Homicho Ammunition Engineering Industry Workers, in West Showa Zone, West Ethiopia, March 2017

Category of Variables	Low back Pain		COR(95%CI)	AOR(95%CI)
	Yes n (%)	No n (%)		
Age				
<30 years	241(52.6)	217(47.4)	1.00	1.00
30-39 years	61(58.1)	44(41.9)	0.80(0.52-1.23)	1.21(0.73-2.00)
40-49 years	58(85.3)	10(14.7)	0.19(0.09-0.38)	0.25(0.10-0.59)
≥ 50 years	24(82.8)	5(17.2)	0.23(0.08-0.61)	0.45(0.15-1.36)
Marital Status				
Married	186(70.2)	79(29.8)	0.34(0.28-0.55)	0.63(0.42-0.94)
Divorced	12(85.7)	2(14.3)	0.15(0.03-0.70)	0.20(0.04-1.02)
Widowed	8(61.5)	5(38.5)	0.58(0.188-1.82)	2.29(0.52-10.01)
Single	178(48.4)	190(51.6)	1.00	1.00
Previous medical history of MSD				
Yes	146(80.7)	35(19.3)	1.00	1.00
No	238(49.7)	241(50.3)	4.22(2.80-6.36)	3.20(2.04-5.03)
Doing too much work				1.00
Never	26(28.3)	66(71.7)	1.00	5.29(2.78-10.07)
Sometimes	229(63.8)	130(36.2)	4.68(2.61-8.37)	1.60(0.98-2.61)
Often	46(56.8)	45(35.2)	1.04(0.68-1.59)	2.38(1.25-4.55)
Always	83(64.8)	45(35.2)	1.40(0.79-2.48)	
Employment status				
Temporary	57(42.5)	77(57.5)	2.22(1.51-3.26)	
Permanent	327(62.2)	199(37.8)	1.00	
Tea break per day				
≤ 15 minutes	158(60.5)	103(39.5)	1.00	
>15 minutes	170(65.6)	89(34.4)	0.80(0.56-1.14)	
None	384(58.2)	276(41.8)	2.30(1.51-3.50)	
OHS training				1.00
Yes	63(42.3)	86(57.7)	1.00	2.55(1.64-3.96)
No	321((62.8)	190(37.2)	0.43(0.24-0.63)	

Discussion

The study revealed that work-related low back pain is highly prevalent in the ammunition engineering industry. The self-reported low back MSDs indicates 58.2% of the workers were developed ache/trouble/pain in the last 12 months prior to the study is conducted. This finding is higher than the study conducted among Turkey ammunition engineering industry workers(14). Those employees who did not checked pre-employment medical examination more likely develop low back pain than those previously diagnosed by physicians with the presence of MSDs. This indicates the majority of the workers did not have the chance of pre-employment and on job medical examination provided by their employers. Which means the Ethiopian occupational health and safety directives sets any employers governed under Ethiopian labor law should be provide pre-employment and on job medical examination without any charges. This indicates that the supervision and enforcement of labor law implementation in the side of government is low. Workers who are always or sometimes forced to do much work by their supervisors were more having the chance of developing low back pain than those never forced on their duties. This is in line with the research conducted in Netherlands(16). This shows that the lack of job description provided by the employer or supervisors is weak. The provision of occupational health and safety service at company level is a tool for the improvement of working population. In similar way this finding revealed that those groups did not attended occupational health and safety training 2.55 times developed low back pain than attended the training [AOR=2.55, 95% CI = 1.64-3.96]. This is also supported the research conducted on the influence of physical fitness training on the manual material-handling capability and road-marching performance of female Soldiers(17). However, the Ethiopian labor law recommends that the employers should be provide health and safety induction training and on job training without any charges.

Limitations

As a limitation there is a lack of ergonomics tools to conduct postural analysis, limitation of literature on the area of topic in developing countries and recall biases might have given vague answer to questions for respondents to easily remembered.

Conclusion

This finding indicates that the prevalence of low back pain among ammunition engineering industry is high. With regarding to the prevalence of low back pain, pre-employment medical examination (previous history of MSDs), provision occupational health and safety training at enterprise level and the load of work is highly significant. Therefore the government and the owner of the company should be work on the implementation of law and prevention of low back pain.

Competing Interests

The authors declare that they have no competing interests

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Abbreviations

HAEI	Homicho Ammunition Engineering Industry (HAEI)
LBP	Low Back Pain
METEC	Metal and Engineering Corporation
MSDs	Musculoskeletal Disorders
SD	Standard Deviation
WMSDs	Work Related Musculoskeletal Disorders

1. Eu A. Work-related musculoskeletal disorders: prevention report Luxembourg europeu. February 2008.
2. Podniece Z, Heuvel S, Blatter B. Work-related musculoskeletal disorders: prevention report. 2008.
3. Kelsey J, White 3rd A, Pastides H, Bisbee Jr G. The impact of musculoskeletal disorders on the population of the United States. *JBJS*. 1979;61(7):959-64.
4. Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. *Bulletin of the World Health Organization*. 2003;81(9):646-56.
5. Snook SH, Webster BS. The cost of disability. *Clinical Orthopaedics and Related Research*. 1987;221:77-84.
6. Jäger PD-IM, Griefahn B, Liebers F, Steinberg D-IU, für Arbeitsschutz B. Preventing musculoskeletal disorders in the workplace. 2003.
7. Silverstein BA, Fine LJ. Cumulative Trauma Disorders of the Upper Extremity: A Preventive Strategy Is Needed. *Journal of Occupational and Environmental Medicine*. 1991;33(5):642-3.
8. NIOSH. Musculoskeletal disorders and workplace factors: A critical review of epidemiologic evidence for workrelated musculoskeletal disorders of the neck, upper extremity, and low back. 1997.
9. WHO. Global strategy on occupational health for all: The way to health at work Recommendation of the second meeting of the WHO Collaborating Centres in Occupational Health. Beijing China WHO. 11-14 October 1994.
10. Punnett L, Prüss-Utün A, Nelson D, Fingerhut M, Leigh J. Estimating the global burden of low back pain attributable to combined occupational exposures. *Am J Ind Med*. 2005;48:459-69.
11. Lipscomb HJ, Dement JM, Silverstein B, Cameron W, Glazner JE. Compensation costs of work - related back disorders among union carpenters, Washington State 1989–2003. *American journal of industrial medicine*. 2009;52(8):587-95.
12. Katz JN. Lumbar disc disorders and low-back pain: socioeconomic factors and consequences. *JBJS*. 2006;88(suppl_2):21-4.
13. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied ergonomics*. 1987;18(3):233-7.
14. Pinar T, Cakmak ZA, Saygun M, Akdur R, Ulu N, Keles I, et al. Symptoms of musculoskeletal disorders among ammunition factory workers in Turkey. *Archives of environmental & occupational health*. 2013;68(1):13-21.
15. Morken T, Riise T, Moen B, Hauge SH, Holien S, Langedrag A, et al. Low back pain and widespread pain predict sickness absence among industrial workers. *BMC Musculoskeletal disorders*. 2003;4(1):21.
16. Hoogendoorn W, Bongers P, De Vet H, Ariens G, Van Mechelen W, Bouter L. High physical work load and low job satisfaction increase the risk of sickness absence due to low back pain: results of a prospective cohort study. *Occupational and environmental medicine*. 2002;59(5):323-8.
17. Knapik JJ, Gerber J. The Influence of Physical Fitness Training on the Manual Material-Handling Capability and Road-Marching Performance of Female Soldiers. *ARMY RESEARCH LAB ABERDEEN PROVING GROUND MD*, 1996.