Indonesian Journal of Medicine (2025), 10(02): 125-132
Masters Program in Public Health, Universitas Sebelas Maret

Research
Open Access

Preventing Occupational Musculoskeletal Disorders: Effect of Stretching Exercise in Reducing Pain Among Factory Workers

Faizah Nurul Fitri[1)], Dea Linia Romadhoni[1)], Alinda Nur Ramadhani[1)], Cahyo Setiawan[1)]

[1)]Study Program of Department of Physiotherapy, Universitas 'Aisyiyah Surakarta, Indonesia

Received: July 05, 2024; Accepted: January 09, 2025; Available online: April 10, 2025

ABSTRACT

Background: Musculoskeletal disorders (MSDs), often caused by prolonged static and repetitive sitting, can lead to pain and discomfort. Regular stretching every two hours may help alleviate this pain. This study aimed to evaluate the effectiveness of performing stretching exercises every two hours in reducing pain associated with the risk of MSDs.
Subjects and Method: A quasi experimental study was carried out at Berdijaya Factory, Surakarta, Central Java, Indonesia. A total of 40 factory workers with MSDs complaint was recruited using a purposive sampling. The dependent variable was pain. The independent variable was stretching exercise every 2 hours per day for 2 weeks. Pain was measured using numeric rating scales (NRS). The data were tested before and after intervention using paired t test.
Results: After two weeks of intervention, mean of pain score (Mean= 3.88; SD= 1.25) was lower than before (Mean= 5.08; SD= 1.09), with (p = 0.025).
Conclusion: Stretching exercises performed every 2 hours per day for 2 weeks can reduce musculoskeletal pain among factory workers.

Keywords: Musculoskeletal disorders, stretching exercise, pain, workers

Correspondence:
Dea Linia Romadhoni. Study Program in Physiotherapy, Universitas 'Aisyiyah. Jl. Ki hajar Dewantara No. 10, Surakarta, Central Java, Indonesia. Email: dealin08@aiska-university.ac.id. Mobile: +628155147705.

Cite this as:
Fitri FN, Romadhoni DL, Ramadhani AN, Setiawan C (2025). Preventing Occupational Musculoskeletal Disorders: Effect of Stretching Exercise in Reducing Pain Among Factory Workers. Indones J Med. 10(02): 125-132. https://doi.org/10.26911/theijmed.2025.10.02.04.

BACKGROUND

Human beings play an important role in industries where sources of labor are used manually. When performing these tasks, ergonomic issues may arise that are frequently overlooked and MSDs continue to occur due to ergonomic problems that are often ignored (Riska *et al.*, 2022). MSDs are often found in workers who spend a lot of time sitting or standing, such as factory workers. If it's prolonged, it can lead to reduced function, restricted movement, and increased neck, shoulder, and lower back pain (Weyh *et al.*, 2020). Most participants experienced pain or discomfort after work in the shoulder (21.8%), lower back (18.7%), upper back (14%), and neck (13.6%) (Qi dan Ramalingam, 2019). These MSDs can result in a loss of productivity for workers and can add to the financial

burden of the company having to pay compensation for the workers' health problems (Romadhoni and Ramadhani, 2021).

According to the latest analysis, around 1.71 billion people worldwide suffer from musculoskeletal disorders (MSDs), which include back pain, neck pain, fractures, and more. People of all ages around the world are affected, although the prevalence of MSDs varies by age and diagnosis. MSDs also account for the highest number of years lived with disability (YLDs) in the world, with around 149 million, or 17 percent of the global total (WHO, 2022).

Worldwide, one worker dies every 15 seconds from work accidents and 160 workers suffer from occupational diseases, along the death rate from accidents and occupational diseases is 2 million per year. Indonesia's health problems show that 40.5% of workers' illnesses are work-related, including 16% MSDs (Shobur *et al*, 2019). MSDs are the most common complaint in industrialized countries, as work-related health disorders are the most common cause of disability among workers; in the 27 EU Member States, MSDs account for 59% of all recognized diseases, and the prevalence in Indonesia is 4.6% of industrial workers aged 25-44 who have experienced a work-related injury (Puspitasari dan Arifin, 2020).

Based on research carried out by Prahastuti *et al.* (2021) of the 150 workers surveyed, 74.7% had an MSD and 25.3% had no MSD. The distribution of respondents showed that 51.3% of workers were at high risk from ergonomic factors, and the majority of respondents were workers ≥38 years old (54.7%), ≥high school education (74.7%), 51.3% were of normal weight, 59.3% had good physical activity habits and 76.7% were smokers.

