Budapest International Research and Critics Institute-Journal (BIRCI-Journal)
Humanities and Social Sciences
ISSN 2615-3076 Online)
ISSN 2615-1715 (Print)
www.bircu-journal.com/index.php/birci
Budapest Institute

Association between Individual, Physical, and Organisational Risk Factors and Low Back Symptoms Among Karawang Industrial-Indonesia Manufacturing Workers

Noviaji Joko Priono[1], Baiduri Widanarko[2]
[1]*Department of Environmental Engineering, Faculty of Engineering, Universitas Pelita Bangsa, Indonesia*
[2]*Department of Occupational Health and Safety, Faculty of Public Health, Universitas Indonesia, Indonesia*
joko.priono@pelitabangsa.ac.id, *baiduri@ui.ac.id*

Abstract

Individual and physical risk factors are reported to increase the risk of low back symptoms (LBS) among workers. This study aimed to identify the association between individual, organisational, and physical risk factors and the occurrence of subjective complaints in LBS among Karawang Industrial-Indonesia manufacturing workers. This preliminary study was cross-sectional. Data in October 2018 were gathered via an online survey using a self-administered questionnaire in 204 workers. The prevalence of LBS was 75.9%. Some risk factors were associated with LBS such as males (OR 4.82, 95% CI 2.26–10.26), overweight (OR 3.54, 95% CI 1.46–8.58), smokers (OR 2.07, 95% CI 1.07–3.99), and regular exercise during the last 30 days (OR 0.19, 95% CI 0.08–0.40), compared with females, normal weight, non-smokers, and never engaged in regular exercise, respectively. Lifting heavy load (>20 kg) also showed a significant association with LBS (OR 3.97, 95% CI 1.59–9.94). Interventions aimed at reducing LBS limit the lifting activity, particularly with objects >30 kg, with a focus on smokers, and overweight workers also never engaged in regular exercise. Meanwhile workers also must improve exercise habit.

Keywords
Indonesia; low back symptoms; manufacturing workers; organizational physical

I. Introduction

Low back symptoms (LBS) is an important public health problem in all industrialised countries [1]. Approximately 80% of adults experience at least one episode of back symptoms during their lifetime [2]–[4]. In Asia, a study in Japan indicated that one-month prevalence and lifetime prevalence of LBS are approximated to be 35.7% and 83.4%, respectively [5]. In Indonesia, the reported prevalence of LBS is more than one-third (38.4%) among the productive-age population in Jatinangor, West Java [6].

Various individual and physical factors increase the risk of LBS in workers [7]–[10]. Individual risk factors for workers such as age [3], [11], [12], gender [4], [11], [12], body mass index (BMI) [2], [10]–[15], marital status [16], [17], smoking [3], [18], regular exercise [3], [10], [19], years as an operator/worker [16], and education level [3], [20], [21] have been reported to have a significant association with a number of reported cases of LBS.

Meanwhile, several studies have reported that physical factors [15] include lifting [7], [22], [23] and frequency lifting [23], [24] increase the risk of LBS. Previous studies also investigated organisational risk factors such as employment status [21], night shift [21], daily working [16], and weekly working [3].

Workers involved in manufacturing often labour in physically harsh environments [22]. They are exposed not only to physical risk factors but also to some organisational factors, a condition that may influence their low back symptom [21]. This study aimed to identify the association between individual, organisational, and physical risk factors and the occurrence of subjective complaints in LBS.

II. Research Method

This preliminary study was cross-sectional. A self-administered questionnaire about physical and organisational was provided to the participants through a web survey based on location (i.e., Karawang) in October 2018.

A total of 212 workers participated in this study. However, eight respondents were excluded, namely those not working in Karawang (3 participants) and not working in the manufacturing industry (5 participants). Hence, 204 data were included in the analysis. Chi-Square test models used for testing relationships between categorical variable. Differences were considered significant for $P<0.05$.

III. Results and Discussion

Karawang Regency, West Java, is a region that has experienced rapid industry growth. In 2018, six industrial estates were located in Karawang, namely Industrial Estate Indotaisei, KIIC Industrial Area, Karawang Mitra Industrial Estate, PT. Timor Putra Nasional, Pupuk Kujang Industrial Area, and Surya Cipta Industrial Estate**.**

3.1 Description of the Sample

Of the total sample (n = 204), 81.86% were by males. Most participants were single (72%), and their age range from 25 to 30 was 67.64%. The distribution for education was 91.67% (basic) and 8.33% (high). BMI respondents were underweight (17.7%), normal (53.9%), and overweight (28.4%).

