

Review**Ergonomic working position in preventing musculoskeletal disorders among farmers**

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Abstract:

Musculoskeletal problems are common occupational health disorders, especially in groups of farmers with heavy physical activity and non-ergonomic working positions. Unfortunately, farmers' awareness and knowledge of risk factors and prevention are still very low, so complaints tend to be ignored, reducing productivity and quality of life. This study aims to determine the complaints felt by farmers and how ergonomic positions affect farmers' musculoskeletal systems. This study uses a literature review method using secondary data from several trusted sources, such as PubMed, Science Direct, and Proquest. The sources of articles used are from publications from 2020 to 2025. The number of complaints in certain body parts indicates a less ergonomic work pattern. Activities such as bending for a long time and lifting heavy loads without proper technique worsen the condition of muscles and joints. The majority of farmers were found to complain of pain in the lower back, shoulders, and neck. Poor posture and lack of education are the dominant causes of musculoskeletal disorders. Education on ergonomic positions and stretching exercises has improved farmers' understanding and awareness of the importance of maintaining proper working posture and stretching regularly. Simple interventions based on education and physical exercise can be effective preventive measures in reducing the risk of musculoskeletal disorders in farmers.

Keywords:

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**INTRODUCTION**

The agricultural sector plays a critical role in global food security and is a significant source of employment, particularly in developing countries (Wudil et al., 2022). Despite a general decline in its relative contribution to national economies with increasing industrialization, agriculture remains a cornerstone of rural livelihoods and economic development (Emezirinwune et al., 2024). According to global estimates from 2020, approximately 847 million individuals were engaged in agricultural

labor, including forestry and fishing, representing a 17% decrease compared to previous years. This downward trend can be attributed to technological advancements, urban migration, and broader economic transitions. Nevertheless, agriculture remains the second-largest employer globally after the services sector (Vitale et al., 2024).

Agricultural work is inherently physically demanding, often involving long working hours, repetitive tasks, and exposure to environmental stressors (Benos et al., 2020). These conditions contribute to a high prevalence of occupational health issues, particularly musculoskeletal disorders (MSDs). Work-related musculoskeletal disorders (WMSDs) are among the most common causes of disability and reduced productivity in the agricultural workforce (Momeni et al., 2020). A range of individual and occupational risk factors contributes to the onset and progression of these disorders, necessitating a comprehensive understanding of their etiology and prevention strategies.

Individual risk factors associated with WMSDs include age, gender, body mass index (BMI), pre-existing medical conditions such as diabetes or rheumatoid arthritis, and lifestyle behaviors such as tobacco and alcohol consumption (Boriboonsuksri et al., 2022). Additionally, a history of prior musculoskeletal injuries increases susceptibility to chronic conditions. These personal attributes interact with physical job demands, amplifying the likelihood of developing MSDs over time. Understanding these factors is essential for identifying vulnerable populations and tailoring preventive interventions accordingly (Madeleine et al., 2024).

Physical and ergonomic risk factors within the agricultural workplace further exacerbate the prevalence of musculoskeletal disorders. Common hazards include awkward postures, repetitive movements, mechanical compression, exposure to whole-body or hand-arm vibrations, and cold environments (Odebiyi & Okafor, 2023). These elements significantly strain the musculoskeletal system, particularly the spine, shoulders, and lower extremities. Without appropriate mitigation strategies, such exposures may lead to chronic pain, reduced functional capacity, and diminished quality of life among agricultural workers.

In Indonesia, agriculture is recognized as a high-risk occupation due to its harsh working conditions and reliance on traditional farming methods, which often involve manual labor. Many farmers continue to use outdated tools and techniques, with limited access to mechanized equipment that could reduce physical burden (Joshi et al., 2024). Planting, weeding, harvesting, and threshing frequently involve prolonged bending, lifting, and static postures. These actions impose substantial compressive forces on the lumbar spine and other musculoskeletal structures, increasing the risk of acute injury and chronic musculoskeletal conditions (Das, 2023).

