ORIGINAL ARTICLE

PHYSICAL ACTIVITY AND LOW BACK PAIN AMONG AUTOMOTIVE INDUSTRY WORKERS IN SELANGOR

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ABSTRACT

Substantial studies reported musculoskeletal disorders among the working population in the developed country, however, a limited number of studies were conducted in Malaysia. The objective of this cross sectional study was to determine the physical activity risk factors for low back pain among automotive workers in Selangor. Modified Risk Factors Questionnaire (RFQ) was used to assess physical activity with the occurrence of low back pain. The significant physical activities associated with the 12 months point prevalence are lifting weight (<5 kg and 11-23 kg) and climbing stairs, not using any mechanical lifting aid, and postures (extreme bending, pushing and pulling, standing, kneeling, and bending and twisting). These findings indicate that the occupational risk factors mainly the physical demands were significant risk for low back pain among manual material handling (MMH) workers. Work task and workstation design should be regularly evaluated and corrective measures need to be taken. In addition, proper lifting technique and occupational safety and health promotion program should be emphasized among MMH workers.

Keyword: Low back pain; manual material handling (MMH); physical activity, risk factors.

INTRODUCTION

The industrial development in the whole world had created numerous occupational related injuries and diseases including musculoskeletal disorders. Low back pain (LBP) is the main musculoskeletal disorders that are costly[1] and lead to loss of workdays[2]. A study on estimation of global burden on low back pain found that 37% of the causes were attributable to occupational exposure[3]. Many studies have reported the prevalence and risk factors associated with low back pain among various occupations[4,5,6,7,8,9,10,11,12]. A systematic review on global prevalence of low back pain shows that the prevalence increased slightly over the past three decades where the mean prevalence was higher in high income countries compared to middle and low income countries[13].

In Malaysia, there are approximately 2.22 million people working in the manufacturing industry and 26, 367 people working in motor vehicle manufacturing[14]. Automotive industry workers involved with manual material handling (MMH) are highly exposed to ergonomic hazards as some studies have shown that there were association between MMH and the occurrence of low back pain[4,6,9,15,16].

Despite the high numbers of workers working in the manufacturing industry, only few studies have been conducted focusing on ergonomics aspects of the manufacturing workers in Malaysia. Majority of the studies have been conducted more than a decade ago and are focusing on general musculoskeletal disorders and not solely focusing on low back pain. With the development of technology and automation of the manual task, most of the manual tasks now are done by the machine in the manufacturing plant. This study was conducted to evaluate the prevalence and the risk of low back pain which encompasses not only work posture and physical activity risk factors but also the effect of training and lifting aid devices provided on the occurrence of low back pain. Findings from this study are expected to be useful in initiating any corrective measure to prevent low back pain among community in general as

well as workers population specifically automotive industry workers.

METHODOLOGY

Study Design and Sampling

A cross sectional study was conducted to evaluate the low back pain problem among workers performing manual material handling in Selangor. A stratified random sampling of the automotive industry based on the assembly, stamping and die-casting work process was conducted. Three automotive plants in Shah Alam, Puchong, and Rawang which met the criteria were selected and invited to participate in this study. The questionnaire survey via convenient sampling among workers in these three plants was carried out.

A standardized and modified Risk Factors Questionnaire (RFQ)[17] also known as Job Descriptions Questionnaire (JDQ) was used to assess the physical demands of 202 automotive manual material handling workers. The Likert-scale were use to assess the posture and physical activity with the scale of 1=never, 2=sometimes, 3=half of the working time, 4=often, and 5=almost all of the working time. Frequency of lifting activity were categorized into 1=never, 2= less than 10 times per hour and 3=more than 10 times per hour for the weight of <5 kg, 6-10 kg, 11-22 kg and >23 kg. In this study, the low back pain was defined as any pain or discomfort occur at the lower back to upper margin of the buttocks [18]. The percentages of individual who have low back pain in the study population for the specific period of time were identified as 12 months, 1 month and 7 days prevalence. Questions regarding administrative control to reduce and prevent musculoskeletal disorders in the workplace such as MMH training, mechanical lifting aid, and lumbar support also were included to assess the relationship of these administrative control to prevent low back pain.

