ORIGINAL ARTICLE

FACTORS ASSOCIATED WITH LOWER BACK PAIN AMONG WORKERS IN A CHEMICAL FERTILIZER FACTORY

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ABSTRACT

Most available data on the prevalence and characteristics of low back pain (LBP) are reported in developed countries. The aim of this study was to investigate the prevalence of LBP and potential risk factors among a group of workers in Malaysia. A cross-sectional study was conducted among 170 workers in a fertilizer company in Malaysia. The sample comprised both blue- and white-collar workers. A set of questionnaires consisting of sociodemographic items, the NORDIC musculoskeletal questionnaire and the Dutch Musculoskeletal Questionnaire was used for this study. The main analysis conducted was a multivariate logistic regression. ***Results showed that*** *a total of 40% of workers experienced LBP. Compared to workers younger than 30 years of age, the risk of LBP was 8 times higher among those over 50 years of age. In addition, workers who were moderately stressed at work had a risk of LBP that was almost five times higher, and workers who did not have awkward posture for a long period of time had an 80% lower risk of LBP. In a multivariate logistic regression, after adjusting for sociodemographic variables, it was found that less repetitive work, shorter sustained positions and less frequent lifting of heavy objects prevented LBP. After the final adjustment including all other variables, only engaging in repetitive work was associated with LBP.* ***In conclusion,*** *each workplace should ensure that older workers, especially those who are working in stressful environments, are prevented from engaging in repetitive work, sustaining prolonged awkward postures and lifting heavy objects.*

Keywords*: low back pain; workers; stress; lifting; posture*

INTRODUCTION

Low back pain (LBP) was one of the most common causes of disability among workers worldwide in 2015[1]. The prevalence peaks in older age groups. As a consequence, the burden of LBP was higher in countries with higher life expectancies[2]. In Malaysia, there has also been an increasing number of cases among workers over the years. The Social Security Organization (SOCSO) of Malaysia reported that the initial cases in 2006 included 14 cases of musculoskeletal disorder (MSD) involving lower back pain, and the number of these cases rose to 268 in 2011, although several cases remain unreported[3]. A local study among automotive manual handling workers calculated the prevalence of lower back pain to be as high as 21.7%[4].

In general, lower back pain is defined as pain in the posterior aspect of the body from the lower margin of the twelve ribs to the lower gluteal folds, with or without pain transferred into one or both lower limbs, that lasts for at least one day[2]. Lower back pain can be categorized as acute (2-4 weeks), subacute (5-12 weeks) and chronic (12 weeks), depending on the duration of the LBP[5]. This medical condition can be severe in many cases and may cause losses in company productivity, sickness absenteeism and presentism, medical loss and indemnity claims, and loss of jobs when the workers need to take unpaid leave because they have abused their medical leave days, which may result in departure from the company[6-8].

The factors causing LBP are multidimensional, including skeletal-, muscular-, nerve-related factors. These factors can be further subdivided into modifiable and non-modifiable risk factors, and they could also be related to individual characteristics, occupational practices or even workstation environments or designs. Individual factors include sex, previous history of LBP, and psychological factors[9,10], whereas occupational factors were found to be related to prolonged standing, prolonged sitting, high job demands at work and poor design of workstations[11, 12]. In addition, occupational activities, such as whole-body vibration, strenuous physical activity, repetitive twisting or bending or standing up, and enhanced demands due to the work environment are among the aggravating factors contributing to the development of lower back pain[13]. Other occupational factors also significantly linked to LBP include hostile work environment, work-family imbalance, job insecurity, prolonged work hours, and difference in occupational groups[8].

To our knowledge, previous studies have concentrated mainly on office workers, patients, and few on manufacturing industries. Our study explored workers working in a chemical manufacturing industry in Malaysia. Workers in this factory fell into various categories, including manual handling workers, technical workers, and managerial and office workers. The types and degree of ergonomic hazards to which they are exposed might also differ from those of other manual handling workers. Nonetheless, this finding has yet to be determined. Hence, in this study, we aim to determine the prevalence of LBP and its associated factors among workers in a chemical fertilizer company.

METHODOLOGY

This study took place at Chemical Fertilizer, which is a Malaysian urea production company located in a town in Kedah Darul Aman, Malaysia. This company was involved in petrochemical manufacturing, mainly producing granular urea with ammonia and methanol as secondary by-products of the manufacturing process for use in local and foreign agricultural industries. A cross-sectional study was conducted among workers who fulfilled the inclusion criteria, such as having LBP at least once, being 18 to 65 years old, being willing and able to give informed consent and being a full-time worker[14]. Exclusion criteria included the following: being pregnant or having had bone surgeries, cardiovascular problems, or a past history of LBP. The study was conducted from June-August 2017. It covered both blue- and white-collar workers in both non-processing and processing areas.