Thirty-six per cent of the respondents reported that they never smoked, and 64% were current smokers with an average of 7 cigarettes a day during the last 30 days. The majority of the respondents were regular exercise (51.4%) during the last 30 days with an average of approximately 2.2 h per week. The majority of the respondents were non-permanent employees or did not have a contract (88.72%). The distribution of respondents working as operators according to length of work was 27% (<2 years), 41% (2–4 years), 12% (4–6 years), and 20% (>6 years).

Table 1. Individual Risk Factors for Low Back Symptoms

Variable	LBS		Total	OR (95% CI)	p-value
	No n (%)	Yes n (%)			
Age					
<25 years old	6 (40.0%)	9 (60.0%)	15	1.00 (Reference)	
25-30 years old	29 (21.0%)	109 (79.0%)	138	2.50 (0.82-7.51)	0,111
>30 years old	14 (27.5%)	37 (72.5%)	51	1.76 (0.53-5.86)	0,358
Gender					
Females	19 (51.4%)	18 (48.6%)	37	1.00 (Reference)	**0,000***
Males	30 (18.0%)	137 (82.0%)	167	4.82 (2.26-10.26)	
Education Level					

Variable	LBS		Total	OR (95% CI)	p-value
	No n (%)	Yes n (%)			
Basic	46 (24.6%)	141 (75.4%)	187	1.00 (Reference)	0,767
High	3 (17.6%)	14 (82.4%)	17	1.52 (0.41-5.53)	
Marital Status					
Single	35 (24.3%)	109 (75.7%)	144	1.00 (Reference)	1,000
Married	14 (23.3%)	46 (76.7%)	60	1.05 (0.51-2.14)	
BMI					
Underweight (<18.5)	6 (16.7%)	30 (83.3%)	36	2.43 (0.92-6.37)	0,089
Normal (18.5-25)	36 (32.7%)	74 (67.3%)	110	1.00 (Reference)	
Overweigh (>25)	7 (12.1%)	51 (87.9%)	58	3.54 (1.46-8.58)	**0,005***
Smoking					
No	24 (32.9%)	49 (67.1%)	73	1.00 (Reference)	**0,039***
Yes	25 (19.1%)	106 (80.9%)	131	2.07 (1.07-3.99)	
Cigarette per Day					
≤ 5 a day	13 (25.5%)	38 (74.5%)	51	1.00 (Reference)	
5-10 a day	9 (13.8%)	56 (86.2%)	65	2.12 (0.82-5.47)	0,152
> 10 a day	3 (20.0%)	12 (80.0%)	15	1.36 (0.33-5.62)	1,000
Regular Exercise					
No	10 (10.1%)	89 (89.1%)	99	1.00 (Reference)	**0,000***
Yes	39 (37.1%)	66 (62.9%)	105	0.19 (0.08-0.40)	
Regular Exercise Weekly (hour)					
< 2	15 (38.5%)	24 (61.5%)	39	1.16 (0.50-2.67)	0,833
2-4	24 (42.1%)	33 (57.9%)	57	1.00 (Reference)	
>4	0 (0.00%)	9 (100%)	9	0.57 (0.46-0.72)	**0,021***
Years as Operator					
≤ 2 years	14 (25.0%)	42 (75.0%)	56	1.00 (Reference)	
2-4 years	14 (16.9%)	69 (83.1%)	83	1.64 (0.71-3.78)	0,284
4-6 years	4 (16.7%)	20 (83.3%)	24	1.66 (0.48-5.71)	0,562
> 6 years	17 (41.5%)	24 (58.5%)	41	0.47 (0.19-1.12)	0,122

P value < 0.05 (Chi-Square Test)
*Significant

3.2 Individual, Organisational, and Physical Factors

Table 1 shows the association between individual factors (i.e., gender, BMI, smoking, and regular exercise) and LBS. Male workers had more than 4.8 times the odds than females. From BMI data, workers with abnormal conditions (i.e., underweight [BMI <18.5] and overweight [BMI> 25]) tend to be more at risk than workers with a normal BMI (18.5–25). BMI was calculated from the height and weight measurements obtained using the equation BMI = weight (kg) × height $(m)^2$ and was converted into generally accepted categories: ideal, overweight, and underweight. In those who smoke, increasing the number of cigarettes tends to increase the risk of LBS.

