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# Reducing Musculoskeletal Disorders through the KURJAMIS Intervention: A Quasi-Experimental Study

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**Abstrak**

Keluhan muskuloskeletal merujuk pada keluhan yang terjadi pada otot dan rangka seseorang, mulai dari yang ringan hingga yang parah. Industri sapu ijuk Sido Makmur merupakan salah satu industri sapu ijuk yang ada di Boyolali. Selama 8 jam kerja, pekerja pada bagian perakitan ijuk melakukan pekerjaannya dengan duduk. Dari hasil survey pekerja mengalami rasa nyeri yang dominan pada pinggang, leher, pantat, betis kanan, betis kiri, paha kiri dan paha kanan. Oleh karena itu diperlukan perbaikan stasiun kerja. Tujuan dari penelitian ini untuk mengetahui pengaruh KURJAMIS terhadap gangguan muskuloskeletal pada Pengrajin Sapu. Metode penelitian yang digunakan menggunakan quasi-eksperimental dengan pendekatan pre-test post-test with control group. Sampel penelitian sebanyak 30 orang diambil menggunakan total sampling. Penilaian Gangguan muskuloskeletal menggunakan kuesioner Nordic Body Map (NBM), Pengambilan data dilakukan 2 kali, sebelum dan sesudah menggunakan KURJAMIS. Analisis menggunakan regresi linear berganda dengan mengontrol jenis kelamin, usia, masa kerja, dan skor RULA. Hasil penelitian menunjukkan bahwa terdapat efek utama yang signifikan dari waktu pengukuran Gangguan muskuloskeletal (pre-test dan post-test) terhadap skor Gangguan muskuloskeletal (p = 0,001). Hal ini menunjukkan bahwa terdapat penurunan skor Gangguan muskuloskeletal yang signifikan setelah penggunaan KURJAMIS. Meskipun terdapat efek utama dari waktu pengukuran Gangguan muskuloskeletal, hasil analisis juga menunjukkan bahwa tidak ada efek signifikan dari variabel kontrol jenis kelamin (p = 0,620), usia (p = 0,105), masa kerja (p = 0,081), dan skor RULA (p = 0,569 ) terhadap skor Gangguan muskuloskeletal. Artinya, penurunan skor Gangguan muskuloskeletal setelah penggunaan KURJAMIS tidak dipengaruhi oleh jenis kelamin, usia, masa kerja atau skor RULA. Kesimpulan dalam penelitian ini ada penurunan gangguan muskuloskeletal setelah menggunakan KURJAMIS. Hasil dari efektifitas penggunaan KURJAMIS tidak dipengaruhi oleh jenis kelamin, usia, masa kerja, dan skor RULA.

**Kata Kunci : Keluhan Muskuloskeletal, Kursi Kerja, RULA**

**Abstract**

Musculoskeletal disorders refer to complaints that occur in a person's muscles and skeleton, ranging from mild to severe. Sido Makmur broomstick industry is one of the broomstick industries in Boyolali. During 8 hours of work, workers in the fiber assembly section do their work by sitting. From the survey results, workers experience pain that is dominant in the waist, neck, buttocks, right calf, left calf, left thigh and right thigh. Therefore, it is necessary to improve the workstation. The purpose of this study was to determine the effect of KURJAMIS (Ergonomic Work Chair) on musculoskeletal disorders in Broom Craftsmen. The research method used was quasi-experimental with a pre-test post-test approach with a control group. The research sample of 30 people was taken using total sampling. Assessment of musculoskeletal disorders using the Nordic Body Map (NBM) questionnaire, data collection was carried out 2 times, before and after using KURJAMIS. Analysis using multiple linear regression by controlling for gender, age, length of service, and RULA score. The results showed that there was a significant main effect of the time of measurement of musculoskeletal disorders (pre-test and post-test) on the score of musculoskeletal disorders (p = 0.001). This shows that there was a significant decrease in the musculoskeletal disorder score after the use of KURJAMIS. Although there was a main effect of the

time of measurement of musculoskeletal disorders, the results of the analysis also showed a significant reduction in the scores of musculoskeletal disorders.