Participation from the workers was voluntary, and all participants provided written informed consent. A self-administered, standardized questionnaire was given to each of the participants after a briefing. The questionnaires were collected after 20 minutes. The study was approved by the Medical Ethics Committee, Faculty of Medicine, Universiti Teknologi Mara, UiTM. The questions were multiple choice and included some binary (yes/no) questions[15]. All respondents completed a questionnaire composed of four parts:

Part 1: Sociodemographic information was collected, including age, gender (male or female), marital status (single or married or divorced), height, weight, etc.

Part 2: A modified and validated Malay version of the NORDIC questionnaire was used to assess body parts with musculoskeletal disorders and the individuals' perceptions of health risks at work. The aim was to develop and test a standardized questionnaire methodology allowing for the comparison of complaints regarding the low back, neck, shoulder and in general for use in epidemiological studies[16].

Part 3: A translated and validated Dutch Musculoskeletal Questionnaire (DMQ) was used for the analysis of workload and associated potentially hazardous working conditions, as well as of musculoskeletal symptoms in the general working population. The risk factors for lower back pain (LBP) were chemical, physical, biology and ergonomic hazards[17]. The DMQ's main focus was on dynamic and static load, force and vibration. It was modified and rearranged in a manner that enabled respondents in the target population to comprehend the content in the Malay version, and it was validated in other local studies[18]. The sample size calculation was based on calculations in the Open Epi software. Assuming a prevalence of 73.1% from a local study among nurses[19], an acceptable error of estimation of 5%, and a 95% confidence interval, the minimum sample size was 138. Allowing for 20% attrition, we calculated the sample size to be 166.

Statistical Analysis

Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS 23), with an alpha of less than 0.05 and a 95% CI. Descriptive statistics were displayed in the form of frequencies, percentages, and standard deviations. In the statistical analysis, differences between normally distributed continuous variables were tested with Student's t-test, and differences between categorical variables were tested with the chi-square test. Backward multiple regression analyses were carried out to assess possible predictors of LBP based on three different models. Model A comprised a crude logistic regression; Model B was adjusted for age, gender, ethnicity, education level, race, employment, household length of service, and work hours; and Model C was adjusted for other factors, such as physical risks, chemical and biological risks, ergonomic risks and psychosocial risks.

RESULTS

Of the 250 workers recruited, only 172 (68.8%) responded; 29% did not respond and 2% were excluded from the study due to incomplete answers. Sociodemographic data, which include personal information were obtained and analyzed. The age range of the group was mainly between 22 and 57 years old, with 32.6% being younger than 30 years old and the fewest workers (9.9%) being older than 50 years old. Most of the sample was composed of Malay workers who were male and from the middle-income group. Blue-collar workers comprised the largest category of workers, with over half having worked for more than five years. Concerning health, the majority of the workers were in the obese group.

Table 1 displays the results of reported musculoskeletal pain by the duration of time it was experienced by the respondents. The most frequently reported type of pain within the last seven days was pain in one or both knees, followed by lower back pain and neck pain, whereas within the previous 12 months, the highest
prevalence involved pain in the neck region and in one or both knees, followed by pain in the lower back. The least pain was experienced in one or both thighs.

Table 1. Reported musculoskeletal pain by the duration of time

Part of body	Experience problem anytime in your life (A)	Experience problem anytime within 12 month (B)	Experience problem anytime within 7 days (C)
Neck			
Yes	63(36.6%)*	54(31.4%)*	22(12.8%)
No	109(63.4%)	118(68.6%)	150(87.2%)
Shoulders			
Yes	52(30.2%)	39(22.7%)	16(9.3%)
No	120(69.88)	133(77.3%)	156(90.7%)
One/both hands			
Yes	27(15.7%)	28(16.3%)	11(6.4%)
No	145(84.3%)	144(83.7%)	161(93.6%)
Upper back			
Yes	40(23.3%)	42(24.4%)	17(9.9%)
No	132(75.6%)	130(75.6%)	155(90.1%)
Lower back			
Yes	56(32.6%)*	46(26.7%)	25(14.5%)*
No	116(67.4%)	126(73.3%)	147(85.5%)
One/both thighs			
Yes	22(12.8%)	18(10.5%)	10(5.8%)
No	150(87.2%)	154(89.5%)	162(94.2%)
One/both knees			
Yes	51(29.7%)	47(27.3%)*	29(16.9%)*
No	121(70.3%)	125(72.7%)	143(83.1%)
One/both feet			
Yes	40(23.3%)	37(21.5%)	17(9.9%)
No	132(76.7%)	135(78.5%)	155(90.1%)