Table 2. Organisational and Physical Risk Factors for Low Back symptoms

Variable	LBS		Total	OR (95% CI)	p-value
	No n (%)	Yes n (%)			
ORGANISATIONAL RISK FACTORS					
Employment Status					
Permanent	7 (30.4%)	16 (69.6%)	23	1.00 (Reference)	0.444
Contract	42 (23.2%)	139 (76.8%)	181	1.44 (0.558-3.755)	

Nigh Shift					
No	12 (25.5%)	35 (74.5%)	47	1.00 (Reference)	0.846
Yes	37 (23.6%)	120 (76.4%)	157	1.11 (0.52-2.35)	
Daily Working					
≤ 8 hours	40 (26.7%)	110 (73.3%)	150	1.00 (Reference)	0.193
> 8 hours	9 (16.7%)	45 (83.3%)	54	1.818 (0.81-4.05)	
Weekly Working					
≤ 40 hours	23 (23.5%)	75 (76.5%)	98	1.00 (Reference)	0.871
> 40 hours	26 (24.5%)	80 (75.5%)	106	0.94 (0.49-1.79)	
PHYSICAL RISK FACTORS					
Lift Load					
<7 kg	25 (32.1%)	53 (67.9%)	78	1.00 (Reference)	
8-20 kg	17 (28.3%)	45 (71.7%)	60	1.19 (0.57-2.49)	0.711
>20 kg	7 (10.6%)	59 (89.4%)	66	3.97 (1.59-9.94)	**0.002***
Lift Frequency/ hour					
< 12	28 (30.4%)	64 (69.6%)	92	1.00 (Reference)	
12-60	10 (16.1%)	52 (83.9%)	62	2.27 (1.01-5.11)	0.056
> 60	11 (22.0%)	39 (78.0%)	50	1.55 (0.69-3.46)	0.329

P value < 0.05 (Chi-Square Test)
*Significant

Table 2 shows the association between organisational and physical risk factors. Only one variable (i.e., lifting heavy load [>20 kg]) showed a significant association with LBS (OR 3.97, 95% CI 1.59–9.94).

Many of the studies found a significant relationship among individual and physical risk factors with LBS. This result is consistent with the findings of most previous studies [12], [25]. Male tended to be more at risk than females [26]. This result is different from some studies which state otherwise [27], [28]. This condition can occur because other factors accepted by male tend to cause complaints of LBS. All female workers in this study did not receive heavy burdens such as male workers. So that the muscles do not contract optimally.

Education level does not have a significant relationship with LBS, which is consistent with other studies [21]. Although in the analysis education level is not related to LBS, the risk of those who have higher education is 1.5 times greater than those who have only basic education. This condition can be biased because there is a possibility of more influential risk factors such as ergonomic knowledge. It is possible for those with lower levels of education to have better knowledge related to prevention of LBS. This knowledge is generally obtained from the training provided. Thus, future research related to the relationship between LBS knowledge and LBS incidence in workers should be conducted.

Workers who were overweight (BMI> 25 kg/m^2) had a significant relationship with LBS and tended to have a greater risk than workers who had a normal BMI [2]. This is thought to occur because people with a BMI higher than 25 will try to support their weight by contracting their lower back muscles. If this condition continues, it will cause sensitivity to the spinal cord [12], [26]. When the weight increases, the spine will be pressured to accept the burdens that cause it to cause damage and danger to the spinal structure. One of the areas of the spine that are most at risk due to the effects of obesity is dolphins [29].

Workers who smoke also have a greater risk of LBS [18], [21], and those who smoke fewer cigarettes tend to have less risk than those who smoke more cigarettes (>5 cigarettes a day). Nicotine in cigarettes causes reduced blood flow to the tissues. In addition, smoking can also cause a decrease in the mineral content of the bones, causing

symptoms due to cracks or damage to the bones [29]. LBS also tends to occur more for workers who in the last 30 days did not exercise. This could mean the workplace should hold a number of regular exercises programs for their employees. Lack of physical activity can reduce oxygen supply to the muscles so that it can cause muscle complaints. In general, muscle complaints are less in someone who in his daily activities has enough time to rest and do enough physical activity. Other study found that lower levels of regular exercise were associated with higher levels of symptoms and disability [19].

All variable of organisational risk factors do not have a significant relationship with LBS. This result is different from some studies which state that permanent employment and night shift work can be increase the OR of LBS and its consequences [21]. Night shift workers tend to have less sleep time and poor quality of rest. Hence, this condition affected the neuroimmunology system, slow down the process of restoring damaged tissues and increase symptoms sensitivity [30]. The limitation in this study is not assessing the sleep quality of the respondents.