To address these challenges, integrating ergonomic principles into agricultural practices is essential. Ergonomics focuses on adapting work tasks and environments to match the physiological capabilities of the worker, thereby minimizing biomechanical stress and preventing injury (Zhang, Li, & Tian, 2023). Practical ergonomic interventions such as using adjustable tools, improved posture techniques, and mechanized support systems can significantly reduce the incidence of musculoskeletal disorders (Hilmi et al., 2024). Moreover, ergonomic improvements have been shown to enhance work efficiency, comfort, and overall productivity among farm workers.

Given the importance of agriculture to Indonesia's economy and rural livelihoods, prioritizing ergonomic considerations in farming activities is crucial for promoting occupational health and safety. Identifying high-risk tasks and implementing targeted ergonomic solutions can help create safer,

more sustainable working environments. This paper aims to examine the impact of ergonomic positioning on musculoskeletal health in agricultural settings and explore potential strategies to mitigate risks, particularly within Indonesian farming communities. Through education, policy reform, and technological advancements, it is possible to improve the health outcomes and working conditions of agricultural workers.

METHOD

This study employs a literature review method, which involves research that is based on existing studies rather than direct observation. In this study, researchers require secondary data, collected through a literature review research design, from several trusted sources. PubMed, ScienceDirect, and Proquest are the database sources used by researchers to find the articles needed in this study. The sources of articles used come from publications from 2020 to 2025. Research articles were identified using the search keywords "Ergonomic Positioning," "Farmers," and "Musculoskeletal System." The method used in analyzing the screening of this article is the PRISMA method. The concept of this method begins with the articles that have been identified, which will be selected and then summarized in a table that includes the article's number, the author's name, and details such as the article's identity, population, sample, method, and summary of the results obtained.