The prevalence and unadjusted factors associated with LBP were identified. The prevalence of LBP was 40%. LBP was shown to be associated with older age groups. Workers who were more than 50 years old have an eightfold higher risk of having LBP than workers aged less than 30 years old. In addition, workers who were moderately stressed at work had an almost 5 times higher risk of LBP, and workers not having awkward posture for a long period of time had 80% lower odds of LBP (Table 2).

Model B: Adjusted for age, gender, ethnicity, education level, race, employment, household length of service, hours of working.
Model C: Adjusted for other factors such as physical risk, chemical risk and biological risk, ergonomic and psychosocial.

Table 3 represents the data of multiple variable regressions of LBP based on three different models: model A (crude logistic regression), model B (adjusted for sociodemographic factors) and model C (adjusted for other factors). The crude logistic regression data showed that LBP was significantly associated with repetitive work, high physical effort in working, having awkward posture for a long period of time and lifting heavy objects. However, after adjusting for sociodemographic factors, it was found that less repetitive work, shorter sustained positions and less frequent lifting of heavy objects protected against LBP. Finally, in model C, after adjusting for all other variables, only having repetitive work was associated with LBP.

DISCUSSION

The prevalence of LBP in the population was 40%, compared with prevalence estimates of other studies from 40-80%[20, 21]. The results revealed that respondents who experienced lower back pain (LBP) were mostly associated with multitasking in their work field. This finding is expected, as multitasking is one of the significant factors contributing to LBP. Workers might be performing too many jobs at the same time and taking less effort to exercise between tasks due to their job demands. Exposures to other hazards, such as physical, chemical and biological hazards, tobacco risks, and working hours, were not significantly associated with LBP but were reported as significant in other studies. These differences may have arisen because an international company, such as the workplace under investigation, presumably has

stringent occupational safety and health policies relating to smoking bans, OSH policies and international standards requirements.

Table 2: Results of prevalence of LBP and unadjusted logistic regression of LBP

RISK FACTORS	N	Prevalence n (%)	OR	95% CI	P
Age					
<30 years	56	18(32.1%)	Ref	Ref	0.12
30-39 years	48	18(32.1%)	1.57	0.49-4.99	0.45
40-49 years	51	21(41.1%)	2.21	0.66-7.46	0.20
>50 years	17	12(70.5%)	8.23	1.46-46.34	0.02*
Transport use to go to work					
Motorcycle	60	18(30%)	Ref	Ref	
Car	112	51(45.5%)	1.83	0.90-3.71	0.09
Expose to physical hazard mainly lighting					
Yes	31	17(54.8%)	Ref	Ref	
No	141	52(36.8%)	0.42	0.17-1.05	0.06
Difficulty in completing task					
Never	95	30(31.5%)		Ref	
Sometimes	74	37(50%)	2.24	0.99-5.07	0.05
Always	2	2(100%)		NS	NS
Level of job satisfaction					
Not at all stressful	26	6(24%)	Ref	Ref	0.19
Might stressful	46	15(32.6%)	1.56	0.43-5.70	0.49
Satisfied	85	39(45.8%)	2.53	0.739-8.64	0.14
Moderately stressful	13	9(69.2%)	4.89	1.33-46.97	0.02*
Very stressful	1	0	NS	NS	NS
Multitasking in work field					
Always	49	26(53%)	Ref	Ref	0.12
Sometimes	108	40(37%)	0.384	0.15-1.01	0.05
Rarely	14	3(21.4%)	0.235	0.03-1.66	0.15
Repeated work continuously					
Always	50	21(42%)	Ref	Ref	0.12
Sometimes	105	46(43.8%)	1.42	0.58-3.48	0.44
Rarely	16	2(13%)	0.20	0.03-1.60	0.13
Awkward posture for long time					
Yes	50	24(48%)	Ref	Ref	
No	122	45(36.9%)	0.20	0.05-0.81	0.02*

