

## RESEARCH ARTICLE

## Ergonomic Risk Level of Work Posture in Leather Shoes Industry

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### Abstract

Posture while working will influence work results and have a health impact on workers. Rapid upper limb assessment (RULA) is a method for analyzing work posture on the job using the upper part of the body. This research examines the risk level of work postures in the leather shoe industry. This research was conducted in the leather shoe industry located in Semarang. This research uses the RULA method to assess the risk level of work postures. Body area measured by RULA was divided into two groups, namely group A (arms, forearms, hands) and group B (neck, body). The RULA score is obtained based on observing the worker's body posture, including neck, arms, back, legs, and load. The observed scores are then converted into final RULA scores. It was found that the body posture of workers in the leather industry was at a score of 6 and 7. This score has implications for the need for further research regarding the body posture of the following workers. Work posture correction must be done immediately to prevent further health impacts.

**Keywords:** Ergonomics risk level, RULA, work posture

### Introduction

One of the potential hazards workers face in the leather shoe industry is the potential for ergonomics, primarily related to work postures. Work in the leather shoe industry is done in a sitting position. Sitting in a non-ergonomic position will trigger bone and skeletal muscle complaints. When work is carried out in a natural posture, weight is balanced on both legs without bending and twisting the torso, and it will reduce fatigue and increase productivity. The sitting position looks more comfortable than other postures while working. However, sitting for long periods will also cause fatigue. Therefore, sitting in a comfortable chair with a backrest supporting the back well will reduce fatigue. Ergonomic risks are common in the modern world of work. Musculoskeletal disorders (MSDs) are the most frequently reported work-related health problems. This causes more lost work days than any other type of health problem in some countries. MSDs represent 40% of global compensation costs resulting from occupational accidents and illnesses worldwide. The characteristics of modern work, such as the fast

pace, tight deadlines, lack of control over the pace of work, and a culture of long working hours, can cause stress and ergonomic risks that are more common than ever. As a result, muscle pain, mental disorders such as anxiety and depression, and cardiovascular disease now impact more of the working population than ever before.<sup>1</sup>

Research conducted in the manufacturing industry showed a relationship between work posture and complaints of low back pain ( $p=0.047$ ). Workers complained of uncomfortable work postures and low back pain in the category of severe crippled disability.<sup>2</sup>

Work posture and fatigue are essential determinants of work musculoskeletal disorders (WMSDs) found in a study on minibus drivers in Nigeria in addition to work stress, work duration, and work frequency. This study recommends that ergonomics training be conducted to reduce the incidence of WMSDs in this population.<sup>3</sup>

To prevent the occurrence of occupational disorders or diseases, it is necessary to identify all risk factors that occur during work. Once determined, preventive measures must be determined to prevent, reduce, or eliminate the complaint.<sup>4</sup>

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Received: 23 July 2024; Revised: 17 September 2024; Accepted: 11 December 2024; Published: 21 December 2024

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Workers in the shoe industry exhibit several awkward work postures, such as hunched backs, sitting on the floor, poor foot position, or sitting in chairs that do not suit their bodies. Based on previous research, these postures can trigger health complaints such as musculoskeletal disorders. Therefore, it is necessary to assess workers' posture in this industry. So, this research aims to analyze the risk level of work postures in the leather shoe industry.

**Methods**

This descriptive research was conducted in the leather shoe industry in Semarang using purposive sampling methods. There were 43 workers involved in this research. However, only five workers had their work postures observed since they demonstrated similar postures in the same production step. They represent workers at every stage of the job. The postures observed were all work postures in each production process in the industry.

To assess rapid upper limb assessment (RULA), researchers took photos of workers while doing their work from a side angle. Using a protractor, the angles required for evaluation in the RULA sheet were measured through photos. The worker's dynamic movement was also observed. This measure was then converted to a RULA score and interpretation (available in the RULA sheet).<sup>5</sup>

The research protocol has been approved, and an ethical clearance certificate Number 472/EA/KEPK-FKM/2019 has been received.