The Malay and English language version questionnaires were validated by local experts for content validity. A pre-testing survey was conducted to evaluate the questionnaire content and reliability. Results and feedback given from the respondents in the pre-test survey was taken into consideration to make the questionnaire easier to be understood. The Cronbach alpha value was found to be in a good reliability with the value of more than 0.8. The modified and improved questionnaire was then used to collect data at the automotive industry. Arrangement for the questionnaire survey was made with the site supervisor of each plant. These supervisors were briefed on the details of the questionnaire, the sampling procedures and targeted study population. The questionnaires are all in Malay language and the English version of the questionnaire were given to the site supervisors for any clarification. The survey for this study conducted was on voluntary approach and respondents need to fill up a consent form prior to the survey conducted. As mentioned in the questionnaire information sheet, all information obtained is confidential and respondents are allowed to withdraw on participation of this study at any time. This study has been approved by the panel reviewers at the Department of Mechanical and Material Engineering, Faculty of Engineering and Built Environment, UKM.

The inclusion criteria for this study are Malaysian citizen, working at the production line, performing manual material handling task and working for more than a year at current plant. Foreign workers, administration and management workers, and workers in the production line servicing less than 12 months for current plant are not eligible for this study.

Statistical Analysis

Statistical analysis was performed using the SPSS for Windows (version 20) software. The Likert-scale in the

questionnaire was categorized into new scale with 1=Never, 2=Occasional, and 3=Frequent to simplify the inferential statistical analysis. Association between risk factors and low back pain was conducted by using the Chi-square test. To determine the contribution of the risk factors for low back pain, all the significant risk factors with the p-value less than 0.25 in the Chi-square test was included in the multivariate logistic regression model for point prevalence of 12 months, 1 month and 7 days. The Hosmer-Lemeshow test with the p-value more than 0.05 indicate a good logistic regression model, and the classification table value shows how good the model can indicate the contributions of risk factors to the prevalence of low back pain.

RESULTS

Socio-demographic Data and Prevalence of Low Back Pain

Of 202 respondents participated in this study, 95% of them are male and only 5% are female. The majority of the workers are Malays (88.1%), age below 30 (47.5%), and have obtained SPM (59.4%) education level. The mean BMI were 23.1±4.10 ranging from 16.3 to 37.6. A total of 144 (71.3%) reported to have experienced low back pain with the percentage of 12 months prevalence were 57.9%, one month prevalence 49.5% and 7 days prevalence 35.1 %.

Work Posture and Physical Demand Risk Factors Associated With Low Back Pain

Working posture has been known as a risk factor for low back pain. Table 1 and Table 2 show the relationship between work posture and physical demand risk factor with the prevalence of low back pain. In this study, most of work posture and physical demand showed a significant association with the prevalence of low back pain for the three point prevalence except lifting weights using one hand. Standing posture and pushing and pulling show no significant association with the prevalence of 1 month and 7 days, bending and twisting for 1 month prevalence and extended reach for 12 months prevalence.

Manual lifting activity examined in this study includes lifting load weight less than 5 kg, 6-10 kg, 11-23 kg and more than 23 kg. From Table 3, it shows that lifting weight between 6-10 kg shows significant associations with point prevalence of 12 months, 1 month and 7 days. The prevalence was higher among respondents lifting weight 6-10 kg less than ten times per hour.

The occupational safety and health promotion were also taken into consideration in determining the risk associated with low back pain. These factors include MMH training, mechanical lifting aid equipment and Personal Protective Equipment provided; lumbar support. There is a significant difference for those attending MMH training and using no mechanical lifting aid equipment with the prevalence of low back pain (Table 4). However, using lumbar support did not show any significant difference with low back pain.