Researchers conducted preliminary studies in several factories, and NBM screening was conducted at UD Berdijaya Palur factory, where 150 workers are at risk of MSDs. In particular, the researchers were interested in following the development of physical therapy, in the form of stretching exercises every 2 hours, as a means of reducing the risk of musculoskeletal disorders (MSD).

SUBJECTS METHOD

1. Study Design

This was a quasi-experimental study conducted at the Berdijaya factory, Surakarta, Central Java, Indonesia, from February 2023 to March 2023

2. Population and Subjects

The study population was factory workers. A total of 40 factory workers with MSDs complaints was selected using purposive sampling.

3. Study Variables

The dependent variable was pain. The independent variable was stretching exercise.

4. Operational Definition of Variables

Stretching Exercise Every 2 Hours is a type of muscle contraction exercise where each movement is held for 10-15 seconds with 3x repetitions, performed once in 2 weeks for 2 hours, to reduce muscle tension during work.

MSDs screening is a screening method used to identify symptoms in parts of the skeletal muscles experienced by factory workers, ranging from very mild to very painful, when the muscles are subjected to prolonged, repetitive, static loading, causing symptoms in the form of damage or injury to the joints, ligaments, and tendons in the back, shoulders, hands, and neck.

Pain relief is a reduction in unpleasant sensations in the body in connection with tissue damage in the body.

5. Study Instruments

Pain was measured using the numerical rating scale (NRS).

6. Data Analysis

The test of significance to be used is the Wilcoxon signed rank test, because the data to be used are ordinal, both normally distributed and un-normally distributed. If the significance of $p<0.05$ indicates an effect before and after treatment, and $p>0.05$ indicates no effect.

7. Research Ethics

Ethical clearance was obtained from the Health Research Ethics Committee (KEPK) of Universitas 'Aisyiyah Surakarta, with number of letter: 041/IV/AUEC/2023.

RESULTS

1. Sample Characteristics

A total of 40 respondents participated in the two-week study. The majority were aged 30–40 years, comprising 35 individuals (87.5%), while the remaining 5 respondents (12.5%) were aged 41–50 years. This age distribution reflects the predominant age group among the workers. In terms of gender, 17 respondents (42.5%) were male and 23 (57.5%) were female.

Table 1. Sample Characteristics of Factory Workers at UD Berdijaya Palur

Characteristic	Category	Frequency (n)	Present (%)
Age	30-40 years	35	87.5
	41-50 years	5	12.5
Gender	Man	17	42.5
	Woman	23	57.5
IPAQ	Light activity	4	10.0
	Moderate activity	36	90.0
NBM	Low scale	13	32.5
	Moderate scale	27	67.5
NRS	Mild pain	13	32.5
	Moderate pain	27	67.5

2. Bivariate Analysis

From Table 2, it can be concluded that there is an effect on the NRS value before and after stretching every 2 hours. The mean NRS score before the intervention was 5.08 (SD= 1.09), indicating moderate pain. After two weeks of stretching every 2 hours, the mean NRS score decreased to 3.88 (SD= 1.25), indicating a reduction in pain. The Wilcoxon signed-rank test showed a significant difference between the pre- and post-intervention pain scores ($p = 0.025$).

Changes in pain experienced by respondents in this study were 1 respondent from moderate pain to mild pain, 2 respondents with moderate pain decreased to no pain and there were 20 respondents with moderate pain who experienced pain changes still in the moderate pain range, and 4 respondents still in moderate pain, then 2 respondents from mild pain to no pain, 7 respondents with mild pain experienced changes still in the mild pain range and 4 respondents with mild pain were still in mild pain.

Table 2. Wilcoxon Test Effects of Stretching Exercise Every 2 Hours on MSDs Pain

Group	Mean (NRS)	SD	p
Pre-strestching	5.08	1.09	0.025
Post-Stretching	3.88	1.25	

DISCUSSION

Musculoskeletal disorders (MSDs) are a group of symptoms or disorders that affect muscle, tendon, ligament, cartilage, nerve, bone, and vascular structures. MSD symptoms occur in the skeletal musculature and can be caused by heavy and repetitive static loading over time, and the symptoms of MSDs range from mild to very painful (Marcilin dan Situngkir, 2020).

MSDs result from occupational illnesses caused by a mismatch between the demands of the job and the ability to perform it (Aprianto *et al*., 2021). MSDs are often caused by prolonged standing or sitting in the work environment, affecting the upper and lower extremities, neck, and lower back. They can also be caused by exposure to physical factors such as repetitive movements, poor posture, and the lifting of heavy weights during the workday (Qi and Ramalingam, 2019).

