

## Effectiveness of innovative ergonomic models in preventing musculoskeletal in rice farmer

Budi Aswin<sup>1</sup>, Guspianto<sup>1</sup>, Hubaybah<sup>1</sup>, David Kusmawan<sup>1</sup>

<sup>1</sup>Public Health Sciences Study Program, Faculty of Medicine and Health Sciences, Jambi University, Jambi city, 36361 pos code, Indonesia

\*Coessponding Authors: budiaswin@unja.ac.id

### Abstract

**Background:** Ergonomic work hazards are potential dangers that can have a negative impact on farmers' health. One of the ergonomic work hazards often experienced by farmers is musculoskeletal disorders and work fatigue. **Methods:** The type of research is a randomized controlled trial (RCT) design, which is the strongest design to evaluate the intervention used, namely the effectiveness of innovative ergonomic models in preventing musculoskeletal disorders in rice farmers. The population in this study was all 238 farmers in Puduk Village, Kumpeh Ulu District, Muaro Jambi Regency. The total research sample of 68 farmers was calculated based on the lameshow method taken using a simple random sampling technique. Data were analyzed to determine the effectiveness of the innovative ergonomics model using the ANOVA test with ( $\alpha = 0.05$ ). **Results:** There are differences in the effectiveness of innovative ergonomic models in preventing musculoskeletal disorders between at least two groups of rice farmers. **Conclusion:** The conclusion of this study is that providing stretching and snacks coupled with rest periods is the most effective in preventing the occurrence of MSDs.

**Keywords:** Innovative ergonomic models; musculoskeletal disorders; rice farmers.

### Cite This Article

Aswin, B., Guspianto, Hubaybah, & Kusmawan, D. (2025). Effectiveness of innovative ergonomic models in preventing musculoskeletal in rice farmer. *Proceedings Academic Universitas Jambi*, 1(2), 963–972.

### Editor

I Made Dwi Mertha Adnyana, M.Ked.Trop.

### Article info

Received: October 04, 2025. Revised: October 30, 2025. Accepted: November 09, 2025



## INTRODUCTION

A work hazard that often has an impact on reducing work capacity and work productivity is ergonomic work hazards. According to Tarwaka (2016) who states that ergonomics is the science, art and application of technology to harmonize and proportion all facilities used both during activities and when resting with all human capacities, capabilities and limitations both physically and mentally so as to achieve quality of life holistic. [1–3] Musculoskeletal disorders are one of the leading occupational diseases causing disability worldwide, with a total of 149 million cases in 160 countries according to data from the World Health Organization (2018).[4] This is a symptoms of skeletal muscles that people experience and can range from very mild to extremely painful.[5] This also includes occupational health problems with high disability in workers.[6]

Ergonomic work hazards are potential dangers that can have a negative effect on workers' health, for example ergonomic work hazards that often occur in workers is musculoskeletal disorders. Musculoskeletal disorders (MSDs) are skeletal muscle complaints or injuries to the muscle musculoskeletal system.[7] Unergonomic conditions, such as work attitudes and the work environment, can result in work-related illnesses.[8,9] Workers will get harmony between labor, environment, methods and work process. How it should work arranged in such a way that it doesn't will cause muscle complaints, fatigue or health other. [10]

Indonesia's main food needs are commodities such as rice. This is because the staple food of Indonesian people is rice. Therefore, the consumption of rice is higher compared to other food sources while the type of business that poses a high risk for workers is the agricultural sector. The problem of musculoskeletal disorders is often overlooked. In 2017 in Thailand there were around 122,859 work-related musculoskeletal cases and of the 69,094 cases, they were found in farmers or agricultural workers.[11,12] According to 2018 Basic Health Research data, the prevalence of musculoskeletal diseases in Indonesia is 7.30% and the highest prevalence rate is found in agricultural work at 9.86%. In Jambi Province, the prevalence of joint diseases (Musculoskeletal Disorders) based on a doctor's diagnosis is 8.67% and according to the occupation of agricultural laborers/farmers, the highest prevalence is 12.79%.[13]