**Keywords:** ***Musculoskeletal disorders, Work Chairs, RULA***

## INTRODUCTION

The handicraft sector in Indonesia plays an important role in the economy, contributing significantly to GDP and providing employment opportunities, especially through micro, small, and medium enterprises (Darmastuti et al., 2022). Sapu Ijuk, made from the durable natural fibers of palm trees, is a popular handicraft product known for its effectiveness in cleaning dirt, with production centers in regions such as West Java, Central Java, and East Java (Darmastuti et al., 2022). The industry not only supports livelihoods, especially in rural areas, but also promotes environmental sustainability due to the renewable nature of palm fiber as a raw material (Gautam et al., 2023). Palm fiber broom artisans, especially those working in the informal sector, often face various occupational health risks, with musculoskeletal disorders being one of the most significant (Salammia et al., 2016). Uncontrolled muscle use, prolonged activity, and maintaining an unchanged body position for long periods of time can cause complaints in the muscles and skeleton known as musculoskeletal complaints (Soedirman & Suma'mur, 2014). The same opinion was conveyed by Tarwaka (2015) who stated that musculoskeletal complaints refer to complaints that occur in a person's muscles and skeleton, ranging from mild to severe.

The process of making palm fiber brooms involves repetitive movements and postures that are not ergonomic for long periods of time. This can lead to muscle strain, inflammation, and damage to joints and tendons (Masayuki et al., 2022). One of the factors that increase the risk of musculoskeletal disorders in fiber broom workers is inadequate work tools because fiber broom workers often use work tools that are not ergonomic and do not fit their posture which can cause muscle strain and damage to the joints. Therefore, it is important to take measures to prevent musculoskeletal disorders in fiber broom craftsmen through the provision of adequate work tools, i.e. fiber broom craftsmen should be equipped with ergonomic work tools that are suitable for their posture.

Palm fiber broom craftsmen sit using a short, small, and backless chair during work or often called a dingklik (Sumardiyono, Chahyadhi, Syahrotun, Suratna, Paskanita, et al., 2023) for 8 hours can result in strain on joints, back muscles, and hips (Mondal et al., 2017). This is as experienced by Sido Makmur broomstick craftsmen in Boyolali Regency. Every day for 8 hours of work craftsmen in the fibers assembly section do their work by sitting using a dingklik.

Research on the occupational health of palm fiber broom craftsmen is still relatively limited. This study is expected to fill the gap in the existing research literature by analyzing ergonomic factors associated with musculoskeletal disorders in fibre broom craftsmen. In addition, this study is also expected to make a significant contribution to the development of effective ergonomic interventions to improve the occupational health of palm fiber broom craftsmen. From the results of a preliminary survey on palm

fiber broom craftsmen at UD Sido Makmur in Boyolali, based on measurements using the Nordic Body Map (NBM) questionnaire of 10 craftsmen found they experienced pain dominant in the waist and neck as many as 9 people (90%), buttocks, right calf, and left calf as many as 8 people (80%), left thigh and right thigh as many as 7 people (70%).

The main objectives of this study were to analyze the effect of the KURJAMIS intervention on the level of MSDs in workers, compare the severity of MSDs in the group of workers who received the Kurjamis intervention with the control group who did not receive the intervention, and calculate the effect size of KURJAMIS in reducing MSDs of palm fiber broom craftsmen at UD Sidomakmur, Boyolali Regency.

This study has several novel aspects that distinguish it from previous studies. First, this study uses an ergonomic analysis approach to identify ergonomic factors related to musculoskeletal disorders in palm fiber broom craftsmen. Second, this study developed a specific ergonomic intervention using an ergonomic work chair called KURJAMIS (Ergonomic Work Chair) to overcome the problem of musculoskeletal disorders of fiber broom craftsmen, which in the analysis considered the variables of gender, age, length of service, and Rapid Upper Limb Assessment (RULA) score. Third, this study evaluates the effectiveness of ergonomic interventions in reducing musculoskeletal disorders of palm fiber broom workers.

## METHODS

### Research Design

This study used a quasi-experimental research design with a pre-test post-test with control group approach. This design was chosen to test the effect of the KURJAMIS intervention on musculoskeletal disorders in palm fiber broom craftsmen at UD Sidomakmur, Boyolali Regency. The research team collaborated with UD Sido Makmur to prepare the KURJAMIS (Ergonomic Work Chair) tool and research materials, namely a set of anthropometers, Nordic Body Map (NBM) questionnaires and respondent characteristic data sheets. The design of KURJAMIS (Ergonomic Work Chair) was made based on the anthropometric measurement results where this measurement is based on the dimensions of the worker's body.