The pain of an MSDs can range from mild to severe and can be felt anywhere in the body, with muscle tension, tightness, twitchiness, or tingling, depending on where the pain occurs (Chambers, 2022). MSDs are conditions in which people experience pain, discomfort, and/or disability in their musculoskeletal system, usually due to cumulative damage to one or more components of the system, including musculature, tendon, ligament, nerve, cartilage, tendon, bone, and/or fascia. MSDs also result from repetitive strain injuries from work, sports, and other physical activities (Gallagher and Barbe, 2022).

MSDs are usually caused by long periods of hard work that result in excessive muscle contraction, and the amount of energy that can be exerted will influence the increase in muscle contraction. The maximum level of muscle soreness is 15-20%, so when muscles are contracted above 20%, there is reduced blood flow to the muscles (Susanti dan Septi, 2021). Oxygen levels in the body decrease due to reduced blood circulation. Reduced oxygen levels in the body can cause anaerobic metabolism in the body, resulting in lactic acid build-up in the muscles which can cause MSD pain (Yosineba et al., 2020).

MSDs are one of the leading causes of lost productivity, lost time, health care costs, and poor quality of work, and may be caused by the frequency or duration of muscle effort to achieve continuous static loading, resulting in sudden injuries, or by heavy or unpredictable activity leading to muscle fatigue (Izzah, 2021). What's more, MSD complaints can be caused by injuries suffered by workers and by factors in the working environment, which can increase the risk of MSDs by a factor of 20, because an unsupportive or unergonomic working environment can lead to working postures that are not ergonomic, often triggering the onset of MSD pain, particularly in the upper and lower extremities (Romadhoni *et al*., 2021).

MSDs can be reduced if workers perform stretching exercises that help to lengthen shortened muscle structures. Stretching can facilitate blood flow, allowing muscles to relax and facilitating the vasodilatation process. Stretching also helps to reduce muscle spasms, which cause pain, because once the muscles have started to feel tired and spasm, stretching can speed up recovery from the spasm and the build-up of metabolic waste products (Candrawati, 2020). Stretching exercises that can be performed on the neck, the upper and lower extremities, and the back (Shariat et al., 2018).

If you are working in a static and repetitive position, you may develop muscular tension, which is why you need to stretch your muscles every two hours. This increases the blood flow to the muscular

system, which in turn increases the nutrient and oxygen supply to the muscular system (Nooryana et al., 2020). In addition to reducing spasms by increasing blood flow, stretching can also trigger the activation of muscle proprioceptors or muscle spindles to regulate signals to the brain about changes in muscle length and muscle tone. This can lead to increased muscle flexibility because it can increase the resting time in the muscles so that muscle flexibility reduces muscle spasms, increases joint mobility and joint range of motion, so that increased mobility and range of motion of joints that cause injury or accidents at work can be reduced, and complaints of MSDs can be reduced (Oktaviani et al., 2022).

According to the recommendations of Kemenkes RI (2017) on the occasion of the 13th Meeting of ASEAN Health Ministers, the Indonesian Minister of Health called for stretching to be used to build a culture of healthy living throughout the ASEAN region. Simple stretches that are easy to remember can be part of a healthy lifestyle and can be done 3 times a day. Stretching itself may trigger the occurrence of vasodilatation of the blood vessels in the musculature, increasing the oxygen in the musculature and causing the blood circulation in the musculature to improve, thus reducing muscular tension (Saphira, 2022).

Regular stretches improve functional movement and mobility in daily life, improve body flexibility, enhance maximum performance, and help sore muscles to heal by reducing muscle tension (Kerroum dan Zerf, 2020). Even for workers who do static work for long periods, stretching is beneficial in reducing pain levels. And almost 90% of those surveyed who stretched for a period set by researchers experienced a reduction in pain from MSD complaints (Widyaningsih et al., 2021).

The study is consistent with Purwantini et al. (2021) 30 participants at PT Naka Tujuh Gemilang reported a decrease in VDS scores after stretching. According to Priyoto (2019), stretching exercise carried out 2 times a day at work can improve the circulation of blood can help to relax muscles that are stressed or tense as a result of sitting in a static position for a long time. Contrary to the research conducted by Prima *et al.*, (2022) showing that the variable of providing an anti-fatigue mat with stretch has a significant effect on reducing pain in MSD complaints, while the variables of providing an anti-fatigue mat and stretch each have no significant effect on reducing pain in MSD complaints.

