

Risk Factors for Low Back Pain Among Rubber Factory Workers

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ABSTRACT

Low back pain (LBP) significantly impacts Indonesian workers, including those in Jambi's rubber processing factories. This study, involving 102 respondents, used a cross-sectional design to identify LBP-associated factors. Statistical analysis found significant correlations: age (p-value 0.000, PR 1.83), years of service (p-value 0.000, PR 3.50), workload (p-value 0.000, PR 6.00), work attitude (p-value 0.000, PR 0.06), BMI (p-value 0.005, PR 1.20), and smoking (p-value 0.000, PR 2.42) with LBP complaints. Medical history had no significant association (p-value 0.351, PR 1.13). LBP complaints in rubber factory workers may be triggered by factors such as advancing age, length of service, heavy workloads, suboptimal work attitudes, abnormal BMI, and smoking habits.

INTRODUCTION

Presidential Regulation (Perpres) Number 7 of 2019 defines Occupational Diseases (OD) as illnesses that arise due to factors related to one's occupation or work environment (Perpres RI No 7, 2019). Inappropriate work equipment and environments, not in line with human skills, can lead to imperfect work outcomes and potentially give rise to complaints (Sujono et al., 2018). The International Labour Organization (ILO) records approximately 2 million cases of deaths and work-related diseases each year resulting from accidents and job-related conditions (Kemenkes RI, 2019). One of the diseases attributed to work is Low Back Pain (LBP), a major cause of work-related disabilities stemming from poor ergonomics. LBP represents a musculoskeletal disorder resulting from improper ergonomics (Group, 2003). The essence of this pain can be described as discomfort distributed between the costal margin and the inferior gluteal fold, lasting for more than one day and accompanied by leg pain, excluding pain due to menstruation and pregnancy (Wu et al., 2020).

According to the World Health Organization (WHO), it has been reported that one of the risk factors for work-related illnesses and mortality is as high as 37%. This includes musculoskeletal disorders, which tend to be quite prevalent in Indonesia. Every year, between 15% to 45% of adults experience Low Back Pain (LBP), primarily in the age range of 35 to 55. Shockingly, one out of every 20 individuals suffering from Low Back Pain requires hospital treatment (Tito Nurfajri, Subakir, 2022). Interestingly, in just 2 weeks, chronic LBP often heals spontaneously, and only about 1-2% of cases necessitate surgical intervention (Tito Nurfajri, Subakir, 2022).

Prevalence rates for Low Back Pain (LBP) diagnoses by healthcare professionals in Indonesia range from 11.9% to 24.7%. Additionally, data specific to LBP cases in the province of Jambi reveals 85 patients complaining of lower back pain and an additional 18 cases of LBP (Yanra, 2013). The city of Jambi, known for its crumb rubber factories, including those from state-owned and privately-owned plantations, has seen the establishment of 10 crumb rubber companies between 2011 and 2019. For instance, PT. Remco Rubber Indonesia employs 144 workers in its production department and specializes in rubber processing. During the production process, they utilize equipment and machines in a zinc-roofed environment, which can be physically demanding.

After conducting initial observations on 10 workers, we found that 7 of them reported experiencing Low Back Pain. This is primarily attributed to the manual nature of many tasks in this section, which can be a contributing factor to LBP complaints. The objective of this study is to identify the risk factors associated with the occurrence of Low Back Pain among workers in the production department of rubber processing factories.

THEORETICAL REVIEW

The theory name here

Explanation of theory here If your work is quantitative, please provide previous research that agrees or rejects your proposed hypothesis.

H1: Hypothesis one and so on here

The theory name here

Explanation of theory here

H2: Hypothesis two and so on here After the hypothesis section, if your study is quantitative, please provide a contextual framework here, or your mind map, if qualitative.

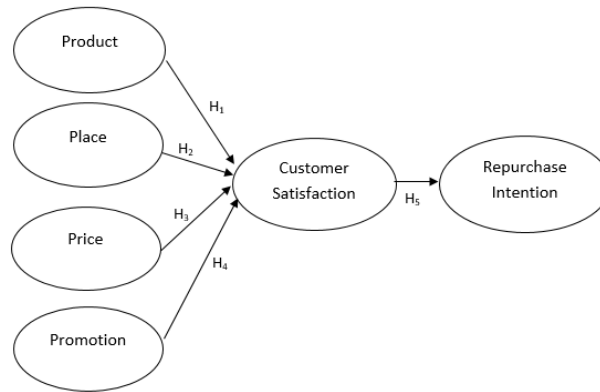


Figure 1. Conceptual Framework (Images Must Be In Good Quality)

METHODOLOGY

This research employs a quantitative research design with an analytical observational approach utilizing a cross-sectional study. The population for this study comprises 144 workers in the production department of a rubber processing factory. Based on sample calculations, a sample of 102 individuals was selected. The research was conducted at a rubber processing factory in the province of Jambi, during the period from April to November 2023.