### Population and Sample

The population of this study was all 30 palm fiber broom craftsmen at UD Sido Makmur in Boyolali, all taken as samples using total sampling, so that the total sample was 30 people. Of the 30 people, 15 fibers broom craftsmen were randomly selected using simple random sampling technique to be used as an intervention group (using KURJAMIS), while the remaining 15 people as a control group (using Dingklik). Palm fiber broom craftsmen sit using a short, small, and backless chair during work or often called a dingklik

**Ethical clearance**

This study has received research permission from the ethics committee conducted at Dr. Moewardi Surakarta Hospital with number: 1.041/IV/HREC/2024 dated April 29, 2024.

**Research Procedure**

This research was conducted in several stages, namely:

1. Preparatory stage. The research team coordinated with UD Sido Makmur to obtain research permits and access to palm fiber broom craftsmen. The research team also prepared research tools and materials, namely a set of anthropometers, Nordic Body Map (NBM) questionnaires and respondent characteristic data sheets. KURJAMIS (Ergonomic Work Chair) design is based on the results of anthropometric measurements where these measurements are based on the dimensions of the worker's body and the design principle can use the extreme individuals of the 5% percentile and 95% percentile (Sumardiyono & Rante Ada, 2014).
2. Initial data collection stage. The research team collected data from palm fiber broom craftsmen who had become research samples. Data collection was carried out using the NBM questionnaire and the respondent's characteristic data sheet.
3. Intervention stage. The fiberglass broom craftsmen received the KURJAMIS intervention for 6 days based on a minimum intervention period of 6 days (Yuliana et al., 2019). The pre-test assessment was carried out when the palm fiber broom craftsmen used dingklik (initial position) and the post-test assessment after one group of craftsmen used KURJAMIS for 6 days.
4. Post-intervention data collection stage. The research team conducted data collection again to the palm fiber broom craftsmen after 1 week of intervention. Data collection was carried out using the NBM questionnaire and the respondent's characteristic data sheet.
5. Data analysis stage. The data that has been collected is analyzed using Multiple Linear Regression analysis techniques. This analysis technique was used to test the effect of the KURJAMIS intervention on musculoskeletal disorders in palm fiber broom craftsmen by controlling the confounding variables of gender, age, length of service, and initial RULA score.

**Data Collection Technique**

The data collection technique used in this study used the Nordic Body Map (NBM) Questionnaire to measure the level of musculoskeletal pain in palm fiber broom craftsmen. This questionnaire consists of 28 questions that ask about the level of pain in 28 different areas of the body; The respondent characteristics data sheet is used to collect information about the characteristics of respondents, such as age, gender, length of service, and RULA score.

**Data Analysis Technique**

The data analysis technique used in this research is Multiple Linear Regression. This analysis technique is used to test the effect of KURJAMIS intervention on musculoskeletal disorders in palm fiber broom craftsmen by controlling the variables of age, gender, working period, and RULA score.

## RESEARCH RESULTS

KURJAMIS (Ergonomic Work Chair) design is determined based on the results of anthropometric measurements of palm fiber broom craftsmen. The basic dimensions of KURJAMIS are adjusted to the anthropometry of the worker's body using the 5% percentile, namely seat height, determined based on the dimensions of the height of the sitting knee bend (30 cm); seat length, determined based on the dimensions of the distance from the knee bend to the back line (30 cm); seat width, determined based on the dimensions of the hip width (32 cm); Backrest height, determined based on the dimensions of the sitting back height (47 cm).

**Statistical description of research variables**

This study used 30 palm fiber broom craftsmen at the assembly stage as samples. The characteristics of the respondents are presented in Table 1.