**Results**

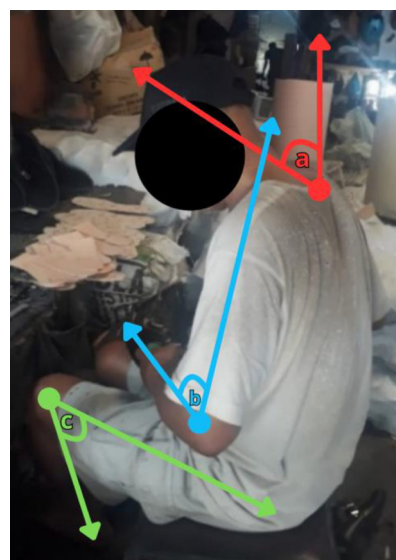
Table 1 shows that 40 of 43 workers were in the old age category. About 27 of 43 workers were in the new work period category. Based on the study's results, it was found that work in the leather shoe industry was carried out for 8 hours every day with 1 hour of rest. The workers' work posture was sitting on a small chair without a backrest. There are even workers who sit on the floor while doing their jobs. Such a work posture could be more ergonomic and more comfortable for workers. The workplace layout needs to be more tidy. Some unused objects are still visible around the workplace. This makes it difficult for workers to carry out their work, and sometimes,

**Table 1 Characteristics of Respondents**

Characteristics	n=43
Age (years)	
>30	40
≤30	3
Work period (years)	
<5	27
≥5	16

some work equipment may be difficult to find because of the large number of items mixed with unused items.

Based on Figure 1, it is known that workers' posture when cutting shoe materials is according to the pattern in a sitting posture, bent back (angle a), and head bowed position. This posture puts extra pressure on the lower back and neck. The assessment of this posture showed that the upper arm, lower arm, and wrist scores were 2, 1, and 3, respectively. Adding muscle score one and load score 1, the total wrist and arm score was 4. For the neck and trunk score, each section scored 3, and the leg score was 1. This score, added to section B's muscle and load score, became 7. So, the final score for this posture was 6. It can be interpreted from the RULA sheet that further investigation and improvement of posture is needed immediately, considering that this type of work posture looks like a highly bent back.



**Figure 1 Process of Cutting according to the Pattern**

The assessment of this posture (Figure 2) showed that the upper arm, lower arm, and wrist scores were 2, 1, and 3, respectively. Adding by muscle score and load score 2, the total wrist and arm score was 6. For the neck and trunk score, each section gained a score of 3; besides, each section scored 3. Besides, each section scored 3, and the leg score was 1. This score, added to section B's muscle and load score, became 6. So, the final score for this posture was 7. It can be interpreted from the RULA sheet that further investigation or research is needed to determine the impact that can arise from this posture. In addition, a change in work posture will likely be necessary given the very non-ergonomic work posture.

The work posture in Figure 3 showed that the upper arm, lower arm, and wrist scores were 2, 1, and 3, respectively. Adding muscle score one and load score 1, the total wrist and arm score was 5. For the neck and trunk score, each section scored 3 and 2, respectively; each section scored 3 and 2, respectively, and the leg score was 1. This score, added to section B's muscle and load score, became 5. So, the final score for this posture was 6. It can be interpreted from the RULA sheet that further investigation is needed regarding the posture, and the posture must be corrected immediately. It can be seen in the picture that workers are very uncomfortable in their sitting conditions; workers have to fold their legs for a



Figure 3 Gluing and Pasting the Sole

long time. Of course, this will most likely cause complaints such as aches, cramps, and tingling. If the sitting posture is not immediately corrected, workers also tend to experience fatigue quickly.

