



# Risk Factors for Low Back Pain (LBP) in Tofu Industry Workers in Palembang, Indonesia

Rahmi Garmini

IKesT Muhammadiyah Palembang, Sumatera Selatan. Indonesia

## ARTIKEL INFO

Received August 27, 2024

Accepted November 20, 2024

Available online December 31, 2024

### Keyword:

Work Posture; Low Back Pain; REBA; Tofu

### Kata kunci:

Postur Kerja; Low Back Pain; REBA; Tahu



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## ABSTRACT

Tofu industry workers are at risk of experiencing Low Back Pain (LBP) because they work with heavy loads and risky work postures for a continuous period of time. The study aims to analyze the relationship between work posture, work period, and knowledge with LBP.: Descriptive analytical research with a cross-sectional design, conducted in Palembang City from March to April 2024. The study involved 40 participants. Data collection was carried out by observation and interviews. Work posture was assessed using the Rapid Entire Body Assessment (REBA) method, while the variables of length of service, knowledge, and LBP were obtained from interviews. All data were analyzed using the Chi-Square test and Prevalence Odds Ratio (POR) at a 95% confidence level. The study found that 17 (42.5%) respondents experienced LBP, 13 (32.5%) had risky work postures, and 22 (55%) respondents had a work period of 6-10 years. The analysis results found that there was a significant relationship between work posture ( $P=0.007$ ) and work period ( $P=0.010$ ). At the same time, knowledge did not show a significant relationship with LBP ( $P=0.167$ ). Risk factors for LBP in tofu industry workers are work posture ( $POR=9.524$ ) and work period ( $POR=9.750$ ). The study results found that LBP is closely related to work posture and work period. Muscle stretching, getting enough rest, and using ergonomic work tools are research recommendations.

Pekerja industri tahu merupakan kelompok berisiko mengalami keluhan *Low Back Pain* (LBP) karena bekerja dengan beban berat dan postur kerja berisiko dalam waktu yang secara terus-menerus. Penelitian bertujuan menganalisis hubungan postur kerja, masa kerja dan tingkat pengetahuan terhadap keluhan LBP. Penelitian deskriptif analitis dengan desain *cross sectional*, dilaksanakan di Kota Palembang, pada bulan Maret hingga April 2024. Penelitian melibatkan 40 orang partisipan. Pengumpulan data dilakukan dengan observasi dan wawancara. Postur kerja dinilai dengan metode *Rapid Entire Body Assessment* (REBA), sedangkan variabel masa kerja, pengetahuan, dan keluhan LBP diperoleh dari wawancara. Keseluruhan data dianalisis dengan uji *Chi Square* dan *Prevalence Odds Ratio* (POR), pada tingkat kepercayaan 95%. Penelitian mendapatkan bahwa mendapatkan bahwa 17 (42,5%) responden mengalami keluhan LBP, 13 (32,5%) memiliki postur kerja berisiko, dan 22 (55%) responden memiliki masa kerja 6-10 tahun. Hasil analisis menunjukkan bahwa hubungan yang signifikan antara postur kerja ( $P=0,007$ ) dan masa kerja ( $P=0,010$ ). Sedangkan pengetahuan tidak menunjukkan hubungan signifikan dengan keluhan LBP ( $P=0,167$ ). Faktor risiko LBP pada pekerja industri tahu adalah postur kerja ( $POR=9,524$ ) dan masa kerja ( $POR=9,750$ ). Hasil penelitian mendapatkan bahwa LBP berkaitan erat dengan postur kerja dan masa kerja. Melakukan peregangan otot, istirahat yang cukup, penggunaan alat kerja yang ergonomis menjadi rekomendasi penelitian.

\* Corresponding author: Rahmi Garmini

IKesT Muhammadiyah Palembang, Sumatera Selatan, Indonesia.

Email: [rahmi.garmini@gmail.com](mailto:rahmi.garmini@gmail.com)

## 1. Introduction

Occupational health and safety are an important part of employment. However, various

health problems occur due to workers' or companies' lack of understanding of potential hazards in the work environment. Potential

occupational hazards can be biological, chemical, physical, and ergonomic hazards.

Ergonomics is the suitability of body posture to the workload received by workers, using a fitting the person to the job approach (Khattak, 2021; Purbasari, 2019; Setyawan, 2012). Mismatched ergonomic factors will result in errors in work posture, which are generally accompanied by symptoms of Musculoskeletal Disorders (MSDs) in the form of muscle pain (Alhamda & Sriani, 2015; Maulana et al., 2021; Sumardiyono et al., 2023).

One of the MSDs often experienced by workers is Low Back Pain (LBP), which is a common complaint globally (Murtezani et al., 2011; Pal et al., 2016; Sambrook et al., 2010; WHO, 2023; Wu et al., 2020). LBP is a pain in the waist area, from below the ribs to the buttocks, with or without pain spreading to the legs (Ilmidin et al., 2023; Sumardiyono et al., 2023; WHO, 2023; Wu et al., 2020). LBP is caused by excessive muscle stretching, static postures, repetitive activities, and unnatural work postures, such as working postures that always stand, squat, and bend over for a long time (Kurnianto, 2018; Purbasari, 2019). Other factors are individual characteristics, osteoporosis, lifestyle, and psychology (Sinaga & Makkiyah, 2021; WHO, 2023).