**Table 1.** Characteristics of Respondents at Baseline (N = 30)

| No | Respondent Characteristics | Intervention Group | | | Control Group | | | p-value* |
|---|---|---|---|---|---|---|---|---|
| | | $\bar{x}$ | SD | Median | $\bar{x}$ | SD | Median | |
| 1 | MSDs (Pre-test) | 87,47 | 3,357 | 88 | 86,47 | 3,523 | 86 | 0,466 |
| 2 | RULA (score, Before) | 6,67 | 0,488 | 7 | 6,67 | 0,488 | 7 | 0,723 |
| 3 | Age (year) | 42,40 | 8,484 | 41 | 41,73 | 10,313 | 40 | 0,502 |
| 4 | Length of Service (year) | 11,93 | 7,914 | 10 | 12,27 | 7,977 | 10 | 0,620 |
| | | Frequency (n) | Presentase (%) | | Frequency (n) | Presentase (%) | | |
| 5 | Gender | | | | | | | |
| | Female | 13 | 86,7 | | 13 | 86,7 | | 0,116 |
| | Male | 2 | 13,3 | | 2 | 13,3 | | |

Source: Primary Data, 2024

Table 1 shows that there is no significant difference between the intervention group and the control group. These results can be said that the data obtained before the study was homogeneous and ready to receive intervention.

**Description of MSDs Before and After Intervention using KURJAMIS**

The difference in mean MSDs complaints between post-test and pre-test between control and intervention groups is shown in Table 2.

Table 2. Differences in MSDs Complaints Results between Post-test and Pre-test of Control Group and Intervention Group

| Group | MSDs | | t | p-value* | *Cohen's d* |
|---|---|---|---|---|---|
| | $\bar{x}$ ± SD | Δ | | | |
| ***Pre-test*** | | | | | |
| *Pre-test* Control | 86,47 ± 3,523 | 1,000 | 0,796 | 0,433 | 0,291 |
| *Pre-test* Intervention | 87,47 ± 3,357 | | | | |
| ***Post-Test*** | | | | | |
| *Post-test* Control | 86,53 ± 3,72 | 37,8 | 28,224 | < 0,001 | 10,3 |
| *Post-test* Intervention | 48,73 ± 3,62 | | | | |

Source: Primary Data, 2024

* *T- Independent*

Table 2 shows that the results of the p-value in the pre-test and post-test of different groups are (0.433 and 0.001). From these results, it states that there is a significant difference after the KURJAMIS intervention. The differences in the results of MSDs complaints pre-test and post-test of the control group and intervention group are shown in Table 3.

**Table 3.** Differences in MSDs Complaints Pre-test and Post-test Results of Control Group and Intervention Group

| Group | MSDs | | t | p-value* | *Cohen's d* |
|---|---|---|---|---|---|
| | $\bar{x}$ ± SD | Δ | | | |
| **Control** | | | | | |
| *Pre-test* | 86,47 ± 3,5 | -0,1 | - 0,211 | 0,836 | - 0,055 |
| *Post-test* | 86,53 ± 3,7 | | | | |
| **Intervention** | | | | | |
| *Pre-test* | 87,47 ± 3,4 | 38,7 | 36,777 | < 0,001 | 9,5 |
| *Post-test* | 48,73 ± 3,6 | | | | |

Source: Primary Data, 2024

* *T- Paired*

From Table 3, it can be seen that the p-value of the control group and the intervention group respectively (0.836 and 0.001). Where these results show that the intervention group that received KURJAMIS experienced a significant reduction in MSDs complaints with a difference of 38.7 points.

Tables 2 and 3 contain information on the Cohen's d test, to interpret it based on the criteria presented in Table 4.

**Table 4.** Effect Size Classification of Cohen's Test (Juandi et al., 2021)

| Effect Size (ES) | Interpretation |
|---|---|
| $0,00 \leq ES < 0,20$ | Ignored |
| $0,20 \leq ES < 0,50$ | Small |
| $0,50 \leq ES < 0,80$ | Moderate |
| $0,80 \leq ES < 1,30$ | Large |
| $1,30 \leq ES$ | Very Large |

Source: Primary Data, 2024

Based on Table 4, we can see the interpretation of the effect size value, the cohen's d value from the T-Independent and T-Paired tests respectively (10.3 and 9.5). These values indicate that the effect of using KURJAMIS is very large.

Table 5 presents the results of multivariate multiple linear regression to determine whether there is an effect of confounding variables on the reduction of musculoskeletal complaints experienced by workers apart from the use of KURJAMIS.