This study has limitations in the data collection process, namely the amount of work of the respondents can affect the concentration of the respondents during the interview process, so this study has limitations in the data collection process, namely the amount of workload of interviewees may affect the concentration of the interviewees to answer the questions asked by the researcher during the interviewing process, so the researcher conducts the interviewing during the breaks to minimize the limitations of the research. The researcher cannot control the workload of the respondent, which may be more or less than every two hours, and the researcher cannot control the respondent's daily activities, which may affect the expected findings, because the activities performed differ. This study concludes that performing stretching exercises every two hours throughout the day can effectively reduce pain associated with the risk of musculoskeletal disorders (MSDs).

AUTHOR CONTRIBUTION

Faizah Nurul Fitri as the principal investigator selected the topics, collected the data,

analyzed the data, and prepared the manuscripts for publication. Dea Linia Romadhoni, Alinda Nur Ramadhani, and Cahyo Setiawan as research associates, assisting in the drafting of publications.

ACKNOWLEDGMENTS

The researcher would like to thank the Berdijaya factory, Palur, Surakarta, Central Java, Indonesia for hosting our research site.

FINANCE AND SPONSORSHIP

None.

CONFLICT OF INTEREST

The authors claim to have carried out the study without any commercial or financial relationship which might constitute a potential conflict of interest.

REFERENCE

Aprianto B, Hidayatulloh A F, Zuchri F N, Seviana I, Amalia R (2021). Faktor risiko penyebab musculoskeletal disorders (MSDs) pada pekerja: A systematic review. Jurnal Kesehatan Tambusai, 2(2)16-25. https://doi.org/10.-31004/jkt.v2i2.1767.

Chambers J (2022). Musculoskeletal disorders sourcebook, in Hayes K (ed.). Health Reference Series. First Edition. Britania Raya: Infobase Publishing. 44–46. https://www.google.co.id/-books/edition/Musculoskeletal_Disorders_Sourcebook_Fir/DP2nEAAAQBAJ?hl=id&gbpv=1.

Gallagher S, Barbe M F (2022). Musculoskeletal disorders: The Fatigue Failure Mechanism, in Wiley J and Sons (eds.). USA: Wiley. https://doi.org/10-.1002/9781119640172.

Izzah N (2021). Hubungan faktor risiko dengan kejadian musculoskeletal disorders (MSDs) pada supir penumpang Trans Tolitoli-Palu. Doctoral dissertation. Universitas Hasanuddin. https:-//repository.unhas.ac.id/id/eprint/-17836/.

Kemenkes RI (2017). Senam peregangan Indonesia bakal jadi gaya hidup sehat ASEAN. Kementerian Kesehatan Republik Indonesia. https://kemkes.-go.id/id/%20senam-peregangan-indonesia-bakal-jadi-gaya-hidup-sehat-asean.

Kerroum MA, Zerf M (2020). Types of classroom chair stretch exercises and their feasibility and potential to structure the recommend classroom-based physical activity break primary programs. Acta Facultatis Educationis Physicae Universitatis Comenianae. 60(2): 229–240. https://doi.org/10.2478/-afepuc-2020-0019.

Marcilin M, Situngkir D (2020). Faktor-faktor yang berhubungan dengan keluhan musculoskeletal disorders pada unit sortir di PT. Indah Kiat Pulp and Paper Tangerang TBK tahun 2018. Journal of Industrial Hygiene and Occupational Health. 4(2). https://-doi.org/10.21111/jihoh.v4i2.3482.

Nooryana S, Adiatmika IPG, Purnawati S (2020). Latihan peregangan dinamis dan istirahat aktif menurunkan keluhan muskuloskeletal pada pekerja di industri garmen. Jurnal Ergonomi Indonesia. 6(1): 61. https://doi.org/10-.24843/JEI.2020.v06.i01.p08.

Oktaviani D, Ismayenti L, Nugroho D (2022). Pengaruh gerakan peregangan pada penjahit garmen terhadap penurunan keluhan musculoskeletal disorders (MSDs). J Ergon dan K3. 7(1): 19–24. https://doi.org/10.34012/bkk-p.v4i1.6547.

Prahastuti BS, Djaali NA, Usman S (2021). Faktor risiko gejala muskuloskeletal disorder (MSDs) pada pekerja buruh pasar. Jurnal Ilmiah Kesehatan. 13(1) :

47–54. https://doi.org/10.37012/jik.-v13i1.516.

Prima DW, Setyaningsih Y, Lestantyo D (2022). The effect of anti-fatigue mat and stretching on musculoskeletal disorders (MSDs) complaints of sewing operator PT. X. Jurnal Aisyah : Jurnal Ilmu Kesehatan. 7(S1). https://doi.-org/10.30604/jika.v7is1.1094.