Workers lifting heavy load >20 kg need more attention. They are 3.97 times more at risk of experiencing LBS. Work or movement that uses large force will provide a large mechanical load on muscles, tendons, ligaments and joints. However, further research needs to consider the duration and repetitive work. During contraction, the muscles need oxygen, if repetitive movements of the muscle become too fast so that oxygen has not reached the tissue muscle fatigue will occur. We suspect that this also happens to workers who have substantial lift frequency [29]. Future studies should deeply analyse the combination of lift load and lift frequency to determine the causes of LBS [23]. In some conditions, those who receive heavier burdens tend to get fewer elevator frequencies than those who receive lighter loads. Thus, it is important to analyse further the combination of these two physical factors against LBS complaints.

Several other factors should also be analysed, namely the length of travel from the place of residence to the workplace and the type of transportation used to work. The longer the worker travels, the longer the worker will be seated. This condition could cause LBS subjective complaints from workers. This sitting condition was also observed by a number of researchers [1], [21], [22] to determine the relationship of sitting with LBS or identify how serious the risk of sitting is in experiencing LBS.

IV. Conclusion

We conclude that interventions aimed at reducing LBS should address some risk factors with a focus on smokers, and workers with an abnormal BMI also never engaged in any regular exercise. Organisations should also concern themselves with workers who lift heavy load. The limitation of this study is on sample size. The results may not have the accuracy needed to generalise the results because of the limited sample size. However, information obtained from this study will be useful for future studies.

References

[1] Lis AM, Black KM, Korn H, Nordin M. Association between sitting and occupational LBS. Eur Spine J. 2007;16(2):283–98.

[2] Chou L, Brady SRE, Urquhart DM, Teichtahl AJ, Cicuttini FM, Pasco JA, et al. The Association between Obesity and Low Back symptoms and Disability Is Affected by Mood Disorders. Med (United States). 2016;95(15):1–7.

[3] Jia N, Li T, Hu S, Zhu X, Sun K, Yi L, et al. Prevalence and its risk factors for low back symptoms among operation and maintenance personnel in wind farms. BMC Musculoskelet Disord. 2016;17(1):1–11.
[4] Wáng YXJ, Wáng J-Q, Káplár Z. Increased low back symptoms prevalence in females than in males after menopause age: evidences based on synthetic literature review. Quant Imaging Med Surg [Internet]. 2016;6(2):199–206. Available from: http://qims.amegroups.com/article/view/10221/10921
[5] Fujii T, Matsudaira K. Prevalence of low back symptoms and factors associated with chronic disabling back symptoms in Japan. Eur Spine J. 2013;22(2):432–8.
[6] Novitasari DD, Sadeli HA, Sofiatin Y, Roesli RMA, Sukandar H, Soenggono A. Prevalence and Characteristics of Low Back Symptoms among Productive Age Population in Jatinangor. Althea Med J. 2017;3(3):469–76.
[7] Parreira P, Maher CG, Steffens D, Hancock MJ, Ferreira ML. Risk factors for low back symptoms and sciatica: an umbrella review. Spine J [Internet]. 2018;18(9):1715–21. Available from: https://doi.org/10.1016/j.spinee.2018.05.018
[8] Buchbinder R, Underwood M. Prognosis in people with back symptoms. Cmaj. 2012;184(11):1229–30.
[9] Hancock MJ, Maher CM, Petocz P, Lin CWC, Steffens D, Luque-Suarez A, et al. Risk factors for a recurrence of low back symptoms. Spine J [Internet]. 2015;15(11):2360–8. Available from: http://dx.doi.org/10.1016/j.spinee.2015.07.007
[10] Govindu NK, Babski-Reeves K. Effects of personal, psychosocial and occupational factors on low back symptoms severity in workers. Int J Ind Ergon [Internet]. 2014;44(2):335–41. Available from: http://dx.doi.org/10.1016/j.ergon.2012.11.007
[11] Depalma MJ, Ketchum JM, Saullo TR. Multivariable Analyses of the Relationships Between Age, Gender, and Body Mass Index and the Source of Chronic Low Back symptoms. 2012;498–506.
[12] Dianat I, Bazazan A, Souraki Azad MA, Salimi SS. Work-related physical, psychosocial and individual factors associated with musculoskeletal symptoms among surgeons: Implications for ergonomic interventions. Appl Ergon [Internet]. 2018;67:115–24. Available from: https://doi.org/10.1016/j.apergo.2017.09.011
[13] Ezemagu UK, Anibeze CIP, Ani CO, Ossi GC. Correlation of Body Mass Index with Low Back symptoms amongst Patients without Injury in a Nigeria Population. IntJCurrMicrobiolAppSci [Internet]. 2016;5(11):371–8. Available from: http://dx.doi.org/10.20546/ijcmas.2016.511.042
[14] Hershkovich O, Friedlander A, Gordon B, Arzi H, Derazne E, Tzur D, et al. Associations of body mass index and body height with low back symptoms in 829,791 adolescents. Am J Epidemiol. 2013;178(4):603–9.
[15] Heuch I, Heuch I, Hagen K, Zwart JA. Physical activity level at work and risk of chronic low back symptoms: A follow-up in the Nord-Trøndelag Health Study. PLoS One [Internet]. 2017;12(4):1–14. Available from: http://dx.doi.org/10.1371/journal.pone.0175086
[16] Dianat I, Kord M, Yahyazade P, Karimi MA, Stedmon AW. Association of individual and work-related risk factors with musculoskeletal symptoms among