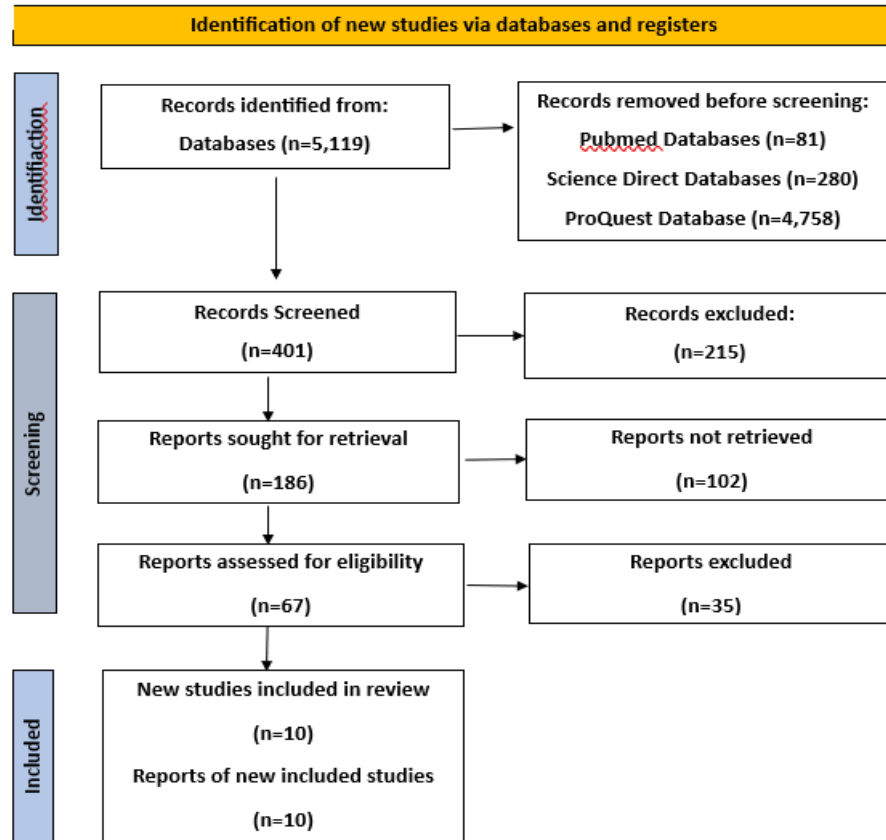


Figure 1. PRISMA Flow Diagram

The article search process begins by identifying the predetermined keywords. At the identification stage, 5,119 articles were identified, comprising PubMed Databases (n=81), ScienceDirect databases (n=280), and ProQuest Databases (n=4,758) that matched the keywords. The next step was to re-filter by determining the year of publication within the last five years (2020-2025), with full and unrestricted access. At the filtering stage, 401 were found to meet the search criteria. The next step was to filter with exclusion and inclusion criteria, including abstract suitability, keyword suitability, and result suitability. From this filtering, 35 articles remained that met the criteria. Finally, from several filtering steps, 10 articles were selected that met the search criteria and could be continued to the article analysis stage.

RESULT

Agriculture is a significant problem, with most farmers reporting high complaints related to musculoskeletal problems. This study indicated that work posture ($p = 0.001$) and work duration ($p = 0.001$) were the two factors that had a significant association with such complaints. However, there was no significant association between increased workload ($p = 0.315$) and body mass index (BMI) (Yenni et al., 2022). The study found 23.7% of farmers in Jeju suffered from low back pain (LBP), which was more common among older adults, women, and individuals with low stress, high-intensity sleep, or emotional stress levels. Some of the principal risk factors identified include age, gender, smoking habits, mental health conditions, and stress levels. Typical agricultural conditions in Jeju, characterized by a subtropical climate, volcanic soil, and a focus on citrus and winter vegetables, necessitate prolonged physical labor, which contributes to an increased risk of LBP (Lee et al., 2021). The prevalence of musculoskeletal disorders (MSDs) was recorded at 74.74%, with the majority of annual crop farmers (95.3%) reporting experiencing such problems. Activities performed by female farmers are often characterized by repetitive and restrictive postures, which can cause impacts on specific body parts, such as the lower back (68.78%), neck/shoulder (62.94%), and elbow/hand (13.54%). Other risk factors included age and marital status, which significantly impacted the lower back, neck/shoulder, and elbow (Dev et al., 2025).

In this study, all mango farmers reported experiencing musculoskeletal disorders, with complaints primarily affecting the waist, shoulders, and knees. The activity of lifting and carrying baskets is considered the highest source of risk, so ergonomic interventions are needed to prevent injuries (Boriboonsuksri et al., 2022). Shoulder disorders are the most common musculoskeletal condition, affecting 63.7% of shoulders, 63% of low backs, and 52% of wrists/hands. Five tasks have been identified as high-risk. Although implementing participatory ergonomics (PE) successfully reduced ergonomic risks, no significant difference was found in the prevalence of MSDs among the studied groups. However, 73% of participants expressed satisfaction with the intervention (Hasheminejad et al., 2021). In-vehicle screenings have detrimental effects on posture, which can result in an increased risk of fatigue and discomfort for workers. This can contribute to the development of musculoskeletal disorders (MSDs). The combined use of sEMG and IRT provides an efficient, non-invasive, and repeatable approach for analyzing relevant mechanical and functional aspects (Vitale et al., 2024). Chokprasit et al. (2023) stated that rubber farmers often experience problems in the lower back, shoulders, legs, and neck. A program, specifically designed for this

purpose, namely PSCP, can reduce musculoskeletal pain, resulting in a two-degree decrease in pain after 28 days. Meanwhile, according to Amarin research (2022), musculoskeletal health problems in tobacco farmers, namely when working hours are reduced during the planting season, can increase the risk of MSD. Not only that, but machine assistance can also reduce the risk of MSD, and group work is more effective than working individually.