The assessment of this posture in Figure 4 showed that the upper arm, lower arm, and wrist scores were 1, 1, and 3, respectively. Adding muscle score one and load score 1, the total wrist and arm score was 4. For the neck and trunk score, each section scored 3, and the leg score

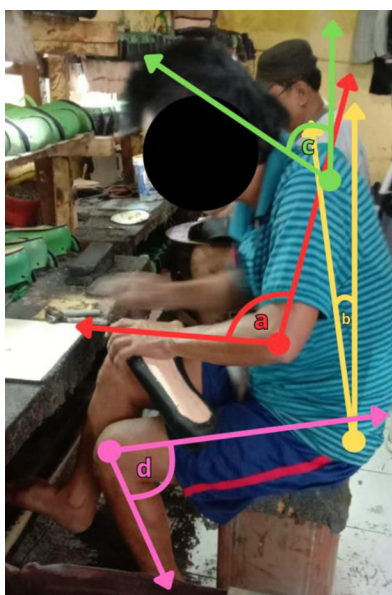


Figure 2 Installation on A Shoe Mold

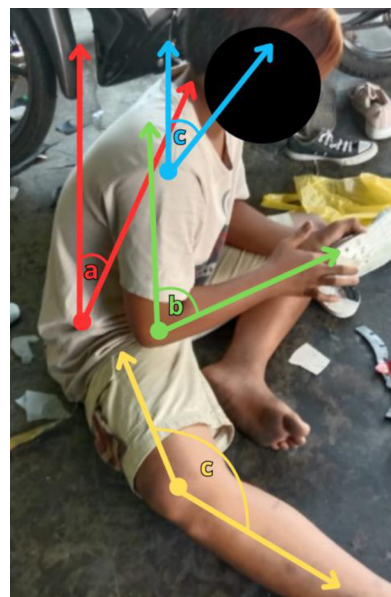


Figure 4 Outsole Installation

was 1. This score, added to section B's muscle and load score, became 6. So, the final score for this posture was 6. So, further investigation is needed in this case, as well as improving the work posture to make it more ergonomic. It can be seen in the picture that workers do their work by sitting on the floor without chairs or cushions. This work posture will make workers feel very uncomfortable and trigger complaints or health problems, such as knee pain and back and neck pain, and they tend to get tired quickly.

The worker in Figure 5 was doing his job with a bent posture because he was sitting on the floor with his legs folded. The assessment of this posture showed that the upper arm, lower arm, and wrist scores were 2, 2, and 3, respectively. Adding muscle score one and load score 1, the total wrist and arm score was 5. For the neck and trunk score, each section scored 3, and the leg score

was 1. This score, added to section B's muscle and load score, became 7. It can be interpreted from the RULA sheet that this posture needs further investigation and that the change must be implemented for a better posture. In addition, workers were also strongly advised to change and improve their work posture immediately. Workers may not feel the impact of the work posture in a short time. However, the longer the work duration, the more workers' complaints, such as cramps, tingling, aches, and even back and neck pain, will gradually appear. The table below summarizes the RULA final score.

Table 2 shows that the work postures observed resulted in final scores between 6 and 7.

**Discussion**

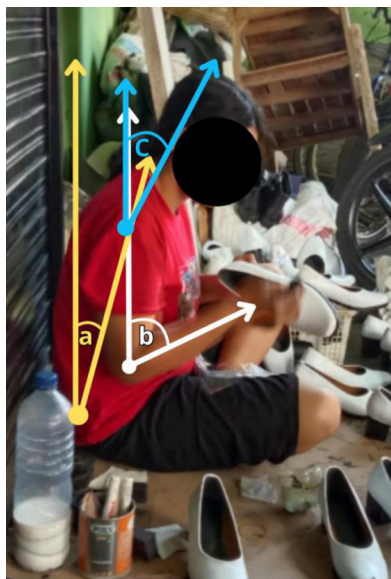
Workers do their work by sitting on tiny chairs without backrests. Some even lie on the floor while doing their work. This work posture is not ergonomic and is uncomfortable for workers. The workplace is organized, and even some unused objects can still be seen around. Workers will have difficulty working, and sometimes work equipment may be difficult to find because many items are mixed with unused items.

The layout or design of the workplace will be primarily determined by the type of work and equipment used to carry out the work. While working conditions can be designed ergonomically by adjusting the work and equipment and workers who will use it.<sup>6-8</sup>

Workers' postures when cutting shoe materials according to the pattern were sitting, bent back, and head bowed (Figure 1). This posture puts extra pressure on the lower back and neck. The final RULA score for this posture was 6, meaning that further investigation and posture improvement are needed immediately, considering that this type of work posture looks like an extremely bent back.

