Musculoskeletal Disorders among Agricultural Workers in Rural Communities of Loja, Ecuador

Dámaris Campaña-Cuichán , Isabel Masson-Palacios , Diana Vásquez-Muñoz , Samuel Iñiguez-Jimenez *

Posted Date: 11 December 2025

doi: 10.20944/preprints202512.1052.v1

Keywords: ergonomics; farmers; musculoskeletal disorders; risk factors

 doi:10.20944/preprints202512.1052.v1

Article

Musculoskeletal Disorders Among Agricultural Workers in Rural Communities of Loja, Ecuador

Dámaris Campaña-Cuichán [1], Isabel Masson-Palacios [2], Diana Vásquez-Muñoz [3] and Samuel Iñiguez-Jimenez [4,*]

[1] Facultad de Salud y Bienestar, Pontificia Universidad Católica del Ecuador, Quito 170150, Ecuador
[2] Escuela de Fisioterapia, Facultad de Ciencias Médicas, de la Salud y la Vida, Universidad Internacional del Ecuador, Quito 170150, Ecuador
[3] Facultad de Salud y Bienestar, Pontificia Universidad Católica del Ecuador, Quito 170150, Ecuador
[4] Facultad de Salud y Bienestar, Pontificia Universidad Católica del Ecuador, Centro de Investigación para la Salud en América Latina (CISeAL), Quito 170150, Ecuador
* Correspondence: soiniguez@puce.edu.ec; Tel.: +593960753024

Abstract

According to the World Health Organization (WHO), Musculoskeletal Disorders (MSDs) are the most common occupational disease worldwide, frequently affecting agricultural workers due to the physical demands of their labor activities. In this context, a descriptive, relational, cross-sectional study was conducted in rural communities of Loja, Ecuador, with the aim of determining the prevalence of MSDs and their relationship with sociodemographic and occupational factors among agricultural workers. The sample consisted of 103 farmers who completed the Standardized Nordic Questionnaire (NMQ). The results showed a high prevalence of MSDs in this population, with symptoms reported over the past 12 months, particularly in the neck, lower back, and knees. Furthermore, a statistically significant association was observed between the presence of MSDs and BMI. In conclusion, MSDs represent a frequent health problem among farmers, highlighting the need to implement preventive strategies and occupational health promotion programs in rural communities.

Keywords: ergonomics; farmers; musculoskeletal disorders; risk factors

1. Introduction

This study was conducted in Ecuador, a country located in the northwestern region of South America. According to data collected by the National Institute of Statistics and Census (INEC), it has a population of approximately 18,249,223 people [1]. In this country, agriculture plays a significant role in the country's economy, representing around 8% of the Gross Domestic Product (GDP) and providing substantial employment opportunities, particularly in rural communities such as those found in Loja [2]. This city situated in the southern part of the Andean region, has a total population of 485,421 inhabitants, according to the 2022 Population and Housing Census by the INEC [3]. Many of these residents are dedicated to agricultural work, primarily cultivating corn, coffee, rice, and cassava, among other crops [4,5]. The main work activities include planting, harvesting, irrigation, crop maintenance, weeding, and product transportation [6].

According to the WHO, approximately 1.71 billion people suffer from MSDs, making it the most common occupational disease worldwide [7,8]. Similarly, the International Labour Organization (ILO) states that among occupational illnesses, ergonomic-related disorders are the most prevalent [9]. Studies conducted among workers have reported a prevalence of musculoskeletal symptoms of up to 88.9%, indicating that these conditions are highly common, especially among farmers [10]. Research conducted in Thailand revealed that this group of workers exhibited a higher prevalence of MSDs (67.8%; 95% CI: 66.3–69.3) compared to other occupational populations [11].

 doi:10.20944/preprints202512.1052.v1

The development of MSDs in farmers is closely related to the type of work and physical exposure involved. Farmers often perform repetitive activities over prolonged periods, adopting forced and awkward postures [12,13]. These factors cause physical fatigue and pain in several body regions, including the neck, shoulders, elbows, wrists/hands, lower back, trunk, legs/ankles, and feet [14]. For instance, a study assessing MSD prevalence among pistachio harvesters using the NMQ reported that many workers experienced at least one type of MSD, with 63.7% in the shoulders, 63% in the lower back, and 52.1% in the wrists/hands [15].