Table 1. Literature Identification and Review

ID	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
1	Author: Lee, et al Journal Identity: Safety and Health at Work, Vol. 12, Issue 4, (2021), 432-438.	Prevalence of Low Back Pain and Associated Risk Factors among Farmers in Jeju	Investigated the prevalence of low back pain (LBP) and related factors among farmers in Jeju, whose demographics and environment differ from those of other areas.	1209 farmers participants.	Cohort study with Safety for Agricultural Injury of Farmers (SAIF) data, Student's t-test, Wilcoxon's rank-sum test, chi-square test, and Fisher's exact test as appropriate.	The results stated that low back pain (LBP) affected 23.7% of farmers' performance in Jeju, mainly those who lacked high stress, sleep deprivation, or emotional distress. The main risks were gender, age, smoking, and mental health. Jeju agriculture is unique in its subtropical climate, volcanic rock used for growing medium, a focus on winter vegetables and citrus farming, and physically strenuous work, contributing to the risk of LBP.
2	Author: Dev, et al. Journal Identity: Clinical Epidemiology and Global Health (2025)	Risk of Musculoskeletal Disorders in Female Farmers and Its Socioeconomic Determinants in Kashmir Valley	Investigated the prevalence of musculoskeletal disorders (MSDs) among female farmers in the Kashmir Valley and identified the occupational risk factors and socioeconomic determinants	293 respondents with 194 perennial cultivators and 99 non-perennial cultivators	Utilizing a cross-sectional design, data were collected through a questionnaire comprising two parts: the Nordic Musculoskeletal Questionnaire (NMQ) for self-reporting MSDs, and the second part dealing with socioeconomic parameters	The prevalence of MSDs was 74.74% with most of the perennial cultivators (95.3%) reporting MSDs. Female farmers had frequent work and repetitive postures, with affected locations being the lower back (68.78%), neck/shoulder (62.94%), and elbow/hand (13.54%). Age and marital status were analyzed as significant risk factors for low back, neck/shoulder, and elbow/hand disorders ($p < 0.05$), with workplace environment emerging as an additional risk factor for elbow/hand.
3	Author: Vitale, et al Journal Identity: Appl.Sci/2024/Vol.14(9):3738	Precision Agriculture: Assessment of Ergonomic Risks of Assisted Driving System	This study explores the impact of display positioning in a semi-automatic tractor system on operator comfort and muscle	The study includes 10 healthy workers with at least 5 years of experience in their	Diagnostic Test Accuracy Studies. The evaluation of muscular strain was carried out using surface electromyographic devices. At the same time, posture was	The result was that the screen placement in the vehicle adversely affected posture. There is a risk of fatigue and discomfort to the worker, which may lead to musculoskeletal disorders (MSDs). The combined use of sEMG