One way to analyze the posture of workers is the Rapid Entire Body Assessment (REBA) method. The REBA method was developed in the field of ergonomics and can be used quickly to assess work positions in the posture of the neck, back, arms, wrists, and feet (Hignett & McAtamney, 2000; Hita-Gutiérrez et al., 2020; Sulaiman & Sari, 2018).

The tofu industry is a small-scale industry that produces tofu from soybean processing. The production process includes washing, grinding, cooking (boiling and filtering), molding (coagulation and molding), and cutting. All work is done in a standing position, bending, repetitive movements, and lifting heavy loads. The study aims to analyze the relationship between LBP and work posture, work period, and knowledge.

## 2. Methods

This research is descriptive and analytical, using a cross-sectional design, and was conducted in Palembang City, South Sumatra, from March to April 2024. The study population was all Palembang tofu factory workers (N = 40 people);

all workers were included in the study. Three variables (work posture, work period, and knowledge) were assessed to determine their relationship with Low Back Pain (LBP).

Data collection was carried out by observation and interviews. Work posture was assessed using the Rapid Entire Body Assessment (REBA) method, with four procedures, namely 1) Activity observation, 2) Selection of work posture, 3) Evaluation of work posture, and 4) Determination of the final value of work posture. While the variables of work period, knowledge, and LBP were obtained from interviews.

The data collected were then analyzed using SPSS software. Univariate analysis was used to obtain an overview of each variable using frequency and proportion. Bivariate analysis with the Chi-Square test and Prevalence Odds Ratio (POR) was used to determine the relationship between independent variables (work posture, work period, and knowledge) and LBP. The overall analysis was performed at a 95% confidence level.

## 3. Results

The study's results (Table 1) found that 17 (42.5%) respondents experienced LBP. Based on work posture, 13 (32.5%) respondents had a risky work posture. The interview results also found that 25 (62.5%) respondents had a work period of 6-10 years, and 22 (55.0%) had a low level of knowledge.

**Table 1.** Distribution of variables (N=40).

Variable	n	%
LBP		
LBP	17	42.5
Normal	23	57.5
Work Posture		
Risk	13	32.5
No. risk	27	67.5
Work period		
6-10 years	25	62.5
1-5 years	15	37.5
Knowledge		
Low	22	55.0
Hight	18	45.0

Bivariate analysis was applied to determine the valid relationship between risk factors and LBP. The study results (Table 2) showed that 10 (76.9%)

respondents with risky work postures experienced LBP. While with non-risk body postures, only 7 (25.9%) respondents. The statistical analysis showed a significant relationship between body

posture and LBP ( $P = 0.007$ ). Respondents with risky work postures were 9.524 times more likely to experience LBP than those who were not at risk ( $OR = 9.524$ ; 95% CI 2.019-44.914;  $P = 0.007$ ).

**Table 2.** Distribution of variables based on LBP

Variabel	LBP n (%)	Normal n (%)	P	POR (CI 95%)
Work Posture				
Risk	10 (76.9%)	3 (23.1%)	0.007	9.524 (2.019-44.914)
No. risk	7 (25.9%)	20 (74.1%)		
Work period				
6-10 years	15 (60.0%)	10 (40.0%)	0.010	9.750 (1.799-52.846)
1-5 years	2 (13.3%)	13 (86.7%)		
Knowledge				
Low	12 (54.5%)	10 (45.5%)	0.167	3.120 (0.825-11.793)
Hight	5 (27.8%)	13 (72.2%)		

Table 2 also shows that 15 (60.0%) respondents with a work period of 6-10 years experienced LBP, while with a work period of 1-5 years, only 2 (13.3%) respondents. The statistical analysis results showed a significant relationship between work period and LBP ( $P = 0.010$ ). Respondents with a work period of 6-10 years were 9.750 times more likely to experience LBP than those with a work period of 1-5 years ( $OR = 9.750$ ; 95% 1.799-52.846;  $P = 0.010$ ).

Based on knowledge (Table 2), 12 (54.4%) respondents with poor knowledge experienced LBP, while only 5 (27.8%) people with good knowledge did. The statistical results did not show a significant relationship between the level of knowledge and LBP ( $P = 0.167$ ).

## 4. Discussion

### 4.1. Work posture and LBP

The study results found that LBP was related to the worker's body posture ( $P = 0.007$ ). Workers with risky body postures were 9.524 times more likely to experience LBP than those with non-risky work postures (95% CI 2.019-44.914).

The study results are in accordance with Sumardiyono et al. (2023), who found a significant relationship between work posture and LBP in tea pickers at PT Perkebunan Tambi Wonosobo. Agustin et al. (2023) reported a significant relationship between work posture and LBP in office workers in Jakarta. The same results were

also reported by Yacob et al. (2018) in health workers in Manado, Ningsih et al. (2016) in agricultural workers in Riau Province, and Fitriani et al. (2021) in Jakarta.