If the potential ergonomic hazards are not immediately corrected, the workers will be at risk of experiencing health problems related to musculoskeletal. The risk of health problems and occupational diseases must be minimized so that workers are always healthy and safe when doing their jobs.<sup>9</sup>

Sitting work posture was also found among smoked fish workers in Demak. Workers sit in tiny chairs that make their backs bend and even twist



**Figure 5 Finishing**

**Table 2 Summarize the RULA Final Score**

Worker in Section	Final Score
Process of cutting according to the pattern	6
Installation on a shoe mold	7
Gluing and pasting the sole	6
Outsole installation	6
Finishing	7

while working. As many as 87% of the smoking fish workers experienced musculoskeletal complaints, including 85% neck stiffness, 90% back pain, 95% leg tingling, and 75% pain in the shoulders and hands.<sup>10</sup>

Based on the measurement results using the RULA method, posture when installing a shoe mold (Figure 2) produces a score of 7, meaning that further investigation or research is needed to determine the impact that can arise from this posture. In addition, a change in work posture will likely be necessary given the very non-ergonomic work posture. Workers must work in a sitting posture for long periods and use their hands so that complaints of discomfort in the back, arms, and wrists will arise.<sup>7,11</sup>

A high prevalence of MSD symptoms was found among shoe workers in Iran. The average RULA score obtained is 6.3. It indicates that in most cases, workers' posture in the workplace needs to be investigated and changed immediately to prevent musculoskeletal injuries. The highest prevalence rates of MSDs were found in the shoulder, wrist, and arm areas. Based on statistical tests conducted show that several risk factors associated with upper extremity musculoskeletal disorders (UEMSD) symptoms include work experience, daily working hours, job satisfaction, work posture, work pressure, and discomfort at work, as well as individual factors such as age, gender, body mass index, working conditions, education level, and lack of regular physical/sports activity.<sup>12</sup>

A study on welding workers also found that non-ergonomic work postures such as sitting very low or squatting with the head lowered will cause complaints in several parts of the worker's body. As many as 100% of workers experience pain in the back, waist, and calves; 80% of workers experience neck pain; 70% of workers experience shoulder pain; and 10% of workers complain of arm pain.<sup>13</sup>

The measurement results using the RULA method show that the working posture when gluing and pasting the sole (Figure 3) is categorized at a score of 6. This indicates that further investigation is needed regarding the posture, which must be corrected immediately. It can be seen in the picture that workers are very uncomfortable in their sitting conditions; workers have to fold their legs for a long time. Of course, this will most likely cause complaints

such as aches, cramps, and tingling. If the sitting posture is not immediately corrected, workers also tend to experience fatigue quickly.

This is in line with the results of a study in the shoe industry in Medan, which found that the activities carried out by workers are categorized as requiring further action. Activities carried out by workers do not make workers feel too much pain. However, an improvement in the working position and adequate rest are needed to restore the worker's condition and stamina after working with that posture.<sup>14</sup>

Research conducted on farmers in Iran showed that the highest prevalence of MSD symptoms was associated with the lower back (59.3%), knees (36.9%), and upper back (36.6%). The quick exposure check (QEC) scores indicated high or very high yields (action levels 3 and 4) in 83.1% of farmers. In addition, the checklist for ergonomic working conditions revealed that the workers' "work posture" index had the lowest average. It indicates poor ergonomic conditions, while "work equipment" has the highest average, indicating proper ergonomic conditions. In this study, it is also recommended that hazardous work postures be eliminated and that working conditions be improved.<sup>15</sup>

The work posture when the worker installed the outsole in Figure 4 is categorized at a score of 6 based on the RULA assessment. Further investigation is needed in this case, and it is necessary to improve the work posture to make it more ergonomic. It can be seen in the picture that workers do their work by sitting on the floor without chairs or cushions. This work posture will make workers feel very uncomfortable and will trigger complaints or health problems, such as knee pain, back and neck pain, and tend to get tired quickly.<sup>16</sup>