Agricultural workers are thus exposed to multiple work-related physical risks, one of which is the occurrence of MSDs [16]. Moreover, the onset of these disorders has been related to sociodemographic factors such as gender, age, and body composition [17]. A study found that the prevalence of knee-related MSDs reached 54.04% among male workers over 60 years old, some of whom were overweight, which influenced this result [18]. These findings support that MSDs are associated with sociodemographic characteristics, as prevalence tends to increase with age due to prolonged occupational exposure and age-related degenerative changes [19].

Given the occupational conditions and sociodemographic characteristics of farmers, it is essential to examine the prevalence of MSDs in this population and their relationship with these factors. MSDs can become a critical occupational health problem among farmers due to repetitive movements, heavy lifting, intense manual labor, and forced working postures [20], compounded by the influence of personal and occupational aspects such as job position and working hours [21,22]. As there is a lack of sufficient scientific evidence regarding this issue in the Ecuadorian agricultural workers, the present study aims to determine the prevalence of MSDs and their relationship with sociodemographic and occupational factors among farmers in rural communities of Loja, Ecuador.

2. Materials and Methods

2.1. Study Design

A quantitative, descriptive, and field-based investigation was conducted using a cross-sectional design to determine the relationship between sociodemographic or occupational factors and the presence of MSDs in agricultural communities in Loja. This research was developed as part of the project titled Relationship between Musculoskeletal Disorders and Occupational Activity in the Communities of Loja [5], from which the study data were collected.

2.2. Sample Size

The study sample consisted of 103 farmers from the communities of Changaimina, Cruz de Yazapa, Lucero, Naranjillo, Tablón, Bellamaría, and Cariamanga in the province of Loja. A non-probabilistic, intentional sampling method was chosen to select participants who met the specific characteristics of the research.

Inclusion criteria comprised adult individuals aged 30 to 60 years residing in the agricultural communities of Loja and working as farmers. Exclusion criteria included the presence of any physical or mental disability and a medical history of severe injuries or congenital pathology, or its equivalent.

2.3. Data Collection Process

Data collection was carried out in person with the study participants through field visits to their homes, where they were invited to participate. Each participant was individually evaluated using the study instrument NMQ. Once the data was collected, it was securely stored in the office of the principal investigator.

2.4. Data Analysis

Data were analyzed using IBM SPSS Statistics software. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to describe the participants and the

 doi:10.20944/preprints202512.1052.v1

prevalence of MSDs. The 95% confidence intervals were calculated for the most affected body regions. To determine the factors associated with MSDs, multivariate logistic regression analyses were performed, including gender, age, BMI, weekly working hours, and family income as risk factors. Adjusted odds ratios (aOR) with 95% confidence intervals were obtained, and $p < 0.05$ was considered statistically significant [23].

2.5. Instrument

The NMQ was used for data collection. This instrument aims to detect initial symptoms of MSDs in workers exposed to physical demands [24]. Previous studies assessing its reliability and validity have reported a Cronbach's alpha of 0.863, indicating good reliability and high validity [25].

This instrument contains 27 multiple-choice questions divided into two sections: a general part and the specific part [26,27]. The general section asks about musculoskeletal symptoms experienced within the last 12 months or 7 days across 9 body parts (neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet). The specific section asks about symptoms in 3 body parts (neck, shoulders, and lower back) within the last 12 months or 7 days and whether these discomforts interfered with their daily or occupational activities [27].

2.6. Ethical Considerations

The research adhered to the ethical principles protecting the rights, privacy, and confidentiality of the participants. The principle of voluntary participation and the right to withdraw from studying at any time were established. The study received approval from the Research Ethics Committee for Human Beings (CEISH) of the Pontifical Catholic University of Ecuador (PUCE) under code CEISH-461-2023.

2.7. Use of Artificial Intelligence Tools:

The authors used artificial intelligence (AI) tools (ChatGPT, OpenAI) to support the translation of the manuscript and to improve grammatical clarity.