Data collection was carried out through observation, interviews, measurements, and the completion of REBA worksheets by workers in the production department of the rubber processing factory. Data analysis to determine the relationship between independent and dependent variables was performed using the chi-square statistical test.

RESEARCH RESULT

Univariate Analysis

Below is a table showing the univariate frequency distribution of the variables: Low Back Pain (LBP) status, age, years of service, workload, work attitude, Body Mass Index (BMI), medical history, and smoking habits.

Table 1. Univariate Analysis

	Variable	N	%
LBP Status	Yes	92	90,2
	No	10	9,8
Age	At risk (\geq 35 years old)	80	78,4
	Not at risk ($<$ 35 years old)	22	21,6

Years of Service	Long-term (≥ 5 years)	88	86,3
	Short-term (< 5 years)	14	13,7
Workload	At Risk	90	88,2
	Not at risk	12	11,8
Work Attitude	Non-Ergonomic	98	96,1
	Ergonomic	4	3,9
BMI	Abnormal	42	41,2
	Normal	60	58,8
Medical History	Present	15	14,7
	Absent	87	85,3
Smoking Habits	Smoker	85	83,3
	Non-smoker	17	16,7
Total		102	100,0

Based on Table 1, it can be observed that the highest proportion of LBP status is in the 'yes' category, which is 90.2%. The highest proportion of individuals at risk, defined as aged ≥ 35 years, is 78.4%. Those with a years of service more than five years have the highest proportion at 86.3%. Respondents with a higher risk workload compared to those at lower risk represent 88.2% of the sample. Regarding work attitude, the highest proportion falls into the 'non-ergonomic' category at 96.1%, while the highest proportion for Body Mass Index (BMI) is in the 'normal' category at 58.8%. A total of 85.3% of respondents do not have a medical history, and 83.3% have a smoking habit.

Bivariate Analysis

Table 2. Bivariate Analysis

Variable	LBP				Total	PR	(95% CI)	P-Value
	Yes		No					
	n	%	n	%				
Age								
At Risk	80	100,0	0	0,0	80	1,83	1,25-2,68	0,000
Not At Risk	12	54,5	10	45,5	22			
Years of Service								
Long-term	88	100,0	0	0,0	88	3,50	1,52-8,01	0,000
Short-term	4	28,6	10	71,4	14			
Workload								
At Risk	90	100,0	0	0,0	90	6,00	1,69-21,26	0,000
Not At Risk	2	16,7	10	83,3	12			

Work Attitude									
Non-ergonomic	92	93,9	6	6,1	98	0,06	0,02-0,13	0,000	
Ergonomic	0	0,0	4	100,0	4				
BMI									
Abnormal	42	100,0	0	0,0	42	1,20	1,07-1,34	0,005	
Normal	50	83,3	10	16,7	60				
Medical History									
Present	15	100,0	0	0,0	15	1,13	1,04-1,21	0,351	
Absent	77	88,5	10	11,5	87				
Smoking Habits									
Smoker	85	100,0	0	0,0	85	2,42	1,37-4,28	0,000	
Non-smoker	7	41,2	10	58,8	17				
Total	92		10		102				

Based on Table 2, it can be observed that the proportion of high LBP status is significantly greater in the at-risk age category (≥ 35 years) at 100.0%, compared to the not-at-risk age category (< 35 years). Bivariate analysis results show a significant relationship between age and LBP status with a p-value of 0.000. Individuals aged ≥ 35 years are 1.83 times more likely to experience high work fatigue compared to those aged < 35 years (PR 1.83, 95% CI 1.25-2.68).

Regarding the years of service variable, respondents with LBP have the highest proportion in the "long-term" category (≥ 5 years) at 100.0%, compared to the "new" category (< 5 years). Based on bivariate analysis, there is a relationship between years of service and LBP status (p-value 0.000). Respondents with more than 5 years of service are 3.50 times more likely to experience LBP compared to those with less than 5 years of service (PR 3.50, 95% CI 1.52-8.01).