Priyoto WBW (2019). Pengaruh pemberian intervensi senam peregangan di tempat kerja terhadap penurunan gangguan MSDs dan kadar asam urat darah. Jurnal Keperawatan. 12(1) : 53–68. https://e-journal.lppmdianhusa-da.ac.id/index.php/jk/article/view/9/6.

Purwantini D, Mariana FN, Ruslani APK (2021). Efektivitas latihan stretching terhadap penurunan nyeri akibat musculoskeletal disorder (MSDs) di tempat kerja. Jurnal Keperawatan Muhammadiyah. 6(2). https://doi.org-/10.30651/jkm.v6i2.7854.

Puspitasari N, Arifin AN (2020). Edukasi kesehatan kerja: Upaya promotif dan preventif musculoskeletal disorder (MSDs) pada pekerja batik tulis di kelompok batik suka maju. Jurnal Pengabdian Masyarakat Al-Irsyad. 2(2). https://doi.org/10.36760/jpma.-v2i2.141.

Qi LM, Ramalingam V (2019). Prevalence of musculoskeletal disorders and associated risk factors among selected factory workers in Penang. Malaysia. Inti Journal. https://iuojs.intimal.edu.my-/index.php/intijournal/article/view/350/346.

Riska, Asikin M, Zarkasyi RR (2022). Gambaran gangguan musculoskeletal disorders (MSDs) pada pekerja mobile dan permanent penggiling padi di Kecamatan Tiroang, Kabupaten Pinrang. Media Komunikasi Sivitas Akademika dan Masyarakat. 22: 369–378. https://doi.org/10.32382/sulolipu.v22i2.2932.

Romadhoni DL, Ramadhani AN (2021). Association between psychosocial factor and risk of musculosceletal disorders in productive age patient at RSUD Dr. Moewardi Surakarta. Gaster. 19(1): 10–19. https://doi.org/-10.30787/gaster.v19i1.661.

Romadhoni DL, Ramadhani AN, Lidiana EH (2021). Relationship of work in pandemic era with increased risk of musculosceletal disorders that lead to change in cervical posture. J Epidemiol Public Health. 06(03): 347–354. https://doi.-org/10.26911/jepublichealth.2021.06-.03.08.

Saphira A Z T (2022). Pengaruh workplace stretching exercise terhadap keluhan musculoskeletal disorders pada tenaga kerja bongkar muat di Pelabuhan Kota Makassar. Doctoral dissertation. Universitas Hasanuddin. https://repository.unhas.ac.id/id/eprint/18127/.

Shariat A, Cleland JA, Danaee M, Kargarfard M, Sangelaji B, Tamrin SBM (2018). Effects of stretching exercise training and ergonomic modifications on musculoskeletal discomforts of office workers: A randomized controlled trial. Brazilian Journal of Physical Therapy. 22(2): 144–153. https://doi.org/10.10-16/j.bjpt.2017.09.003.

Shobur S, Maksuk, Sari F I (2019). Faktor risiko musculoskeletal disorders (MSDs) pada pekerja tenun ikat di Kelurahan Tuan Kentang Kota Palembang. Jurnal Medikes: Media Informasi Kesehatan. 6(2). https://doi.org-/10.36743/medikes.v6i2.188.

Susanti N, Septi A N (2021). Penyuluhan fisioterapi pada sikap ergonomis untuk mengurangi terjadinya gangguan musculoskeletal disorders (MSDs) di

komunitas keluarga Desa Kebojongan Kec. Comal Kab. Pemalang. Pena Abdimas: Jurnal Pengabdian Masyarakat. 2(1). https://doi.org/10.31941/abdms.v2i1.1290.

Weyh C, Pilat C, Krüger K (2020). Musculoskeletal disorders and level of physical activity in welders. Occupational Medicine. 70(8): 586–592. https://doi.org/10.1093/occmed/kqaa169

WHO (2022). Musculoskeletal health. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions.

Widyaningsih F, Parinduri A I, Irmayani, Simarmata H, Jeni S (2021). Pengaruh pemberian gerakan relaksasi terhadap penurunan keluhan nyeri punggung bawah pada pekerja penenun ulos di Galery Ulos Sianipar Medan. Jurnal Kesmas Dan Gizi. 3(2): 226–230. https://doi.org/10.35451/jkg.v3i2.650.

Yosineba TP, Bahar E, Adnindya MR (2020). Risiko ergonomi dan keluhan musculoskeletal disorders (MSDs) pada pengrajin tenun di Palembang. Jurnal Kedokteran dan Kesehatan : Publikasi Ilmiah Fakultas Kedokteran Universitas Sriwijaya. 7(1): 60–66. https://doi.org/10.32539/JKK.V7I1.10699.