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			activation during harrowing tasks.	respective fields.	assessed by analyzing the pressure distribution the operator's body applied on the seat, observed with two barometric pads placed on the backrest and the seat base.	and IRT provides a cost-effective, non-invasive, and repeatable method to analyze mechanical and functional aspects.
4	Author: Kongtawelert, et al. Journal Identity: Int. J. Environ Res. Public Health/2022/Vol. 19: 6779	Prevalence and Factors Associated with Musculoskeletal Disorders among Thai Burley Tobacco Farmers	This research aimed to investigate the occurrence of musculoskeletal disorders (MSDs) and analyze the contributing factors among Thai tobacco farmers throughout the planting and harvesting phases.	603 tobacco farmers from Sukhothai province	The cross-sectional study adhered to the principles outlined in the Declaration of Helsinki. It was approved by the Ethics Committee at the Faculty of Public Health, Mahidol University (Protocol No. 173/2559).	The result is that the prevalence of MSDs in tobacco farming also occurs in other agricultural sectors. Shorter working hours during the growing season reduce the risk of MSDs. Tool work is less risky than manual work. Group work is better at reducing the prevalence of MSDs than individual work.
5	Author: Yenni, et al Journal Identity: Riset Informasi Kesehatan/ 2022/Vol.11(2):187-196	Factors related to Musculoskeletal System Complaints in Horticulture Farmers Spraying Pesticide in Sako Duo Kerinci Village	To investigate the correlation between work posture, workload, work duration, and body proportion with skeletal muscle problems faced by horticulturists during pesticide application in Sako Dua village, Kerinci.	191 horticultural farmers and 51 pesticide spraying farmers.	A cross-sectional approach was used in this quantitative study. Questionnaire sheets were mainly used as a measurement tool. Variables regarding complaints and tenure were collected through direct interviews using the Nordic Body Map questionnaire. The REBA method was used to measure work posture, which involved taking pictures (photos) of workers while spraying pesticides. Nutritional status was measured by calculating the Body Mass Index (BMI), which includes measuring height using a Stature Meter and weight using an Electronic Body Scale. In addition, the workload was measured using the Nhon Hoa Sitting Scale.	High musculoskeletal complaints were mainly reported by farmers, reaching 60.8%. Two factors were associated with these complaints: work posture ($p = 0.001$) and work duration ($p = 0.001$). Meanwhile, additional workload ($p = 0.315$) and Body Mass Index (BMI) ($p = 0.398$) did not show a significant difference.

ID	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
6	Author: Chokprasit, P et al Journal Identity: Heliyon (2023) 9(10)	Development and efficacy evaluation of a personalised self-care programme for reducing work-related musculoskeletal disorders among rubber farmers in Thailand	This study aimed to develop and evaluate the effectiveness of a personalized self-care program (PSCP) in relieving pain caused by WMSDs in a rubber farming environment.	Individual rubber farmers in the study totaled 50 participants, 25 female and 25 males.	Data were collected with a questionnaire adapted from the Nordic Musculoskeletal Questionnaire (IOC 1.00). Three experts verified evidence obtained from specialized tests to develop the PSCP.	The study shows that the neck, shoulders, lower back, and legs are areas of discomfort felt by rubber farmers. The musculoskeletal pain experienced by rubber farmers was treated with PSCP. There was a two-degree decrease in pain after 28 days of PSCP (F5.26, SD 1.96, Xe 2.40, 5D 1.64, p<0.001). Special tests confirmed that the number of painful areas also decreased (0.089, SD 0.067, after 0.016, SD 0.030, p<0.001). In addition, IL-10 levels increased (p<0.001) after PSCP, while IL-6 levels remained unchanged.
7	Author: Arachchige, S. D, et al Journal Identity: Sensors 2024, 24, 7026.	A Review of Potential Exoskeletons for the Prevention of Work-Related Musculoskeletal Disorders in Agriculture.	The review further highlights and deliberates on exoskeletons that could be applicable in an agricultural context. This comprehensive examination serves as a foundational step towards the conceptualization and development of exoskeleton-based approaches tailored explicitly for agricultural tasks.	This study utilized some literature related to work-related musculoskeletal disorders, and 22 papers were selected for citation, as illustrated in the Figure, and 48 papers related to exoskeletons were selected for citation in this review.	Literature searches were carried out in two categories. Initially, a search was performed to find literature on work-related musculoskeletal disorders in various recognized databases, including DOAJ, Gale Academic, IEEE Xplore, JSTOR, ProQuest, PubMed, SpringerLink, Science Direct, Wiley, and Taylor & Francis. The keywords for this search were "WMSD" and "Agriculture". This search criteria included the language (English), peer-reviewed status, publication years (2000-2023), and online availability.	Farmers are at a very high risk of back and lower limb pain when sowing corn by hand. This study concludes that a light motorized corn planter can reduce the risk of MSDs in farmers.
8	Author: Azmon et al. Journal Identity: Adv Agri Food Res J 2021; 2(2): a0000231.	Ergonomic Evaluation of Maize Seeding using Conventional Method and Lightweight Motorized Maize Seeder	To evaluate the ergonomic risks and musculoskeletal disorders (MSDs) experienced by farmers during maize seeding activities, both using the conventional	The experimental subject is a male between 40 and 60 years old, under the 50th percentile of Malaysian	This study was designed to evaluate the various tasks performed by farmers and the working postures they adopt during maize planting using two methods: manual seeding by hand and using a lightweight motorized	Farmers are at a very high risk of back and lower limb pain when sowing corn by hand. This study concludes that a light motorized corn planter can reduce the risk of MSDs in farmers.