According to research by Rovendra et al (2021), there is a relationship between the nature of work and musculoskeletal disorders. Every type and place of work has risks that can cause health problems. Health. In general, workers in the informal sector lack knowledge and awareness of the hazards in their work environment. awareness of the hazards in their work environment.[14] Lack of ergonomics in work posture is one of the triggering factors, such as bending, squatting, resting on one leg, often facing downwards and doing this for a long time, standing on unstable surfaces, lifting or holding loads for long periods of time, working half-standing for long periods of time, and repetitive work positions. can cause pain. This workload can be seen from the physical activity that farmers do every day. If high activity is not balanced by good calorie needs, effective rest periods and muscle stretching, farmers are at risk of experiencing musculoskeletal disorders.[15,16]

Incorrect work posture can increase the risk as it requires the maintenance of muscle strength. Non-ergonomic work posture is related to complaints of Musculoskeletal Disorders (MSDs) among rice farmers in the village of Lembang Nonongan.[8,17] If this condition persists for a prolonged period, the likelihood of

experiencing Musculoskeletal Health Problems (MSDs) can be three times higher compared to workers performing similar tasks in a shorter time.[18]

When working, farmers must have quite a lot of energy. Almost all of the activities carried out by farmers involve physical and muscular movements such as standing, bending and squatting, which are carried out for quite a long time and repeatedly, which will result in the body experiencing Musculoskeletal Disorders.[19] Other researchers also mention that repeated movements can cause Musculoskeletal Disorders.[8]

Based on preliminary observations made in Pudak village, farmers' work has several processes starting from hoeing, plowing, planting, mulching, lifting and harvesting. Farmers spend approximately 8-10 hours in this work process every day, often in hot weather conditions. The high physical activity of farmers and the frequent use of muscles for long periods of time and repeatedly, even monotonously, will increase the risk of farmers experiencing musculoskeletal disorders. From the results of a short interview, it was found that there had never been any socialization regarding K3 and how to farm according to ergonomic principles, rest periods were sometimes 10 minutes, sometimes 20 minutes or sometimes 30 minutes and carried out at irregular hours and lack of understanding of the aspect of calorie needs in work made this research very important to do. The existence of innovative ergonomic models can function as a prevention of musculoskeletal disorders. The innovative ergonomic model in this research is by giving farmers stretching before starting work, making rest hours more effective and providing snacks to balance farmers' calorie needs.

In connection with the high risk of ergonomic problems that occur among rice farmers in Pudak Village, Kumpeh Ulu District, Muaro Jambi Regency, it is necessary to carry out research that provides innovative ergonomic model interventions and the preparation of balanced calorie needs in preventing musculoskeletal disorders. From this background description, researchers are interested in conducting research on "The Effectiveness of Innovative Ergonomic Models and Arranging Balanced Calorie Requirements in Preventing Musculoskeletal Disorders in Rice Farmers".

## **METHODS**

### ***Study design and setting***

This study employed a randomized controlled trial (RCT) design, which is considered the strongest design for assessing the effectiveness of interventions. The research was conducted in Pudak Village, Kumpeh Ulu District, Muaro Jambi Regency, Indonesia.

### ***Population, samples and sampling***

The population in this study consisted of all 238 rice farmers in Pudak Village, Kumpeh Ulu District, Muaro Jambi Regency, Indonesia. The sample size of 68 farmers was determined using the Lemeshow method. Participants were selected using a simple random sampling technique to ensure equal probability of selection.

### ***Instruments and criteria***

Primary data were obtained through direct measurement, structured interviews with respondents, and field observations related to work posture, duration of work, and musculoskeletal disorder complaints. Secondary data were collected from Pudak Village administrative records, including farmer demographic information and village profiles. Inclusion criteria were active rice farmers residing in Pudak Village who agreed to participate in the study. Exclusion criteria were farmers with a history of

severe musculoskeletal injuries or chronic diseases that could interfere with participation in the intervention.

### ***Procedure and data collection***

The study procedure involved dividing the participants into three intervention groups. The first group received stretching exercises before and during work. The second group was provided with snacks and structured rest periods. The third group received simple education about ergonomic hazards in farming activities. Data collection was conducted through direct measurement of musculoskeletal disorder symptoms, interviews using structured questionnaires, and field observations of work postures and activities. Secondary data related to demographic characteristics of farmers were also collected from the village administration office.