For the workload variable, respondents who experience LBP have the highest proportion in the high-risk workload category (100.0%) compared to the low-risk workload category. The p-value is 0.000, indicating a significant relationship between workload and the occurrence of LBP. Based on the association value, high-risk workload carries a 6.00 times higher risk of LBP (PR 6.00, 95% CI 1.69-21.26).

In terms of work attitude, the occurrence of LBP has the highest proportion in the "non-ergonomic" work attitude category (93.9%) compared to the "ergonomic" category. The analysis shows a significant relationship between work attitude and LBP (p-value 0.000), where a non-ergonomic work attitude is protective against LBP (PR 0.06, 95% CI 0.02-0.13).

Regarding Body Mass Index (BMI), the occurrence of LBP has a higher proportion in the "abnormal" BMI category (100.0%) compared to the "normal" BMI category. Statistical tests show a p-value of 0.005, indicating a significant relationship between BMI and the occurrence of LBP (p-value<0.05). Abnormal BMI carries a 1.20 times higher risk of LBP compared to normal BMI (PR 1.20, 95% CI 1.07-1.34).

In the medical history variable, respondents with LBP have the highest proportion among those with a medical history (100.0%) compared to those without a medical history. Statistical tests show no significant relationship between medical history and the occurrence of LBP (p-value 0.351, PR 1.13, 95% CI 1.04-1.21).

Regarding the smoking habit variable, respondents with LBP have the highest proportion among those with a smoking habit (100.0%) compared to those without a smoking habit. Based on the p-value, there is a significant relationship between smoking habits and the occurrence of LBP (p-value 0.000<0.05). Respondents with a smoking habit are 2.42 times more likely to experience LBP (PR 2.42, 95% CI 1.37-4.28).

Multivariate Analysis

Multivariate analysis was conducted to determine the variables that have the most significant impact on the level of work fatigue by simultaneously associating more than one independent variable with the dependent variable. The following table presents the multivariate candidate variables with p-values < 0.25 based on the results of bivariate analysis.

Table 3. Multivariate Candidates

Variabel	p-value	Keterangan
Age	0,000	Multivariates Candidate
Years of Service	0,000	Multivariates Candidate
Workload	0,000	Multivariates Candidate
Work Attitude	0,000	Multivariates Candidate
BMI	0,005	Multivariates Candidate
Medical History	0,351	Not a Multivariates Candidate
Smoking Habits	0,000	Multivariates Candidate

Based on the table above, it is known that the multivariate candidates are the variables: age, years of service, workload, work attitude, BMI, and smoking habits. These variables are included in the initial multivariate model. For subsequent models, variables with p-values > 0.05 will be gradually removed until there are no more variables with p-values > 0.05. The following table presents the initial multivariate model and the final multivariate model.

Table 4. First Multivariate Model

Variabel	B	PR (95%CI)	p-value
Age	0,000	1,00 (0,39-2,54)	1,000
Years of Service	0,000	1,00 (0,16-5,99)	1,000
Workload	1,381	3,97 (0,56-28,21)	0,167
Work Attitude	1,766	5,84 (0,04-809,09)	0,483

BMI	0,000	1,00 (0,64-1,55)	1,000
Smoking Habits	0,000	1,00 (0,23- 4,19)	1,000

Table 5. Final Multivariate Model

Variabel	B	PR (95%CI)	p-value
Berat Beban	1,760	5,81 (1,46-23,10)	0,012

Based on Table 5, the results of the final model indicate that workload is the variable that has the most significant influence on the occurrence of LBP. Respondents with a high-risk workload are 5.81 times more likely to experience LBP after controlling for age, years of service, work attitude, BMI, and smoking habits.

DISCUSSION

The Relationship Between Age and the Occurrence of Low Back Pain

The results of this study indicate a significant relationship between the age of workers and the occurrence of Low Back Pain (LBP). Based on the association value, it can be determined that individuals aged ≥ 35 years are 1.83 times more likely to experience LBP. This finding aligns with the research conducted by Simangunsong and Christman among female transport workers in Pematangsiantar. According to their study, a relationship was found between age and lower back pain complaints with a p-value of 0.038 (Simangunsong, 2019).