ID	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
			hand-seeding method and the lightweight motorized maize seeder developed by MARDI.	adults, 1.686 m	maize seeder developed by MARDI.	
9	Author: Hasheminejad et al., Journal Identity: La Medicina del Lavoro, 2021.	Prevalence of musculoskeletal disorders, ergonomics Risk assessment and implementation of participatory ergonomics program for pistachio farm workers	This study aims to determine the prevalence of musculoskeletal disorders (MSDs) among pistachio farm workers, assess ergonomic risk factors in the harvesting and processing activities, identify high-risk tasks, and design and evaluate the effectiveness of worker-participatory ergonomic interventions to reduce the risk of MSDs.	The study population consisted of pistachio farm workers in Rafsanjan County, Iran, with a sample of 138 workers in the first phase and 64 workers in the second phase, divided into intervention and control groups.	This study consisted of two phases: assessing musculoskeletal disorders and ergonomic risks using NMQ, ManTRA, and HTA; followed by implementing a participatory ergonomics program with training, tools, and exercises. Data were evaluated post-harvest using statistical analysis.	MSDs were most common in the shoulders (63.7%), lower back (63%), and wrists/hands (52.1%). Five high-risk tasks were identified. After applying participatory ergonomics (PE), ergonomic risks decreased, but there was no significant difference in MSD prevalence between groups. However, 73% of participants were satisfied with the interventions.
10	Author: Boriboonsuksri Phonnipha, et al Journal Identity: Safety / 2022 / Vol. 8(1):6	Ergonomic Task Analysis for Prioritization of Work-Related Musculoskeletal Disorders among Mango-Harvesting Farmers	To identify high-risk ergonomic tasks and prioritize work-related musculoskeletal disorder (WMSD) risks in mango-harvesting farmers using ergonomic task analysis combined with various risk assessment tools.	This study involved 30 mango farmers in Phitsanulok Province, Thailand, who were selected by purposive sampling. They were farmers with at least one year of experience in harvesting mangoes and had no medical conditions that affected physical ability.	This study used a combination of Borg CR-10, RULA, REBA, and FEI indices to assess mango farmers' fatigue and work posture. Then it determined the tasks most at risk of causing muscle disorders, resulting in sorting mangoes being the top priority for improvement.	The study used a combination of Borg CR-10, RULA, REBA, and FEI indices to assess the fatigue and work posture of the mango growers. Then it determined the tasks most at risk of causing muscle disorders, resulting in sorting mangoes being the top priority for improvement. All mango farmers in this study experienced musculoskeletal disorders, especially at the waist, shoulders, and knees, with lifting and carrying baskets rated as the most risky activities, requiring ergonomic interventions to prevent injury.

DISCUSSION

Agro-nursing, an interdisciplinary approach that integrates agricultural practices with healthcare principles, is crucial in addressing musculoskeletal disorders (MSDs) among farmers by promoting ergonomic working positions. Farmers are particularly vulnerable to MSDs due to repetitive tasks, heavy lifting, awkward postures, and prolonged physical strain inherent in agricultural labor. Agro-nursing bridges the gap between agricultural productivity and occupational health by educating farmers on ergonomics—designing tasks, tools, and environments to align with the human body's capabilities. For instance, it advocates for techniques like bending at the knees instead of the waist when lifting crops, using adjustable tools to reduce joint stress, and adopting kneeling or squatting postures that minimize spinal compression. By integrating ergonomic principles into daily farming activities, agro-nursing helps mitigate risk factors for MSDs, such as muscle fatigue and joint degeneration, while enhancing overall work efficiency and safety (Kurniyawan et al., 2023; Wulandari et al., 2024).