### ***Statistical analysis***

Data analysis was performed to evaluate the effectiveness of the interventions on musculoskeletal disorders. The normality of data distribution was tested prior to analysis. For normally distributed data, the Analysis of Variance (ANOVA) test with a significance level of  $\alpha = 0.05$  was used. For non-normally distributed data, the Kruskal–Walli’s test was applied. Post hoc tests were conducted to identify differences between intervention groups. All statistical analyses were performed using standard statistical software.

### ***Ethical considerations***

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Health Research Ethics Committee of Universitas Fort De Kock Bukittinggi with approval number 1143/KEPK/X/2023. Written informed consent was obtained from all participants prior to data collection.

## **RESULTS**

The research sample consisted of three groups of farmers, namely the first group who were given stretching, the second group who were given snacks and arranged rest periods and then the third group, namely the sample who were only given simple education about the dangers of work ergonomics.

Table 1. is a univariate table display consisting of age, length of service, length of work, PPE, MSDs in three groups of farmers. For the age of group 1 farmers, the average age is 53 years, with the youngest being 28 years and the oldest being 77 years. The average working period is 27 years with the lowest having worked 5 years and the highest working 50 years. The average length of work for farmers is 7 hours a day with the lowest working time being 3 hours and the highest being 10 hours. For PPE, the average farmer is at a score of 2, namely only wearing a hat and long clothes when working, with the lowest score being 1 and the highest being 5. For MSDs, the average farmer is at a score of 20.29 with the lowest score being 5 and the highest being 60. Farmers in group 2 are on average 55 years old with the youngest being 35 years and the oldest being 72 years.

The average working period is 23 years with the lowest having worked 8 years and the highest working 50 years. The average length of work for farmers is 7 hours a day with the lowest working time being 4 hours and the highest being 10 hours. For PPE, the average farmer is at a score of 2, namely only wearing a hat and long clothes when working, with the lowest score being 1 and the highest being 5. For MSDs, the average farmer is at a score of 33.27 with the lowest score being 10 and the highest

being 50. Meanwhile, farmers in group 3 are on average 51 years old with the youngest being 25 years and the oldest being 75 years.

The average working period is 28 years with the lowest having worked 5 years and the highest working 60 years. The average length of work for farmers is 8 hours a day with the lowest working time being 7 hours and the highest being 11 hours. For PPE, the average farmer is at a score of 2, namely only wearing a hat and long clothes when working, with the lowest score being 1 and the highest being 5. For MSDs, the average farmer is at a score of 30.82 with the lowest score being 16 and the highest 54.

Before carrying out multivariate analysis, it is necessary to carry out a normality test to determine the statistical test used. It was found that the MSDs in the groups given stretching and education about ergonomics were equally distributed non-normally/freely with respective significance values of 0.001 and 0.026. Meanwhile, for farmers in the group, snacks and rest periods were distributed normally. Hence, the test used for multivariate analysis is the Kruskal-Wallis test.

**Table 1.** Farmer characteristics

Variable	Min	Max	Mean	Median	SD
<b>Stretching</b>					
Age	28	77	52.96	51.50	12.66
Years of service	5	50	27.08	25.00	11.53
Length of working	3	10	6.73	7.50	1.82
PPE	1	5	1.83	2.0	1.13
MSDs	5	60	20.29	17.0	15.29
<b>Providing snacks and arranging rest times</b>					
Age	35	72	54.95	55.00	9.08
Years of service	8	50	22.59	20.00	10.94
Length of working	4	10	7.16	7.00	1.06
PPE	1	5	1.77	2.00	0.87
MSDs	10	50	33.27	35.0	12.66
<b>Simple education about the dangers of ergonomic work</b>					
Age	25	75	51.36	50.50	12.25
Years of service	5	60	28.09	26.50	17.21
Length of working	7	11	8.18	8.00	1.01
PPE	1	5	1.73	2.0	0.88
MSDs	16	54	30.82	28.50	12.64

The results of the analysis (Kruskal-wallis test) obtained a value of  $p = 0.002$  which is still smaller than alpha 0.05, which means there is a difference in the effectiveness of innovative ergonomic models in preventing musculoskeletal disorders at least between two groups of rice farmers. To find out which groups have differences, a post hoc analysis will be carried out.