Based on our results, there was a significant relationship between LBP and increasing age. This finding showed that our results were consistent with previous studies demonstrating increasing prevalence and peaks at older age[2]. Our study also revealed that the significant association begins at age 55, during the years close to retirement. The LBP may have decreased after retirement age. Nonetheless, our study did not examine the effect of this LBP after retirement. With regard to years of service, we found no significant association of LBP with the length of service, in contrast to the findings of a study among teachers in Pahang, Malaysia[13]. We postulated that the reason behind this finding might be that workers in private industries in Malaysia normally do not stay in one place, as they usually shift from one place to another for higher pay. Hence, future research should look into previous employment history and would benefit more from a prospective design. In addition, respondents who experienced difficulty in completing tasks and who had poor job satisfaction demonstrated significant associations with complaints of LBP. Poor work posture, prolonged standing position and leaning forward were frequently associated with LBP. We also found that the psychological profile might be the cause of these findings, as similar to recent studies[22]. The relationship between poor job satisfaction and LBP is consistent with previous findings of a positive association between distress and work-related musculoskeletal disorders, including LBP[19].

Table 3: Multiple logistic regression models of LBP among workers

MSD		MODEL A		MODEL B		MODEL C	
	N	OR(95% CI)	P	OR(95% CI)	P	OR(95% CI)	P
Repetitive work							
Yes	87	Ref		Ref		Ref	
No	85	0.19(0.06-0.59)	<0.01*	0.02(0.00-0.13)	<0.01*	0.11(0.04-0.28)	<0.01*
Fast and sustained position							
Yes	98	Ref		Ref		Ref	
No	74	0.59(0.21-1.52)	0.25	0.34(0.15-0.79)	0.01*	0.60(0.25-1.49)	0.27
High physical effort in working							
Yes	79	Ref		Ref		Ref	
No	93	4.64(1.52-14.13)	0.01*	0.95(0.42-2.12)	0.89	1.59(0.59-4.29)	0.37
Enough time to finish work							
Yes	142	Ref		Ref		Ref	
No	30	1.03(0.39-2.74)	0.95	1.46(0.54-3.94)	0.453	1.30(0.46-4.2)	0.563
Lifting heavy things							
Yes	57	Ref		Ref		Ref	
No	115	0.34(0.13-0.92)	0.03*	0.32 (0.13-0.79)	0.01*	0.36(0.12-1.08)	0.07
Busy job							
Yes	87	Ref		Ref		Ref	
No	85	0.84(0.44-1.59)	0.59	0.78(0.35-1.76)	0.55	1.06(0.43-2.60)	0.90
Awkward posture for long time							
Yes	50	Ref		Ref		Ref	
No	122	0.20(0.05-0.81)	0.02*	0.61(0.19-1.95)	0.50	0.72(0.30-1.70)	0.45
Team support							
Yes	154	Ref		Ref		Ref	
No	18	1.77(0.66-4.76)	0.26	1.49 (0.44-5.04)	0.52	2.74(0.71-10.57)	0.14

Model A: Crude logistic regression
Model B: Adjusted for age, gender, ethnicity, education level, race, employment, household length of service, hour of working
Model C: Adjusted for other factors such as physical risk, chemical risk and biological risk, ergonomic and psychosocial.

Our study revealed that job satisfaction and stress are essential determinants of LBP, especially if a person reaches the age of 50 years and above. As a person ages, we presumed that work responsibility would increase; hence, the stress levels may also increase. Nonetheless, job satisfaction levels may decrease due to this high level of stress. Although this relationship was not explored in detail, it indicated the importance of exploring this finding further. Other studies also recently looked into this issue[23, 24]. Nonetheless, the relationship's temporality is questionable in terms of which starts first: the job satisfaction/stress or the pain itself as a result of the awkward postures. Thus, this issue requires further examination in future longitudinal studies.

This study had some limitations. First, given the cross-sectional design of the study, the results must be interpreted with caution. The study design does not allow the determination of causality. Second, because this study relied on self-reported data, the answers given might not reflect the participants' actual situations, which might be underreported or exaggerated. Despite these limitations, our results revealed a considerable percentage of LBP. The advantage was that the sample size was considerably large

because it managed to capture over 60% of respondents. Nonetheless, future studies may benefit from a longitudinal design to allow for the identification of suitable predictors of LBP to implement effective prevention strategies. Secondly, we managed to capture various occupational groups within the company, both white collar and blue collar workers. Future studies may also benefit from other data, such as BMI, physical activity, and diet, which were not explored in this study.

CONCLUSION

In conclusion, LBP was highly associated with repetitive work, heavy lifting and older age groups. Besides, workers with prolonged awkward posture and moderate stress at work were at increased risk. Hence, each workplace should ensure that older workers, especially those working in stressful environments, are prevented from engaging in repetitive work, having prolonged awkward posture and performing heavy lifting.

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