Table 1 Work posture risk factors associated with low back pain

Factors	LBP last 12 months		LBP last month		LBP last 7 days	
	n(%)	p value	n(%)	p value	n(%)	p value
Standing						
Occasional	16(13.7)	<0.05*	19(19.0)	0.41	13(18.3)	0.43
Frequent	101(86.3)		81(81.0)		58(81.7)	
Sitting						
Never	37(31.6)	<0.05*	36(36.0)	<0.05*	26(36.6)	<0.05*
Occasional	68(58.1)		51(51.0)		38(53.5)	
Frequent	12(10.3)		13(13.0)		7(9.9)	
Slight bending						
Never	5(4.3)	<0.05*	5(5.0)	<0.05*	5(7.0)	<0.05*
Occasional	52(44.4)		45(45.0)		23(32.4)	
Frequent	60(51.3)		50(50.0)		43(60.6)	
Extreme bending						
Never	9(7.8)	<0.05*	10(10.1)	<0.05*	9(12.9)	<0.05*
Occasional	64(55.2)		53(53.5)		28(40.0)	
Frequent	43(37.1)		36(36.4)		33(47.1)	
Bending and twisting						
Never	5(4.3)	<0.05*	4(4.1)	0.05	4(5.8)	<0.05*
Occasional	50(43.5)		44(44.9)		20(29.0)	
Frequent	60(52.2)		50(51.0)		45(65.2)	
Pushing and pulling						
Never	4(3.4)	<0.05*	7(7.1)	0.19	3(4.3)	0.06
Occasional	53(45.7)		46(46.5)		29(41.4)	
Frequent	59(50.9)		46(46.5)		38(54.3)	
Kneeling						
Never	48(41.4)	<0.05*	42(42.4)	<0.05*	32(45.7)	<0.05*
Occasional	53(45.7)		44(44.4)		25(35.7)	
Frequent	15(12.9)		13(13.1)		13(18.6)	
Squatting						
Never	33(28.7)	<0.05*	33(33.7)	<0.05*	24(34.3)	<0.05*
Occasional	66(57.4)		51(52.0)		32(45.7)	
Frequent	16(13.9)		14(14.3)		14(20.0)	

* Significant, p<0.05

Predictor for Low Back Pain Using Logistic Regression

With multivariate analysis using logistic regression as shown in Table 5 and Table 6, this study found that the significant contributors for 12 months point prevalence were standing, extreme bending, bending and twisting, pushing and pulling, kneeling, climbing stairs, lifting weight <5 kg, 11-23 kg, and using no mechanical lifting aid. For a 1 month point prevalence, the significant predictor were extended reach, and lifting weight of 6-10 kg. Significant contributors for 7 days point prevalence were slight bending, climbing stairs, using vibrating/powered tools, lifting weight 6-10 kg, more than 23 kg, and using no mechanical lifting aid.

Table 2 Physical demand risk factors associated with low back pain

Factors	LBP last 12 months n(%)	p value	LBP last month n(%)	p value	LBP last 7 days n(%)	p value
Lifting using one hand						
Never	19(16.4)	0.52	17(17.2)	0.56	10(14.3)	0.82
Occasional	64(55.2)		54(54.5)		39(55.7)	
Frequent	33(28.4)		28(28.3)		21(30.0)	
Extended reach						
Never	22(19.0)	0.06	14(14.1)	<0.05*	10(14.3)	<0.05*
Occasional	76(65.5)		67(67.7)		45(64.3)	
Frequent	18(15.5)		18(18.2)		15(21.4)	
Climbing stairs						
Never	44(38.6)	<0.05*	40(41.7)	<0.05*	34(49.3)	<0.05*
Occasional	64(56.1)		50(52.1)		32(46.4)	
Frequent	6(5.3)		6(6.3)		3(4.3)	
Using vibrating/ powered tools						
Never	32(27.6)	<0.05*	31(31.3)	<0.05*	20(28.6)	<0.05*
Occasional	53(45.7)		42(42.4)		25(35.7)	
Frequent	31(26.7)		26(26.3)		25(35.7)	

* Significant, p<0.05

Table 3 Lifting activity risk factors associated with low back pain

Factors	LBP last 12 months n(%)	p value	LBP last month n(%)	p value	LBP last 7 days n(%)	p value
Lifting weight						
<5 kg						
Never	5(4.4)	0.11	8(8.2)	0.55	3(4.3)	0.32
<10 times	62(54.4)		49(50.0)		36(52.2)	
>10 times	47(41.2)		41(41.8)		30(43.5)	
6-10 kg						
Never	38(33.3)	<0.05*	36(36.7)	<0.05*	23(23.3)	<0.05*
<10 times	55(48.2)		41(41.8)		29(42.0)	
>10 times	21(18.4)		21(21.4)		17(24.6)	
11-23 kg						
Never	62(54.4)	0.08	55(56.1)	0.37	37(53.6)	0.28
<10 times	35(30.7)		29(29.6)		21(30.4)	
>10 times	17(14.9)		14(14.3)		11(15.9)	
>23 kg						
Never	92(80.0)	0.97	78(78.8)	0.79	52(74.3)	0.25
<10 times	14(12.2)		13(13.1)		11(15.7)	
>10 times	9(7.8)		8(8.1)		7(10.0)	