**Table 2.** Analysis of differences in the incidence of MSDs among farmers

	Occurrence of MSDs	n	Mean Rank	P
1	Stretching	24	23.23	0.002
2	Providing snacks and arranging rest times	22	42.16	
3	Simple education about the dangers of ergonomic work	22	39.14	
	<b>Occurrence of MSDs</b>	n	Mean Rank	P
1	Stretching	24	23.23	0.002
2	Providing snacks and arranging rest times	22	42.16	

The results of the research show that for farmers who were given stretching, the median, mean and standard deviation values were 17.0; 20.29 and 15.29. Farmers who were given snacks and rest periods had median, mean and standard deviation values of 35.0 respectively; 33.27 and 12.66. Then farmers who were given simple education about the dangers of ergonomic work had median, mean and standard deviation values of 28.5 respectively; 30.82 and 12.64.

The results of the analysis (post hoc test) obtained a value of  $p = 0.002$  for the stretching group and the group providing snacks and setting rest times, then  $p = 0.004$  for the stretching group and the group providing simple education about the dangers of work ergonomics and the value  $p = 0.526$  for the group providing snacks and arranging rest time with groups providing simple education about the dangers of work ergonomics. Thus, it can be concluded that the groups that have differences in the incidence of MSDs in farmers are the group that provides stretching and the group that provides snacks and rest time arrangements as well as the group that provides stretching and the group that provides simple education about the dangers of ergonomic work. Meanwhile, between the group providing snacks and arranging rest periods and the group providing simple education about the dangers of work ergonomics, there was no difference in preventing the incidence of MSDs in farmers.

**Table 3.** Post Hoc analysis of differences in the incidence of MSDs among farmers

No	Occurrence of MSDs	n	Median (Min.- max)	Mean±SD	P
1	Stretching	24	17.0 (5.0-60.0)	20.29±15.29	0.002
2	Providing snacks and arranging rest times	24	35.0 (10.0-50.0)	33.27±12.66	0.004
3	Simple education about the dangers of ergonomic work	22	28.5 (16.0-54.0)	30.82±12.64	0.526

## DISCUSSION

Based on the test results for the stretching group and the group providing snacks and setting rest times, the value of  $p = 0.002$  was obtained, which is still smaller than alpha, namely 0.05, which means there is a difference for the stretching group and the group providing snacks and setting rest times. That the stretching group and the group providing snacks and setting rest periods were effective in reducing the dangers of MSDS to these farmers. This is in line with previous research, namely based on the results of research conducted by L & G (2014) in, 20 which shows that stretching regularly has a positive impact on musculoskeletal symptoms and reduces pain. Stretching can also play a role in preventing musculoskeletal injuries that arise due to work, so it is highly recommended to prevent the risk of injury.

Doing regular stretching exercises is beneficial in maintaining joint flexibility, increasing resistance to muscle injury and discomfort, preventing pain in the lower back area and other spinal problems, and improving self-confidence and personal appearance. A stretching routine can help reduce the level of pain and discomfort.[20] This is also in line with research,8 that stretching exercises are effective in reducing MSDs complaints in cleaning services.[8] The existence of rest time arrangements also has a positive impact in reducing MSDs, this is based on the results of research that has been done ,21 there is a relationship between rest time and complaints of

Musculoskeletal Disorders (MSDs) in workers. One study showed that it is important to increase rest time according to the length of work in a day.[21]

Based on the test results for the stretching group and the group providing simple education about the dangers of ergonomic work, the value of  $p = 0.004$  was obtained, which was still smaller than alpha, namely  $0.05$ , which means there was a difference in the test for the stretching group and the group providing simple education about the dangers of ergonomic work. That stretching groups and groups providing simple education about the dangers of ergonomic work are carried out together to provide effectiveness in reducing the dangers of MSDs in farmers. This is in line with previous research.