A similar posture was also found in a study in another shoe industry. Workers in these industries even look less effective due to poor working positions, so the worker postures become awkward, and work postures are static. Workers carry out their work in a sitting position continuously without using a sitting mat, with their necks bent to reach the work object with a bent back.<sup>14</sup> Studies on smoked fish workers found that when the sitting position was not comfortable/not ergonomic or sitting for too long, it caused backache or pain.<sup>16</sup>

A study examining the relationship between

MSD complaints and fatigue in nurses showed that ankles/legs, lower back, knees, and shoulders had the highest prevalence of work-related musculoskeletal symptoms (WMS) among nurses in the last 12 months before the study. Independent variables, including age, years of service, sex, smoking habits, shift work, and type of work, were significantly associated with WMS in different body regions, with odds ratios (OR) ranging from 1.635 to 2.835. In addition, WMS in several areas of the body is also associated with work fatigue. In this study, it is also recommended that ergonomic and organizational interventions be implemented to adjust the work of nurses, taking into account demographic/occupational characteristics to improve the health of the musculoskeletal system and relieve fatigue.<sup>17</sup>

Research conducted on workers in the manufacturing industry shows that workers believe that the pain/pain they feel is due to poor workstation design. The workers also suggested improvements to the workplace design to reduce pain complaints.<sup>18</sup>

In the finishing process (Figure 5), a bent posture was found because the worker was sitting on the floor with his legs folded. Based on the RULA measurement, this posture was included in the score category 7. Further investigation is needed about this work posture. In addition, workers are strongly advised to change and improve their work posture immediately. Workers may not feel the impact of the work posture in a short time. However, the longer the work duration, the more workers' complaints, such as cramps, tingling, aches, and even back and neck pain, will gradually appear.

A study of workers in a shoe factory in Iran found that the prevalence and severity of health complaints were very high in the study population. The mean RULA value of 6.2 indicates that, in most cases, workers' workplace posture needs to be investigated or investigated further. Some changes are even required as soon as possible. This study also showed that work experience, daily working hours, duration of continuous work without rest, feeling of pressure due to work, and work posture were significantly associated with musculoskeletal symptoms from various body areas. These findings help better understand the working conditions of jobs with similar work postures and activities and highlight the potential for ergonomic interventions to

reduce musculoskeletal symptoms in this group of workers.<sup>19</sup>

Research on nurses shows that poor ergonomics, including work posture, caused WMSDs in addition to other factors, namely old age, length of work, high workload, work habits, high levels of physical activity, equipment availability, stress, and anxiety.<sup>20</sup> Other research findings also emphasize that any intervention program in the shoe industry or similar should focus on improving working conditions, primarily by designing ergonomically oriented workstations and hand tools.<sup>14</sup> It is necessary to improve work attitudes and ergonomics. Workplace stretching can be added to reduce musculoskeletal complaints and fatigue and increase productivity.<sup>21</sup>

Overcoming musculoskeletal risk factors through ergonomic interventions regarding workspace design, sitting/standing posture of workers, chairs, and hand postures during work and work-rest cycles can be realized with the cooperation of policymakers, companies, and workers.<sup>21</sup>

Overall, the work posture of workers in the leather shoe industry is in category 6–7. This means that the posture requires further investigation regarding the impact that will occur. In addition, it is also necessary to improve work posture as soon as possible so that the negative impact of non-ergonomic work postures can be avoided.

This research is limited to describing the level of work posture risk experienced by workers in the shoe industry in Semarang. It does not include a description of workers' musculoskeletal complaints. The author suggests further research on reducing or eliminating non-ergonomic work postures in the leather shoe industry and on workers' musculoskeletal complaints.

## Conclusions

It can be concluded that the workers in leather the leather industry's RULA score indicated that it's reinvestigation and needs a better posture. In addition, workers were also advised to change and improve their work posture immediately.

## Conflict of Interest

All authors convey that there is no conflict of

interest to all parties.

### Acknowledgment

The author would like to thank the Faculty of Public Health, Universitas Diponegoro, for face, for facilitating research implementation and the shoe industry for permitting data collection. We also extend our appreciation to the worker's shoe industry workers who have participated in this research.

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