3. Results

3.1. Sociodemographic and Occupational Characteristics

A total of 103 farmers participated in the present study. Table 1 shows that the sample had a similar distribution by gender, with 51 men (49.5%) and 52 women (50.5%), demonstrating a balanced representation of male and female agricultural workers in these communities. The mean age was 46 years ($\sigma = 9.767$), indicating that the majority of workers are middle-aged adults.

Nutritional status was assessed using the Body Mass Index (BMI), categorized according to the WHO criteria: underweight (< 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), and obesity (≥ 30 kg/m²). Table 1 indicates that most workers had normal weight (n = 66, 64.1%). Additionally, 17 participants (16.6%) were classified as underweight, while a smaller proportion fell into the overweight. No participants were classified as obese, and BMI data were missing for 3 participants.

Table 1. Sociodemographic Characteristics.

Variable	n	%	$\bar{x}$	σ
Gender				
Male	51	49.5		
Female	52	50.5		
Age			46.52	9.767
Height (m*)			1.55	9.687
Weight (kg*)			68.75	11.381

 doi:10.20944/preprints202512.1052.v1

BMI		
Underweight	17	16.5
Normal	66	64.1
Overweight	17	16.5

Note: Weight is expressed in kilograms (kg) and height in meters (m).

Regarding occupational conditions, several key variables were analyzed to establish a relationship with the onset of musculoskeletal symptoms. Concerning the job position, Table 2 indicates that the majority of participants performed tasks while standing (n = 82, 79.6%), while a smaller number worked seated (n = 6, 5.8%), bent over (n = 13, 11.7%), and only a few involved lifting weights (n = 3, 2.9%), reflecting the high physical demands of their labor. Furthermore, most participants reported a weekly working time of over 40 hours (n = 43, 41.7%). In terms of household income, the majority earned 0–100 USD per month (n = 43, 41.7%), which may limit access to healthcare and negatively impact worker health.

Table 2. Occupational Characteristics.

Variable	n	%
Job Position		
Sitting	6	5.8
Standing	82	79.6
Bending	13	11.7
Lifting	3	2.9
Weekly Working Hours		
1-10	9	8.7
11-20	8	7.8
21-30	10	9.7
31-40	32	31.1
Over 40	43	41.7
Family Income (USD)		
0-100	43	41.7
101-200	23	22.3
201-300	9	8.7
301-400	3	2.9
401-500	8	7.8
501-600	7	6.8
Over 600	10	9.7

3.2. Prevalence of Musculoskeletal Disorders

Table 3 shows the results obtained through the NMQ. More than half of the participants reported musculoskeletal symptoms in at least one body region in the last 12 months, with the highest prevalence in the lower back (78.6%; 95% CI 69.8–85.5), neck (58.3%; 48.6-67.3), and knees (64.1%; 54.5-72.7). In contrast, the least affected regions were the left wrist/hand (n = 34, 33.0%) and left elbow (n = 28, 27.2%).

Table 3. Twelve-Month prevalence of Musculoskeletal Disorders by Body Region.

Problems with the Musculoskeletal System					
	NO		YES		
Body Region	**n**	**%**	**n**	**%**	**95% CI**
Neck	43	41.7	60	58.3	48.6-67.3
Left Shoulder	60	58.3	43	41.7	32.7-51.4
Right Shoulder	53	51.5	50	48.5	39.1-58.1

 doi:10.20944/preprints202512.1052.v1

Left Elbow	75	72.9	28	27.2	19.5-36.5
Right Elbow	70	68	33	32	23.8-41.6
Left Wrist/Hand	69	67	34	33	24.7-42.6
Right Wrist/Hand	63	61.2	40	38.8	30.0-48.5
Upper Back	44	42.7	59	57.3	47.6-66.4
Lower Back	22	21.4	81	78.6	69.8-85.5
Hips	55	53.4	48	46.6	37.3-56.2
Knees	37	35.9	66	64.1	54.5-72.7
Ankles/Feet	52	50.5	51	49.5	40.1-59.0

3.3. Factors Associated with Musculoskeletal Disorder Prevalence

Logistic regression models adjusted for gender, age, BMI, weekly working hours, and family income. Table 4 revealed that having a high BMI was significantly associated with lower back pain (aOR = 15.01; 95% CI 1.06-212.24; p = 0.045), and a marginally significant association was observed between neck pain and having a BMI in the overweight category (aOR = 6.33; 95% CI 0.99-40.46; p = 0.05). No statistically significant associations were observed between musculoskeletal disorders and the other variables like gender, age, weekly working hours, or family income in any of the three body regions most affected.