The findings of this research are in line with the results of previous research previously carried out by Ginting et al. on a sample of 50 chip factory workers, which also showed the positive impact of stretching on musculoskeletal complaints in workers with 8 hour or 6 hour work schedules.[22] In line with the research, Workers who perform work with static movements, sitting for too long, and non-ergonomic work positions can experience MSDs complaints. Therefore, stretching is considered a necessary thing to do to prevent MSDs. [23]. Apart from that, these findings are consistent with research reported by Anggriawan which showed significant differences before and after providing workplace stretching exercise in reducing complaints of Musculoskeletal Disorders (MSDs) in workers in the production department of PT. Crown Pratama in 2021. [24]

Providing simple education about the dangers of ergonomic work is effective in reducing the dangers of MSDs in farmers, based on research by Luh Nila Agusdianti (2017), that ergonomics education can reduce musculoskeletal complaints and improve the consistency of body posture.[25] That research also shows that education or training on ergonomics and work attitudes need to be provided in the work environment to reduce the risk of musculoskeletal disorders in workers. so providing education is also effective in reducing MSDs [26,27].

Based on test results for The group providing snacks and setting rest times with the group providing simple education about the dangers of work ergonomics obtained a  $p$  value =  $0.526$  which is greater than alpha, namely  $0.05$ , which means there is no difference in the test for the group providing snacks and managing rest times with the group providing simple education. about the dangers of work ergonomics. This means that the group that received snacks and regulated rest periods was no more effective in reducing Musculoskeletal Disorders (MSDs) for farmers when compared to the group that was given simple education about the dangers of work ergonomics. The key point in providing adequate rest time is that if the breaks are too short or too infrequent, efforts to reduce the risk of MSDs may not be optimally successful. In other research, it is stated that length of work can influence MSDs complaints. [28]

Based on the test results for the stretching group and the group providing simple education about the dangers of ergonomic work, a  $p$  value =  $<0.001$  was obtained, which is still lower than alpha, namely  $0.05$ , which means there is a difference in the test for the stretching group and the group providing simple education about the dangers of ergonomic work. The stretching intervention carried out for 10-15 minutes in the middle of work, with 16 movements for each participant, is intended to restore workers' freshness, increase concentration and stimulate creativity. In addition, the provision of Workplace Stretching Exercise (WSE) can also reduce the risk of MSDs complaint.[23] Good ergonomic knowledge can also lead to positive attitudes and influence workers' actions in preventing MSDs complaints.[29] Thus, simple education

related to work posture, stretching, and ergonomic knowledge can play a role in reducing MSDs complaints in farmers.

Based on the test results for the group providing snacks and setting rest times with the group providing simple education about the dangers of work ergonomics, the value of  $p = 0.001$  was obtained, which is still lower than alpha, namely 0.05, which means there is a difference in the test for the group providing snacks and setting rest times with the group providing simple education about the dangers of ergonomic work. This is in line with previous research based on research and also line with the result of Mendonça study that showing different nutritional interventions have different effects on relieving musculoskeletal pain [30]. Of the 17 studies that investigated nutritional interventions, 14 showed significant reductions in musculoskeletal pain, and two reported reduced levels of some inflammatory markers [31].

## CONCLUSIONS

There are differences in the effectiveness of innovative ergonomic models in preventing musculoskeletal disorders between at least two groups of rice farmers. The results of the analysis (post hoc) showed that the groups that had differences in the incidence of MSDs in farmers were the group that provided stretching with the group that provided snacks and rest time arrangements as well as the group that provided stretching and the group that provided simple education about the dangers of ergonomic work. Meanwhile, between the group providing snacks and arranging rest periods and the group providing simple education about the dangers of work ergonomics, there was no difference in preventing the incidence of MSDs in farmers. Farmers should bring food supplies such as bread and sweet tea to increase their calorie needs while working and rest at least fifteen minutes after working for 4 hours. Local regional governments should pay attention to farmers from the K3 and productivity aspects, for example by providing training and promotions on K3.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## FUNDING

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## DECLARATION OF ARTIFICIAL INTELLIGENCE USE

We hereby confirm that no artificial intelligence (AI) tools or methodologies were utilized at any stage of this study, including during data collection, analysis, visualization or manuscript preparation. All work presented in this study was conducted manually by the authors without the assistance of AI-based tools or systems.