**Table 5.** Multiple Linear Regression Results

| **Predictor** | **Estimation** | **SE** | **t** | **p** |
|---|---|---|---|---|
| Intercep | 77,718 | 2,7791 | 27,965 | < 0,001 |
| Group | -38,185 | 0,8065 | -47,347 | < 0,001 |
| Intervention | | | | |
| Control | | | | |
| Gender | 0,607 | 1,2064 | 0,503 | 0,620 |
| Female | | | | |
| Male | | | | |
| Age | 0,165 | 0,0978 | 1,687 | 0,105 |
| Length of Service | 0,206 | 0,1132 | 1,82 | 0,081 |
| RULA | -0,503 | 0,8704 | -0,577 | 0,569 |
| High | | | | |
| Medium | | | | |

Source: Primary Data, 2024

Based on Table 5, it can be seen that the decrease in musculoskeletal complaints is only influenced by the use of KURJAMIS as evidenced by a p-value of 0.001 where the alpha value is <0.05. So that KURJAMIS is effective in reducing musculoskeletal complaints without being influenced by gender, age, length of service, and RULA score.

## DISCUSSION

Based on the results of the research that has been conducted, the benefits of KURJAMIS are great in reducing musculoskeletal disorders of palm fiber broom craftsmen. Some of the theories that support the results of this study include: ergonomic theory, as discussed in Lavalle´e-Bourget et al. (2022), emphasizes designing workplaces and equipment to minimize the risk of musculoskeletal disorders, which is reflected in the design of KURJAMIS to reduce static loads on palm fiber broom artisans. Biomechanical theory, as highlighted in Ji et al. (2023), studies how external forces affect the body, with KURJAMIS providing optimal support to reduce stress on muscles and joints. Occupational stress theory, as mentioned in Norouzi et al. (2023), links work stress to musculoskeletal disorders, and KURJAMIS aims to reduce stress by improving posture and reducing workload. Finally, injury prevention theory, as discussed in Norouzi et al. (2023), focuses on controlling the risk of injury, with KURJAMIS helping to prevent musculoskeletal disorders by promoting ergonomic postures and reducing stress, thus improving safety for palm fiber broom artisans.

Unreasonable work posture (posture factor) and excessive muscle load (weight factor) have an impact on musculoskeletal disorders in batik artisans. Batik artisans usually bow their necks for a long time when using canting, which can cause inelastic abdominal muscles, crooked backbones, and strained eye muscles (Arifin et al., 2020). Ergonomic risk factors such as poor work postures such as awkward work positions and unergonomic workstations (chairs without backrests and foam seats) and tables that cannot be adjusted to the height of the worker require further control and prevention efforts to reduce the risk of musculoskeletal disorders can use reclining chairs and foam seats, and tables that can be adjusted to the height of the worker (Melinda et al., 2023).

Other similar studies conducted by previous researchers have shown that ergonomic interventions, such as the use of ergonomic chairs, can help reduce musculoskeletal disorders in workers in various industrial sectors. Research by Sumardiyono et al. (2014) found that ergonomic chairs are effective for reducing the risk of musculoskeletal disorders in female batik crafters as indicated by statistically significant differences in the reduction of musculoskeletal disorders before and after the use of ergonomic chairs for two months which are not influenced by Body Mass Index (BMI) as a confounding factor. Another study by Sumardiyono & Wijayanti (2019) stated that ergonomic work chair design can reduce musculoskeletal disorders as evidenced by a decrease in RULA scores from the medium risk category (level 3) to low risk (level 2) and reduce the risk of musculoskeletal disorders of workers from moderate risk levels (NBM score = 55.4 points) to low risk (NBM score = 36.0 points).

The results of statistical analysis in this study showed that the KURJAMIS intervention as the main variable had a significant effect from the time of measurement of musculoskeletal disorders (pre test and post test) on the score of musculoskeletal disorders (p-value = 0.001). This shows that there was a significant decrease in musculoskeletal disorder scores after the use of KURJAMIS. The results of the confounding variable analysis showed that there was no significant influence of gender (p-value = 0.520), age (p-value = 0.105), length of service (p-value = 0.081), and RULA score (p-value = 0.569)

on musculoskeletal disorder scores, meaning that the decrease in musculoskeletal disorder scores after using KURJAMIS was not influenced by gender, age, length of service, or individual RULA scores.