Table 4. Factors Associated with Musculoskeletal Disorder Prevalence.

Variable	Neck Pain aOR (95% CI)	*p*-Value	Lower Back Pain aOR (95% CI)	*p*-Value	Knees Pain aOR (95% CI)	*p*-Value
Gender	0.47 (0.18-1.25)	0.13	1.42 (0.43-4.67)	0.56	0.63 (0.24-1.64)	0.34
Age	0.99 (0.96-1.02)	0.46	1.01 (0.97-1.05)	0.77	1.01 (0.98-1.04)	0.53
BMI						
Normal	1.62 (0.47-5.63)	0.45	2.17 (0.57-8.25)	0.26	1.03 (0.31-3.42)	0.96
Overweight	6.33 (0.99-40.46)	0.05*	15.01 (1.06-212.24)	0.045*	1.16 (0.23-5.84)	0.86
Weekly working hours	0.80 (0.53-1.21)	0.29	0.94 (0.59-1.49)	0.78	0.81 (0.55-1.20)	0.29
Family income	Not significant	-	Not significant	-	Not significant	-

Note: *p*-Value < 0.05 was considered statistically significant, OR: Odds Ratio; CI: Confidence Interval.

4. Discussion

In line with the ILO, MSDs are among the most relevant problems in occupational health, as most of these disorders are work-related [28]. These disorders cause impairments in an individual's movement function and may arise from excessive mechanical strain on biological structures. Furthermore, evidence suggests that organizational psychosocial factors also contribute to MSD development, making them one of the leading causes of productivity loss and economic burden worldwide [29].

Regarding agricultural work in rural and urban areas of Loja Province, agricultural activities are predominantly carried out by men, consistent with findings from a study conducted in the canton of Catamayo [2], where 93% of farming households were headed by males. In the present study, males and females were equally represented, indicating no significant gender imbalance in agricultural participation.

Agricultural workers often engage in long working hours that exceed 40 hours per week, increasing the risk of musculoskeletal injury. In contrast, a study conducted in Tulcán, Ecuador, reported that 49.5% of workers worked 32 hours per week, while 29.5% reached 40 hours [30]. In contrast, in the present research, only 5.8% of participants reported working between 21 and 30 hours per week.

Furthermore, studies on coffee harvesters found that most workers remain standing for extended periods during their work activities. Other research indicates that farmers tend to adopt

 doi:10.20944/preprints202512.1052.v1

prolonged sitting postures, increasing the risk of knee and joint disorders. In planting tasks, workers often kneel on one or both knees for extended periods [30–32]. Although this study did not directly assess working postures, these previous findings help contextualize the high prevalence of musculoskeletal pain observed among participants that are commonly affected by awkward postures in agricultural labor.

Similar studies that applied the NMQ among agricultural populations have consistently found that lower back pain is the most prevalent MSD, followed by knee and neck pain [5,31,33]. This investigation reflected similar results, as the prevalence of lower back pain accounted for 78.6% of the sample, followed by the knee region at 64.1%. These outcomes may be attributed to factors such as sustained and awkward postures, whole-body vibrations, work frequency, and task difficulty, in addition to demographic and lifestyle variables such as age, height, BMI, smoking, and psychosocial stressors [34].

Cervical pain ranked third in prevalence (58.3%), affecting more than half of the participants. Other studies have reported lower neck pain prevalence rates (7.4% and 47.2%), which may be explained by differences in workplace settings and daily working hours, ranging between 9 and 12 hours per day [35,36]. In the current study, a marginal association was observed between neck pain and having a BMI in the overweight category. This finding may indicate that even moderate increases in body mass can influence cervical loading and muscular strain during our static agricultural tasks.