* Significant, p<0.05

DISCUSSION

Work posture has been known as risk factors for low back pain. This study found that frequent standing posture at work is a significant contributor for low back pain. This could be due to the fact that most of the work settings in manufacturing plant require workers to stand while performing a task. Sitting has also been found to be associated

with low back pain in this study. Several studies reported that the longer hour of sitting increased risk of low back pain[5,7,10]. However, sitting is not a significant contributor for low back pain in this study.

Table 4 Occupational safety and health promotion and low back pain

Factors	LBP last 12 months		LBP last month		LBP last 7 days	
	n(%)	p value	n(%)	p value	n(%)	p value
Attend MMH Training						
Yes	35(30.4)	<0.05*	32(32.3)	<0.05*	21(30.0)	<0.05*
No	80(69.6)		67(67.7)		49(70.0)	
Use mechanical lifting aid equipment						
Yes	76(66.1)	<0.05*	65(67.0)	<0.05*	45(65.2)	<0.05*
No	39(33.9)		32(32.0)		24(34.8)	
Use lumbar support						
Yes	38(32.8)	0.32	35(35.4)	0.1	21(30.0)	1.00
No	78(67.2)		64(64.6)		49(70.0)	

* Significant, p<0.05

Besides standing and sitting, awkward postures such as slight and extreme bending, bending and twisting, extended reach, kneeling, squatting, and climbing were also performed at work. These awkward postures showed association with low back pain and were found to be significant contributors for low back pain. Performing tasks requiring too often awkward postures will exposed workers to low back pain risk[19, 20, 12]. The risk of back pain is more likely to occur immediately due to deviation from neutral postition[21]. This risk could be attributed to the force given to the spine especially in the lumbar region[20], and also the energy needed for the muscle to sustain posture during awkward movement[22].

This study found that workers with frequent extreme bending shows 15 times higher odds of getting low back pain; while pushing and pulling, and extended reach were 12 times higher odds of getting low back pain. These findings are similar with a study among municipal workers where frequent bending, twisting and extended reach are 42% higher risk of getting back pain[12]. The risk of getting low back pain was 1.6 higher among Chinese coal miners performing task with extreme bending posture[23]. However, a study among rubber tapper did not find any significant association with low back pain[24]. A study among textile workers also showed increased odds of low back pain for pushing and pulling weights[25].

This study also showed that using vibrating powered tools was found to be as a significant contributor for low back pain. This finding is supported by a study among automobile manufacturing workers[26] and foundry workers[8].

Lifting was found to be the risk factor for low back pain[10,8,6]. In this study, a significant risk was found for workers lifting weight ranging from 1 kg to more than 23 kg. Respondents lifting weight less than 5 kg and 11-23 kg had 22 times and 15 times higher odds of getting low back pain respectively. This finding was supported by other study where jobs requiring frequent lifting of objects weighing 25 kg load more than 15 times a day will increase risk to low back pain[20]. The size of the object lifted play a significant role in the pain severity due to the high energy required for larger objects[15]. The bigger the size, the larger the energy needed, thus, a huge amount of force will be produced during lifting.

Table 5 Multivariate analysis of posture risk factors for low back pain

Factors	LBP last 12 months		LBP last month		LBP last 7 days	
	OR(95%CI)	p value	OR(95%CI)	p value	OR(95%CI)	p value
Standing (Frequent)	5.92 (1.0-35.03)	<0.05*	NS		NS	
Slight bending (Frequent)	NS		NS		0.01 (0.0-0.56)	<0.05*
Extreme bending (Frequent)	15.19 (1.05-220.1)	<0.05*	NS		NS	
Bending and twisting (Occasional)	0.05 (0.0-0.68)	<0.05*	NS		NS	
Pushing and pulling (Occasional)	12.31 (1.15-131.3)	<0.05*	NS		NS	
Extended reach (Occasional)	NS		12.58 (1.77-89.29)	<0.05*	NS	
Extended reach (frequent)	NS		234.6 (10.6-5183.3)	<0.05*	NS	
Kneeling (Occasional)	0.1 (0.02-0.64)	<0.05*	NS		NS	
Climbing stairs (Frequent)	0.03 (0.0-0.39)	<0.05*	NS		0.02 (0.0-0.3)	<0.05*
Using vibrating/powered tools (Frequent)	NS		NS		39.93 (3.85-414.2)	<0.05*