## REFERENCES

- [1] Tarwaka & BS. Ergonomi untuk Keselamatan, Kesehatan Kerja dan Produktivitas. Surakarta: Harapan Press; 2016.
- [2] Yunika C, Prodi S, Kesehatan I, Masyarakat K, Prodi S. Analisis Postur Kerja Dan Keluhan Musculoskeletal Disorders (Msds) Pada Petani (Studi Literature Riview). Zahra: Journal of Health and Medical Research 2023;3:395–405.
- [3] Nanda Anisa Fahmiawati AFR. Faktor - Faktor Yang Berhubungan Dengan Keluhan Muskuloskeletal Disorder (Msds) Pada Petani Padi Desa Neglasari Kecamatan Purabaya Kabupaten Sukabumi. Computer Music Journal 2002;26:109. <https://doi.org/10.1162/comj.2002.26.2.109>.

- [4] Bausad AAP AA. Analisis Pengaruh Postur Kerja Dan Beban Kerja Dengan Kejadian Musculoskeletal Disorders Petani Kecamatan Marioriawa. *J Heal Educ Dan Lit* 2023;5:128–34.
- [5] Budiana Yazid HS. Hubungan Aktivitas Fisik Dengan Gangguan Muskuloskeletal Pada Perawat Di Rsu Sundari Medan. *J Kel Sehat Sejah* 2021;19.
- [6] Indika Poloriani Tunang WTUH. Gangguan Muskuloskeletal Akibat Kerja : Epidemiologi , Faktor Risiko , Gejala Work-Related Musculoskeletal Disorder : Epidemiology , Risk Factors , Clinical Symptoms , Management and Prevention n.d.
- [7] Tarwaka. *Ergonomi Industri*. 2nd ed. Surakarta: 2020.
- [8] Jesica Natalia Simanungkalit YRBS. Bahaya Ergonomi Dan Gangguan Muskuloskeletal Pada Petani Kebun Teh. *J Penelit Perawat Prof* 2020;2:48–94.
- [9] Wiwik Eko Pertiwi, Annissa, Sri Rahayu RL. Faktor-Faktor Yang Berhubungan Dengan Musculoskeletal Disorders (Msds) Pada Petani Sawah. *J Semesta Sehat* 2022;2:19–25.
- [10] Manoppo F, Malonda NSH KP. Hubungan Antara Aktivitas Fisik Dengan Keluhan Muskuloskeletal Pada Nelayan Desa Kalinaun Kecamatan Likupang Timur Kabupaten Minahasa Utara. *J Kesmas* 2017;6:1–5.
- [11] Wardani SM RB. Ketersediaan Pangan Rumah Tangga Petani Di Desa Karanganyar Jawa Tengah. *J Gizi Kerja Dan Produkt* 2022;3:31.
- [12] Kaewdok T SSTS. Agricultural Risk Factors Related Musculoskeletal Disorders among Older Farmers in Pathum Thani Province. Thailand *J Agromedicine* 2021;2:185–92.
- [13] Kemenkes RI. Laporan Nasional Riskesdas 2018. Jakarta, Indonesia: 2018.
- [14] Ismayenti L WT. Program Peregangan Di Tempat Kerja Untuk Mengurangi Keluhan Muskuloskeletal Pekerja Sektor Informal Workplace Stretching Program To Reduce Musculoskeletal Complaints Of Information Sector Workers 2022;7:94–102.
- [15] Rovendra E, Meilinda V SN. Hubungan Sikap Kerja Petani Laki-Laki Terhadap Keluhan Musculoskeletal Disorder (MSDs) 2021;6:602–9.
- [16] Syfanah H ZM. Faktor – faktor yang berhubungan dengan keluhan musculoskeletal disorders (MSDs) pada petani di Kelurahan Purwakarta, Kota Cilegon. *Period Occup Saf Heal* 2022;1:1–7.
- [17] Nurftah L, Rini WNE II. Analisi Faktor Risiko Musculoskeletal Disorder (MSDs) Pada Pekerja Petik Teh di PT X Kayu Aro. *Jambi Med J "Jurnal Kedokteran Dan Kesehatan* 2022;10:172–85.
- [18] Aprianto B, Hidayatulloh AF, Zuchri FN, Seviana I AR. Faktor Risiko Penyebab Musculoskeletal Disorders (Msds) Pada Pekerja: A Systematic Review. *J Kesehatan Tambusai* 2021;2:16–25.
- [19] Kanti LDAS MMY. Prevalensi dan Karakteristik Keluhan Muskuloskeletal Pada Petani di Desa Aan Kabupaten Klungkung Tahun 2018. 2018 n.d.;1:18–24.
- [20] Purwantini D, Mariana FN RA. Efektifitas Latihan Stretching Terhadap Penurunan Nyeri Akibat Musculoskeletal Disorder (MSDs) Di Tempat Kerja. *J Keperawatan Muhammadiyah* 2021;6:147–50.
- [21] Sari EN, Handayani L SA. Hubungan Antara Umur dan Masa Kerja dengan Keluhan Musculoskeletal Disorders ( MSDs ) pada Pekerja Laundry Correlation Between Age and Working Periods with Musculoskeletal Disorders (MSDs) in Laundry Workers. *J Kedokt Dan Kesehat* 2017;13:183–94.
- [22] Ginting T, Ginting R, Panjaitan TR MD. Pengaruh Pemberian Peregangan Terhadap Keluhan Muskuloskeletal Pada Pekerja Pabrik Keripik Rumah Adat Minang Di Desa Tadukan Raga, Deli Serdang. *J Darma Agung* 2020;28:472.
- [23] Harahap MA, Situngkir D, Irfandi A AIM. The Difference Of Musculoskeletal Disorders Before And After Workplace Stretching Exercise. *J Vocat Heal Stud* 2021;5:126–32.
- [24] Ronny Anggriawan. Pengaruh Pemberian Peregangan Otot (Stretching) Terhadap Keluhan Muskuloskeletal Dan Kejenuhan Pada Pekerja Bagian Menjahit Divisi Garment Di PT. Tyfountex Indonesia 2016;13:44–50.