Among female tobacco farmers, a study revealed that cervical pain was more prevalent with a ratio of 1.7 compared to a population under 40 years old. This may be related to the length of time spent in labor activity at an intense or accelerated pace and exposure to other environmental factors [36]. The present study also found a high prevalence of cervical pain, although the association with gender was not statistically significant.

In contrast, the multivariate analysis revealed a statistically significant association between lower back pain and having a high BMI. This supports previous research linking overweight and obesity to lumbar disorders due to increased mechanical stress on the spinal structures and degenerative musculoskeletal changes [5,37,38]. These findings underscore the importance of controlling body weight among agricultural workers [39,40].

It is relevant to note that the main limitation of this study is its cross-sectional design, which does not allow for temporal follow-up of sociodemographic and occupational factors related to MSD occurrence. Future research should consider longitudinal or cohort designs. Likewise, the sample size may limit the generalization of the results to other agricultural contexts in Ecuador. Nonetheless, these limitations do not diminish the relevance of the findings, as the analysis identified significant associations that constitute a substantial contribution to understanding the problem and guiding future interventions within this population.

The study findings offer important practical implications for occupational health, ergonomics, and physiotherapy within agricultural communities. The high prevalence of lumbar, cervical, and knee pain highlights the urgent need to implement preventive strategies tailored to the agricultural work context. Furthermore, the results emphasize the importance of addressing the specific needs of female agricultural workers to develop interventions that consider their unique occupational conditions. For future research, it is suggested to develop studies with larger samples to allow for greater representativeness of the farmers, in addition to combining the use of self-reported questionnaires with clinical, biomechanical, and field evaluations to enrich the understanding of the different factors involved in MSDs.

5. Conclusions

In conclusion, the findings of this study revealed a high prevalence of MSDs in farmers, mainly affecting the lower back, neck, and knees. Also, the results of this study indicate a high prevalence of MSDs in farmers, mainly in the lower back, neck, and knees, with statistically significant associations observed between lumbar pain and having a high BMI, and a marginally significant association was observed between neck pain and having a BMI in the overweight category. These findings underscore

 doi:10.20944/preprints202512.1052.v1

the importance of implementing preventive measures through ergonomic strategies and health education, aiming to improve the quality of life of agricultural workers and reduce the incidence of musculoskeletal disorders. It is recommended that future research be conducted on a broader population to allow for a more detailed exploration of related risk factors, thereby strengthening scientific evidence on occupational health in rural contexts.

Author Contributions: "Conceptualization, M.I.M.P. and D.S.C.C.; methodology, M.I.M.P. and D.S.C.C; software, S.O.I.J., D.S.C.C. and M.I.M.P.; validation, D.S.C.C. and S.O.I.J.; formal analysis, M.I.M.P. and S.O.I.J.; investigation, M.I.M.P., D.E.V.M. and D.S.C.C.; resources, M.I.M.P.; data curation, M.I.M.P., S.O.I.J. and D.S.C.C.; writing—original draft preparation, D.S.C.C. and D.E.V.M.; writing—review and editing, D.S.C.C., S.O.I.J. and D.E.V.M.; visualization, D.S.C.C., M.I.M.P. and D.E.V.M.; supervision, M.I.M.P. and S.O.I.J.; project administration, M.I.M.P.; funding acquisition, M.I.M.P. All authors have read and agreed to the published version of the manuscript."

Institutional Review Board Statement: This study was approved by the CEISH of the PUCE under code CEISH-461-2023, 27 June 2023.

Informed Consent Statement: All the participants who engaged in the study provided informed consent.

Data Availability Statement: The data described in this study are accessible from the corresponding author upon request. Due to the confidentiality concerns, the data is not publicly available.