Furthermore, agro-nursing emphasizes proactive strategies to prevent MSDs through tailored interventions and community-based health programs. This includes conducting ergonomic assessments of farm tasks, recommending assistive devices (such as ergonomic hand tools or mechanical lifters), and providing training to farmers on exercises that strengthen the muscles used in labor-intensive tasks. Collaborative efforts between agricultural experts and healthcare professionals enable agro-nursing to address systemic issues, such as the lack of awareness about ergonomic practices in rural communities. By fostering a culture of preventive care and adapting ergonomic solutions to local contexts—such as low-cost modifications for small-scale farms—it empowers farmers to sustain their livelihoods while reducing chronic pain and injury risks. Ultimately, agro-nursing enhances individual well-being and contributes to the long-term viability of agricultural industries by preserving the health of the workforce (Musta'adah et al., 2024; Nur et al., 2024).

In several journals mentioned above, there are similarities, focusing on ergonomic risk assessment and the prevention of musculoskeletal complaints in agricultural workers, with an emphasis on work posture, physical load, and ergonomic solutions (both through assistive devices and technological interventions). The research by Dev et al. (2025) underscores the importance of implementing ergonomic interventions and preventive measures to reduce the prevalence of musculoskeletal pain among female farmers. However, this study has limitations, such as its cross-sectional design and reliance on survey-based data collection, which may introduce reporting bias. Despite these limitations, this study underscores the pressing need for targeted interventions to enhance the musculoskeletal health and overall well-being of female agricultural workers. Research conducted by Arachchige et al. (2024) also noted that exoskeletons have high potential to assist the human workforce while reducing or eliminating the risk of work-related musculoskeletal disorders (WMSDs). However, their use in agricultural work, where numerous reported cases of WMSDs have been documented, is limited. However, commercial exoskeletons are already used in various other industries, such as logistics, military, medicine, and manufacturing. Thus, it is expected that these existing exoskeleton solutions can be applied to agricultural tasks.

Then the two studies are also supported by research conducted by Hasheminejad et al. (2021), which explained that after implementing the PE intervention, the results of the ergonomic evaluation

of five tasks in the first stage showed that for all five tasks, the level of risk of exposure to ergonomic risk factors had decreased. However, the prevalence rate of MSDs in the control and intervention groups did not show significant differences. Although the journals mentioned have limitations in their research methods, they all emphasize the importance of ergonomic interventions in improving the health and well-being of workers, especially women farmers.

Research conducted by Yenni et al. (2022). All respondents experienced musculoskeletal complaints, with most having moderate musculoskeletal complaints (68.3%). Among the clove farmers, the highest complaints were found in the feet, which amounted to 98.3% (Pandey et al., 2019). According to research by Afro & Paskarini (2022), the strong relationship between BMI and MSD complaints is very weak. So, it can be interpreted that there is a significant relationship between work attitude and the level of MSDs among farmers. From the interview results, on average, they stated that they often feel pain, especially in the lower back and shoulders. This may be due to the vast terrain of the land surface that must be sprayed, and most farmers have more than one garden. They take care of it individually, including spraying pesticides using a mistral manual sprayer. In addition, based on the measurement of work postures using the REBA method on one of the farmers in the initial survey, the performance standard resulted in a score of 9, indicating it falls in the high-risk category. The posture of bending and bowing when spraying pesticides, if done repeatedly and for a prolonged duration, and carrying a heavy load, can cause musculoskeletal disorders. From the research results obtained, theory and related research, it can be assumed that MSD disorders can occur as a result of several factors such as inappropriate posture, heavy workload, long working hours, and other risk factors.