The results of this study also align with the research conducted by Vernando et al., titled "Factors Related to Low Back Pain in the Working Area of Wamlana Health Center, Buru Regency." Their research involved respondents aged between 26 years and over 65 years. The findings showed that age has a significant association with the occurrence of low back pain based on a p-value of 0.0489 (Lameky et al., 2023). As a person's age increases, the elasticity of their bones decreases. Bones undergo degeneration, characterized by scar tissue formation and a decrease in fluid. This is a common occurrence after the age of 30. Consequently, there is a decrease in the stability of bones and muscles, leading to the development of low back pain complaints (Sahara & Pristya, 2020).

The Relationship Between Years of Service and the Occurrence of Low Back Pain.

The research conducted has yielded results indicating a relationship between years of service and the occurrence of low back pain (LBP). Based on the findings of this study, workers classified as long-term employees with a service duration of ≥ 5 years face a 3.50 times higher risk of experiencing LBP. This finding aligns with the research conducted by Deli et al. among citrus farmers in Dokan Village, Karo Regency. According to their study, a significant relationship was found between years of service and the occurrence of LBP with a p-value of 0.016 (Sitepu, D.S., Sinaga M.M., 2015).

This research also aligns with the study conducted by Simangunsong and Christman among female transport workers in Pematangsiantar. Their research revealed a relationship between years of service and lower back pain complaints with a p-value of 0.026 (Simangunsong, 2019).

The results of this study are also consistent with the research conducted by Vernando et al. in Buru Regency. Their findings showed a relationship between years of service and the occurrence of low back pain with a p-value of 0.029 (Lameky et al., 2023). Low back pain can be attributed to a decrease in muscle endurance to support the body's weight due to fatigue resulting from accumulated work activities over several years (Wati et al., 2021).

The Relationship Between Workload and the Occurrence of Low Back Pain

In the variable of workload, this research has shown significant findings regarding its relationship with the occurrence of low back pain (LBP). Workers who bear a high-risk workload are at a 6.00 times higher risk of experiencing LBP. Based on the multivariate analysis conducted in this study, workload is the most influential variable on the occurrence of low back pain among rubber factory workers, with an association value of 5.81 times (p-value 0.012, PR 5.81, 95% CI 1.46-23.10).

These results align with research conducted by Awaluddin et al. among sewing house workers in Makassar. According to their study, a relationship was found between workload and complaints of low back pain with a p-value of 0.005. Similarly, research conducted by Syarifullah is in line with the findings of this study. Based on their research, it was found that workload has a significant association with complaints of low back pain with a p-value of 0.003 (Syarifullah, 2020).

Workload refers to activities that workers must complete within a specified time frame. Tasks that require significant physical effort impose a substantial mechanical load on muscles, tendons, ligaments, and joints. This can lead to muscle fatigue, irritation, inflammation, and even damage to tendons and other tissues (Sahara & Pristya, 2020).

In rubber factories, many activities involve heavy workloads, such as the process of transferring bales from raw materials to a bucket conveyor and the drying process of heavy blankets weighing between 150 kg and 280 kg. These processes are often carried out manually, relying on human strength.

The Relationship Between Work Attitude and the Occurrence of Low Back Pain

The results of this study indicate a significant relationship between work attitude and the occurrence of low back pain (LBP). The association value suggests that work attitude is protective against LBP. Workers with non-ergonomic work attitudes have a 0.06 times lower risk of experiencing LBP (p-value 0.000, PR 0.06, 95% CI 0.02-0.13).

These findings align with the research conducted by Vernando et al. in Buru Regency. Their results showed a significant relationship between sitting posture and the occurrence of low back pain with a p-value of 0.015 (Lameky et al., 2023). Similarly, this study is in line with the research conducted by Aynil

among rubber tappers in Simbolon Village. This study examined the relationship between work posture and complaints of low back pain using the REBA (Rapid Entry Body Assessment) measurement tool. The results revealed a significant relationship between work posture and low back pain complaints with a p-value of 0.018. However, when considering the association value, the results of this study do not align with the findings of the present study. Their research showed an association value of 3.86, indicating that high-risk work postures were 3.86 times more likely to lead to complaints of low back pain (HArachap, 2021).

Initial data observation conducted on 10 workers in the blanket section (blending process) revealed that 7 of them complained of lower back pain. They began experiencing this pain after performing tasks that involved bending for approximately 8 hours a day. Repeatedly adopting a bent work posture requires considerable energy and leads to quicker fatigue, increasing the risk of low back pain.