Iranian sewing machine operators. Appl Ergon [Internet]. 2015;51:180–8. Available from: http://dx.doi.org/10.1016/j.apergo.2015.04.017

[17] Sanjoy SS, Ahsan GU, Nabi H, Joy ZF, Hossain A. Occupational factors and low back symptoms: a cross-sectional study of Bangladeshi female nurses. BMC Res Notes. 2017;10(1):1–6.

[18] Green BN, Johnson CD, Snodgrass J, Smith M, Dunn AS. Association Between Smoking and Back symptoms in a Cross-Section of Adult Americans. Cureus [Internet]. 2016;8(9):13–4. Available from: http://www.cureus.com/articles/5220-association-between-smoking-and-back-symptoms-in-a-cross-section-of-adult-americans

[19] Hendrick P, Milosavljevic S, Hale L, Hurley DA, McDonough S, Ryan B, et al. The relationship between physical activity and low back symptoms outcomes: A systematic review of observational studies. Eur Spine J. 2011;20(3):464–74.

[20] Leclerc A, Gourmelen J, Chastang JF, Plouvier S, Niedhammer I, Lanoë JL. Level of education and back symptoms in France: The role of demographic, lifestyle and physical work factors. Int Arch Occup Environ Health. 2009;82(5):643–52.

[21] Widanarko B, Legg S, Devereux J, Stevenson M. Interaction between physical and psychosocial work risk factors for low back symptoms and its consequences amongst Indonesian coal mining workers. Appl Ergon. 2015;46(Part A).

[22] Watanabe S, Takahashi T, Takeba J, Miura H. Factors associated with the prevalence of back symptoms and work absence in shipyard workers. BMC Musculoskelet Disord. 2018;19(1):1–9.

[23] Holtermann A, Clausen T, Aust B, Mortensen OS, Andersen LL. Risk for low back symptoms from different frequencies, load mass and trunk postures of lifting and carrying among female healthcare workers. Int Arch Occup Environ Health. 2013;86(4):463–70.

[24] Yang G, Chany AM, Parakkat J, Burr D, Marras WS. The effects of work experience, lift frequency and exposure duration on low back muscle oxygenation. Clin Biomech. 2007;22(1):21–7.

[25] Shah ZA, Darain H. Association of age , weight and gender with work related low back symptoms among clinical physical therapists in Pakistan. 2015;(September).

[26] Hossain MD, Aftab A, Al Imam MH, Mahmud I, Chowdhury IA, Kabir RI, et al. Prevalence of work related musculoskeletal disorders (WMSDs) and ergonomic risk assessment among readymade garment workers of Bangladesh: A cross sectional study. PLoS One [Internet]. 2018;13(7):1–19. Available from: http://dx.doi.org/10.1371/journal.pone.0200122

[27] Vandergrift JL, Gold JE, Hanlon A, Punnett L. Physical and psychosocial ergonomic risk factors for low back symptoms in automobile manufacturing workers. Occup Environ Med. 2012;69(1):29–34.

[28] Barbe MF, Gallagher S, Massicotte VS, Tytell M, Popoff SN, Barr-Gillespie AE. The interaction of force and repetition on musculoskeletal and neural tissue responses and sensorimotor behavior in a rat model of work-related musculoskeletal disorders. BMC Musculoskelet Disord [Internet]. 2013;14(1):1. Available from:

BMC Musculoskeletal Disorders
[29] Andini F. Risk Factors of Low Back symptoms in Workers. J Funct Foods [Internet]. 2015;5(4):1582–90. Available from: http://juke.kedokteran.unila.ac.id/index.php/majority/article/viewFile/495/496
[30] Rochman D, Mediani HS, Nur A. Factors Affecting Low Back symptoms among ICU Nurses. 2019;6(3):271–80.