NS= not significant, *Significant, p<0.05

The benefit of safety and health program implemented by employer was shown in this study. It was found that attending MMH training and using mechanical lifting aid showed significant different with low back pain where the prevalence is higher among those who did not attended MMH training and did not use any mechanical lifting aid equipment. Not using any mechanical lifting aid equipment was found to be a significant contributor to low back pain. Respondents who did not use any mechanical lifting aid equipment showed 20 times higher odds of experiencing low back pain. It is suggested that continuous training and educational approach should be implemented to remind workers about healthy and proper way of safe lifting techniques[27]. Vocational and proper training are important towards decreasing the musculoskeletal symptoms as workers will improve working techniques and use proper body postures[28]. This finding indicates that MMH training and using mechanical lifting aid is very useful in reducing the risk of low back pain among automotive manual workers.

Table 6 Multivariate analysis of lifting activity risk factors for low back pain

Factors	LBP last 12 months		LBP last month		LBP last 7 days	
	OR(95%CI)	p value	OR(95%CI)	p value	OR(95%CI)	p value
Lifting weight						
<5kg (<10 times/hour)	11.65 (1.05-129.2)	0.046	NS		NS	
<5kg (>10 times/hour)	22.65 (1.31-392.9)	0.032	NS		NS	
6-10 kg (>10 times/hour)	NS		17.54 (2.37-129.6)	<0.05*	7.66 (1.02-57.56)	<0.05*
11-23 kg (<10 times/hour)	15.46 (1.82-131.6)	<0.05*	NS		NS	
11-23 kg (>10 times/hour)	14.43 (1.14-182.9)	<0.05*	NS		NS	
>23kg (>10 times/hour)	NS		NS		16.5 (1.46-186.6)	<0.05*
No mechanical lifting aid	20.96 (3.0-146.1)	<0.05*	NS		4.33 (1.09-17.25)	<0.05*

NS= not significant, *Significant, p<0.05

A study in food manufacturing company manual handling workers showed that respondent give a positive response on the effectiveness of lumbar support provided by employer to prevent back injury[27]. However, the use of lumbar support to prevent low back pain did not show any significant association or contribute to the occurrence of low back pain in this study. This result is supported by a study conducted among cargo airline company[29]. A review on lumbar support for prevention and treatment of low back pain reported that the use of lumbar support did not reduce low back pain, nevertheless the effectiveness of lumbar support in preventing low back pain is still unclear[30]. Alternatively, administrative control can be implemented such as performing variety of task during working hour, and active rest breaks such as stretching and light muscular activity during break at work to reduce muscle strain[29].

This cross sectional study has shown the relationship of low back pain and its associated risk factors. Further investigation on the causality and dose response relationship of exposure to manual handling activity and the occurrence of low back pain using other study designs such as experimental, case control and cohort studies are recommended.

CONCLUSION

The findings in this study indicate that the occupational risk factors namely the physical demands were significant risk for low back pain among manual material handling (MMH) workers. It is recommended that employer or management to promote the ergonomics or safety and health related training to exposed workers. This initiative could improve the workers knowledge on the potential risk factors and injuries at work and their preventive measures respectively. This study has also shown that using mechanical aid could reduce the risk of getting low back pain. Employer has to provide lifting-assistance devices and personal protective equipment (PPE) to employees such as adjustable pallet racking, and hydraulic hand pallet. Work task and workstation design should be

regularly evaluated and corrective measures need to be taken. The proposed corrective measures to be recommended include adjusting the height of the pallet, shelf of platform according to workers' height, platforms and conveyors can be built at waist height, minimize the weight and range of motion and reduce the frequency of lifting activity. In addition, proper and safe lifting technique and occupational safety and health promotion program should be emphasized among MMH workers.

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