- 
- [25] Agusdianti LN, Sudirman PL MIM. Edukasi Ergonomi Menurunkan Keluhan Muskuloskeletal dan Memperbaiki Konsistensi Postur Tubuh pada Mahasiswa PSPDG Universitas Udayana. *Bali Dent J* 2017;1:47–53.
- [26] Balaputra I. Hubungan Pengetahuan dan Masa Kerja dengan Gangguan Muskuloskeletal pada Perawat di Rumah Sakit. 2016 n.d.:85–91.
- [27] Ahmad N, Hidayat AJ, Sari RM, Rusliafa J, Asriati, Khairati S, et al. *Epidemiologi Dasar*. 1st ed. Malang: Future Science Publisher; 2024.
- [28] Erit Rovendra VM. Hubungan Lama Kerja Dan Beban Kerja Terhadap Keluhan Muskuloskeletal Disorder Pada Petani Padi Laki-Laki Di Kanagarian Koto Baru Kecamatan X Koto. *Urnal Hum Care* 2021;6:598–602.
- [29] Rizki P, Badri A, Oktariza RT RRS. Analisis Hubungan Usia , Masa kerja dan Pengetahuan terhadap Keluhan Musculoskeletal Disorders (MSDs) Analysis of Age , Years of Service , and Knowledge Relationship to Musculoskeletal Disorders Complaints (MSDs). *J Kesehatan* 2022;13.
- [30] Sagala SUB, Sucipta IN TI. Pemberian Kudapan (Makanan Ringan) Pada Petani Daun Bawang Prei Untuk Menurunkan Kelelahan dan Beban Kerja Saat Bekerja di Kebun. *J BETA (Biosistem Dan Tek Pertanian)* 2021;10:147.
- [31] Mendonça CR, Noll M, Castro MCR SE. Effects Of Nutritional Interventions In The Control Of Musculoskeletal Pain: An Integrative Review. *Nutrients*. 2020;12:1–17.