Pain management is an important part of nursing care for patients with femoral fractures, because untreated pain can interfere with the physical and psychological recovery process. Persistent pain can cause sleep disturbances, limited mobility, increased stress, and the risk of other complications due to prolonged immobilization. Therefore, a multimodal pain management approach is highly recommended. According to Lee et al. (2021), the regular administration of analgesics, such as NSAIDs, effectively reduces acute postoperative pain and helps patients feel more comfortable during the mobilization process. This is in line with Hasheminejad et al. (2021), who stated that a pharmacological approach can improve a patient's functional abilities if administered according to the dose and clinical conditions.

In addition, non-pharmacological therapies such as relaxation techniques and music therapy also play an important role in managing pain. Chokprasit et al. (2023) demonstrated that self-care programs, including structured relaxation and music therapy, can effectively reduce pain levels and enhance patient emotional comfort. Meanwhile, Dev et al. (2025) emphasized the importance of educating patients and their families, including understanding the timing of drug administration, deep breathing techniques, and the use of mobilization aids. This education enhances compliance with therapy and fosters patient confidence and independence throughout the healing process. By combining medical, non-medical, and educational interventions, comprehensive, effective, and patient-centered pain management can be achieved.

The issue of work-related musculoskeletal disorders (WMSDs) in agriculture necessitates a comprehensive approach that encompasses risk identification and targeted intervention strategies. Boriboonsuksri et al. (2022) and Azmon et al. (2021) emphasize the importance of early ergonomic risk assessment and implementing practical solutions. Boriboonsuksri et al. (2022) identified mango

size sorting as a high-risk activity due to significant strain and fatigue on the posture, while Azmon et al. (2021) demonstrated that the adoption of a lightweight motorized maize seeder effectively reduced physical workload compared to manual seeding methods. These findings are consistent with previous ergonomic studies utilizing tools like the Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA) to evaluate and mitigate musculoskeletal risks in repetitive agricultural tasks.

Additionally, recent interventions have explored the rehabilitative aspects of WMSD management. A self-care program incorporating stretching exercises, strengthening routines, and thermal therapies has been shown to reduce pain and inflammation markers among agricultural workers (Chokprasit et al., 2023). The increase in interleukin-10 (IL-10), an anti-inflammatory biomarker, further supports the physiological effectiveness of such interventions, as supported by other rehabilitation-focused studies in occupational health.

An integrative strategy that combines task-based risk prioritization, ergonomic tool innovation, and structured self-care can provide a holistic solution to reducing WMSDs in agricultural contexts. By addressing both the causes and consequences of musculoskeletal disorders, such combined efforts can significantly improve farm workers' safety, productivity, and long-term well-being.

CONCLUSION

A common occurrence among farmers is musculoskeletal problems, especially in the lower back, shoulders, neck, and knees. The primary factors contributing to this musculoskeletal disorder are poor posture at work and prolonged work hours. This can be seen from the farmer's activity of spraying pesticides, which involves lifting a too-heavy load on the back, causing fatigue in the back muscles. Another example of poor posture at work is bending over for an extended period while caring for plants, which can strain the muscles, particularly in the lower back, neck, and shoulders. In addition to work-related factors, several non-work-related conditions also affect musculoskeletal disorders, including age and gender.

These ergonomic factors are important aspects that must be considered in the agricultural sector. These ergonomic factors are needed to minimize the risk of musculoskeletal disorders. These skeletal disorders can have a long-term impact on the health of farmers. Ergonomically poor work positions and prolonged durations are closely related to musculoskeletal-related disorders. Interventions for ergonomic positioning significantly contribute to reducing musculoskeletal complaints and can also enhance work comfort. In addition, several technological innovations can reduce the risk of musculoskeletal disorders, such as semi-automatic tractors, fabric exoskeletons, and motorized corn planting machines. Applying the principles of ergonomics in the agricultural sector is a step towards improving the health and safety, as well as the work productivity, of farmers, and can also minimize the risk of musculoskeletal disorders.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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