Non-ergonomic positions like bending add additional strain. If such positions are sustained for extended periods without proper management, they can result in tissue damage, especially in the lumbar vertebral segments (Guesteva et al., 2021).

The Relationship Between BMI and the Occurrence of Low Back Pain

The results of this study demonstrate a significant relationship between respondents' BMI and the occurrence of low back pain (LBP). Workers with a non-normal BMI category have a 1.20 times higher risk of experiencing LBP (p-value 0.005, PR 1.20, 95% CI 1.07-1.34).

These findings are consistent with the research conducted by Ruli and Endang on LBP patients at the neurology clinic of RSUDZA Banda Aceh. Their results indicated a significant relationship between BMI and LBP patients with a p-value of 0.00 (Maulana et al., 2016).

The results of this study also align with the research conducted by Anisa among diving fishermen in Surabaya. Their research showed a significant relationship between BMI and complaints of low back pain with a p-value of 0.048 (Anisa, 2018). Similarly, this study is in line with the research conducted by Marpaung among employees at Sultan Thaha Airport in Jambi Province. Based on their research, they found a significant relationship between nutritional status and complaints of low back pain, with a p-value of 0.054 (Marpaung, 2023).

However, the results of this study do not align with the research conducted by Wibowo among cargo handling workers. Their research stated that there was no significant relationship between BMI and the occurrence of low back pain, with a p-value of 0.838 (Wibowo, 2017).

These results are consistent with the research conducted by Evan et al. among Ulos weavers in Medan. Their research showed a significant relationship between BMI and complaints of low back pain with a p-value of 0.044 (Filemon et al., 2021).

Non-normal BMI, such as obesity, has various impacts on body health, one of which is an increased risk of musculoskeletal disorders, especially lower back pain (LBP). In theory, obesity increases the load on the body's support joints. Obesity can cause chronic strain on vertebral bones, leading to complaints of back pain (Filemon et al., 2021).

The Relationship Between Medical History and the Occurrence of Low Back Pain

The research results indicate that there is no significant association between the workers' medical history and the occurrence of low back pain (LBP) (p-value 0.351, PR 1.13, 95% CI 1.04-1.21). These findings align with a study conducted by Anisa on deep-sea divers in Surabaya, which found no association between medical history and LBP occurrence (p-value 0.057) (Anisa, 2018).

However, these results do not align with a study by Arinta et al. on ride-hailing drivers, which showed a significant relationship between disability history and increased lower back pain (p-value 0.017) (Wati et al., 2021). Similarly, a study by Patience et al. on schoolteachers in Botswana, conducted over a year with 1747 respondents, found an association between medical history and LBP occurrence (OR: 3.01, 95% CI 0.43-0.93) (Erick & Smith, 2014).

Relationship between Smoking Habits and the Occurrence of Low Back Pain

The research results indicate a significant relationship between smoking habits among workers and the occurrence of low back pain. Workers who smoke are at a 2.42 times higher risk of experiencing low back pain (p-value 0.000, PR 2.42, 95% CI 1.37-4.28). These findings are consistent with a study conducted by Deli et al. among citrus farmers in Dokan Village, Karo Regency, which found a significant association between smoking habits and the occurrence of low back pain (p-value 0.032) (Sitepu, D.S., Sinaga M.M., 2015).

One of the constituents of cigarettes, nicotine, can lead to reduced blood flow to tissues. Additionally, smoking can result in a decrease in minerals in the bones, leading to bone damage or fractures. This can contribute to the development of low back pain (Sahara & Pristya, 2020).

CONCLUSIONS AND RECOMMENDATIONS

The factors associated with complaints of low back pain in the rubber processing factory are age (p-value 0.000, PR 1.83, 95% CI 1.25-2.68), years of service (p-value 0.000, PR 3.50, 95% CI 1.52-8.01), workload (p-value 0.000, PR 6.00, 95% CI 1.69-21.26), work attitude (p-value 0.000, PR 0.06, 95% CI 0.02-0.13), body mass index (BMI) (p-value 0.005, PR 1.20, 95% CI 1.07-1.34), and smoking habits (p-value 0.000, PR 2.42, 95% CI 1.37-4.28).

The researcher's recommendations for the company include creating a comfortable working environment for employees so that they can work with ergonomic postures. Additionally, to alleviate the workload of employees, the company can invest in equipment that facilitates tasks such as lifting and drying.

ADVANCED RESEARCH

Each study has limitations; thus, you can describe it here and briefly provide suggestions for further research.

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