In research conducted by Helmina et al. (2019) stated that there was a relationship between gender and musculoskeletal disorders (p-value = 0.009). However, in this study the gender variable did not affect musculoskeletal disorders because it was controlled (p-value = 0.520). Research conducted by Hargiani et al. (2024) stated that age has an influence on musculoskeletal complaints (p-value = 0.000). However, another study conducted by Hardianto et al. (2015) showed no significant relationship between age and musculoskeletal disorders (p-value = 0.399). Likewise with this study, the presence of age has been controlled so it does not affect the relationship between KURJAMIS and musculoskeletal disorders (p-value = 0.105). The relationship between working period and musculoskeletal disorders was stated by Hardianto et al. (2015) that there is no significant relationship (p-value = 1.000). However, this is not in line with the research of Kattang et al. (2018) which states that there is a relationship between working period and musculoskeletal disorders, where the longer the working period experienced by workers can result in reduced muscle strength which can affect body stamina and can cause musculoskeletal disorders. In this study, the working period was controlled (p-value = 0.0,081). The relationship between RULA score and musculoskeletal disorders conducted by Salcha & Arni Julian (2021) stated that there was an influential relationship between RULA score and musculoskeletal complaints where the value (p-value = 0.028). This is different from the results of this study where in this study the RULA score did not affect musculoskeletal complaints (p-value = 0.569).

Thus, based on analysis using the T-Independent test, T-Paired test, and multiple linear regression test, it was found that KURJAMIS is effective in reducing musculoskeletal disorders. The effectiveness of KURJAMIS is not influenced by gender, age, length of service, or individual RULA scores. Ergonomic chairs can be used in various industries that allow workers to take short breaks in a sitting-like position when tired of standing, and return to standing when needed. With this concept, workers can improve productivity and health (such as preventing illnesses due to constant standing), and work comfort Gokul et al. (2023). Ergonomic chairs for batik crafters replace traditional dingkliks that are not ergonomic and have the potential to cause musculoskeletal problems can effectively reduce musculoskeletal disorders whose use is not influenced by age, length of work, and body mass index (Sumardiyono et al., 2023). Research by Emaputra et al. (2020) found the use of ergonomic chairs that are comfortable, durable, and strong with adjustable seat heights between 361-414 mm for grinding workers can reduce occupational risks from high and medium categories to low categories.

This study makes important contributions to the theory of ergonomic work chairs and musculoskeletal disorders. Firstly, this study strengthens the evidence that the KURJAMIS intervention can effectively reduce musculoskeletal disorder scores in palm fiber broom artisans. These results support ergonomic theory which states that proper chair design can help reduce unergonomic postures, static loads, and work stress, which in turn can reduce the risk of musculoskeletal disorders. Secondly, this study shows that KURJAMIS can provide significant benefits to palm fiber broom artisans in a relatively short period

of time, supporting biomechanical theory which states that changes in posture and workload can have a positive impact on musculoskeletal health in a relatively short period of time. Thirdly, this study shows that KURJAMIS can be effectively applied in the informal sector, such as the palm fiber broom industry. This extends the injury prevention theory that ergonomic interventions can benefit workers in a variety of occupations.

This study has several limitations that need to be considered, including: 1) Small Sample Size. This study only involved 30 palm fiber broom craftsmen as samples. This small sample size may limit the generalizability of the research findings to a wider population of fibre broom artisans; 2) Short intervention duration. The KURJAMIS intervention was only conducted for 3 weeks. This short duration of intervention may not be sufficient to demonstrate the long-term effects of KURJAMIS on musculoskeletal disorders. Suggestions for future research include: involving a larger sample and increasing the duration of the intervention. However, this study has some important social and ethical implications, namely: 1) the KURJAMIS intervention can help improve worker well-being by reducing musculoskeletal disorders. This can have a positive impact on the occupational health of artisans; 2) KURJAMIS supports the importance of preventing musculoskeletal disorders in the workplace; 3) KURJAMIS shows the importance of considering ergonomic and occupational health aspects in workplace design.

## CONCLUSIONS

The KURJAMIS intervention proved effective in reducing the score of musculoskeletal disorders in palm fiber broom craftsmen. The use of KURJAMIS for 3 weeks can help reduce neck pain, back pain, and shoulder pain and other body parts in palm fiber broom craftsmen. The KURJAMIS intervention was not influenced by age, working period, gender, and RULA score. Recommendations for the results of this study are the implementation of KURJAMIS in the workplace of fiber broom craftsmen to help improve occupational health and prevent musculoskeletal disorders. For further research with a longer duration of intervention and a larger sample to confirm the effectiveness of KURJAMIS. Development of an integrated ergonomic intervention program to address musculoskeletal disorders in various work sectors.

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