In the tofu industry, Cahyani et al. (2021) reported that the majority (72.7%) of tofu factory workers in Pasuruan had abnormal working postures and were statistically significantly related to LBP ( $P = 0.020$ ). Meanwhile, Azzahra and Manik (2025), who studied LBP in tofu factory workers in Depok, also reported a significant relationship between working posture and LBP ( $P = 0.012$ ). LBP is mainly due to repeated lifting of heavy loads with an unnatural posture, so that a person's posture becomes hunched (Arwinno, 2018; Muslim et al., 2021; Salsabila & Muslimah, 2022; Sumardiyono et al., 2023). According to Cahyani et al. (2021), lifting loads of more than five kilograms has a 2.3 times greater risk of experiencing LBP. Clearly, Murtezani et al. (2011) concluded that the main factor in LBP is lifting, pushing, or pulling heavy loads. Unnatural work posture is a work posture that always stands, squats, and bends for a long time (Kurnianto, 2018; Purbasari, 2019).

Non-ergonomic work posture for a long time is also a cause of LBP (Arwinno, 2018; Cahyani et al., 2021; Ningsih et al., 2016; Salsabila & Muslimah, 2022; Sumardiyono et al., 2023). Body posture that deviates from normal body posture can cause local mechanical stress on joints, muscles, and

ligaments, resulting in pain and injury (Icsal et al., 2016).

Ergonomics is the suitability of body posture to the workload received by workers (Khattak, 2021; Purbasari, 2019; Setyawan, 2012). Inappropriate body posture with the workload causes muscle contractions and obstructs blood flow for a long time, causing pain (Muslim et al., 2021).

Several efforts can be made to reduce the risk of LBP in workers. According to Muslim et al. (2021), doing muscle stretching or gymnastics that is done regularly can reduce muscle fatigue and block blood flow due to unergonomic work postures. The use of work tools that are appropriate for body posture and aids for lifting heavy loads is highly recommended to prevent LBP (Arwinno, 2018; Azzahra & Manik, 2025; Cahyani et al., 2021; Murtezani et al., 2011; Muslim et al., 2021; Ningsih et al., 2016; Salsabila & Muslimah, 2022).

#### 4.2. Length of Service and LBP

The study results (Table 2) found that LBP was related to length of service ( $P = 0.010$ ). Workers with a work period of 6-10 years are 9.750 times more likely to experience LBP than those with a work period of 1-5 years ( $OR = 9.750$ ; 95% 1.799-52.846).

The study results are in line with Herawati & Bratajaya (2022), who found a significant relationship between work period and LBP in rubber workers in South Sumatra. Meanwhile, Yacob et al. (2018) reported a significant relationship between work periods and LBP in nurses in Manado City. In the tofu industry, a significant relationship between a work period and LBP has been reported by Cahyani et al. (2021) in Pasuruan, Azzahra & Manik (2025) in Depok, and Noli et al. (2021) in Manado.

Work period is the length of time a person works for a company, so the work period is the accumulation of a person's work activities carried out over a long period (Noli et al., 2021). Thus, the longer the working period, the longer the exposure to risk factors received (Andriani et al., 2023; Azzahra & Manik, 2025; Cahyani et al., 2021; Icsal et al., 2016; Murtezani et al., 2011; Noli et al., 2021; Yacob et al., 2018).

The working period causes continuous static loads that cause pain (Noli et al., 2021) due to the disc cavity narrowing permanently (Andriani et al.,

2023). According to Pal et al. (2016), constant repetitive movements provide a cumulative workload, causing pain due to impaired muscle function and tissue damage. The level of tissue damage depends on the amount of force, repetition and duration of exposure.

#### 4.3. Knowledge and LBP

In this study (Table 2), there was no significant relationship between the level of knowledge and LBP ( $P = 0.167$ ). The study results are in line with those of Ningsih et al. (2016) in Riau Province, who also found no significant relationship between worker knowledge and LBP.

According to Notoatmodjo (2014), knowledge is the result of knowing after sensing a particular object, which is a very important domain in shaping behavior. In this study, 22 (55.0%) workers still had a low level of knowledge about LBP, so they did not take preventive measures against the risk of LBP.

Workers with low knowledge tend not to take preventive measures against work risks (Hidayah & Kawuryan, 2022; Ningsih et al., 2016; Salsabil et al., 2024). According to Murtezani et al. (2011), companies play an important role in increasing worker knowledge, in addition to providing work equipment and supervision to prevent the risk of LBP.

## 5. Conclusions

The study's results found that LBP was closely related to work posture ( $P = 0.007$ ) and work period ( $P = 0.010$ ), while knowledge did not show a significant relationship ( $P = 0.167$ ). Work posture is associated with heavy lifting work that is done repeatedly for a long time in an unnatural position. Muscle stretching, getting enough rest, and ergonomic work tools are study recommendations.

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