Acknowledgments: The authors express their gratitude to Belén Allauca and Adriana Espín for their valuable support in data collection and test administration. We are also deeply grateful to the PUCE and the Center for Health Research in Latin America (CISeAL) for their contribution to the development of this research. And finally, the authors acknowledge the use of ChatGPT (GPT-5.1 model, OpenAI) for assistance with translation and grammar polishing.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

MSDs	Musculoskeletal Disorders
NMQ	Standardized Nordic Questionnaire
BMI	Body Mass Index

References

1. Obaco, A.M.; Díaz-Sánchez, J.P. Urbanization in Ecuador: An Overview Using the Functional Urban Area Definition. *Region* **2018**, *5*, 39–48, doi:10.18335/REGION.V5I3.235.
2. Chamba-Morales, M.D.; Lapo-Paredes, L.E.; Vásquez, E.R. Family Farming in the Catamayo Canton, Loja Province. *Revista del Centro de Estudio y Desarrollo de la Amazonia* **2019**, *9*, 66–74.
3. Ordóñez-Gutiérrez, O.R.; Claro-Valdés, A.R.; Valarezo-Aguilar, K.J. Ecological Requirements of Forest Species for Their Geographical Distribution in the Province of Loja, Ecuador. *Ciencias de la Tierra y el Espacio* **2018**, *19*, 32–43.
4. Vásquez-Dávila, S.; Bravo-Benavides, D. Impact of Climate Change on Agricultural Production in the Province of Loja, Period 2007-2020. *Rev Econ* **2023**, *11*, 95–106, doi:10.54753/rve.v11i1.1623.
5. Masson Palacios, I.; Vinueza-Fernandez, I.; Iñiguez-Jiminez, S.-O.; Grijalva, M.J.; Bates, B.R. Predictors of Low Back Pain Risk Among Farmers in Rural Communities of Loja, Ecuador. *Int J Environ Res Public Health* **2025**, *22*, 885, doi:10.3390/ijerph22060885.
6. Vasconcellos Fernández, N.A. Ecuadorian Agriculture amidst the Pandemic. Effects of Public Policy on the Peasant Farmer. *Revista Española de Estudios Agrosociales y Pesqueros* **2023**, 15–37, doi:10.24197/reeap.261.2023.15-37.

 doi:10.20944/preprints202512.1052.v1

7. López, L.; Campos, Y. Prevalence of Musculoskeletal Disorders and Forced Postures in Shoe Artisans in Ambato-Ecuador. *Revista Conecta Libertad* **2020**, *4*, 43–51.
8. Kongtawelert, A.; Buchholz, B.; Sujitrarath, D.; Laohaudomchok, W.; Kongtip, P.; Woskie, S. Prevalence and Factors Associated with Musculoskeletal Disorders among Thai Burley Tobacco Farmers. *Int J Environ Res Public Health* **2022**, *19*, doi:10.3390/ijerph19116779.
9. Angulo, E.A.; Autónoma, U.; Moreno, G.R.; Gabriela, J.; Marquez, P.; Antonio, J.; Taboada, R. Prevalence of Musculoskeletal Disorders Associated with the Work of Administrative Positions: A Cross-Cutting Study. *Investigación Negocios & Revista Científica* **2023**, doi:10.38147/invneg.v16i28.230
10. Kaewdok, T.; Sirisawasd, S.; Taptagaporn, S. Agricultural Risk Factors Related Musculoskeletal Disorders among Older Farmers in Pathum Thani Province, Thailand. *J Agromedicine* **2021**, *26*, 185–192, doi:10.1080/1059924X.2020.1795029.
11. Poochada, W.; Chaiklieng, S.; Andajani, S. Musculoskeletal Disorders among Agricultural Workers of Various Cultivation Activities in Upper Northeastern Thailand. *Safety* **2022**, *8*, 61, doi:10.3390/SAFETY8030061/S1.
12. Boriboonsuksri, P.; Taptagaporn, S.; Kaewdok, T. Ergonomic Task Analysis for Prioritization of Work-Related Musculoskeletal Disorders among Mango-Harvesting Farmers. *Safety* **2022**, *8*, 6, doi:10.3390/SAFETY8010006.
13. Ong-Artborirak, P.; Kantow, S.; Seangpraw, K.; Tonchoy, P.; Auttama, N.; Choowanthanapakorn, M.; Boonyathee, S. Ergonomic Risk Factors for Musculoskeletal Disorders among Ethnic Lychee–Longan Harvesting Workers in Northern Thailand. *Healthcare* **2022**, *10*, 2446, doi:10.3390/HEALTHCARE10122446.
14. Chaiklieng, S.; Suggaravetsiri, P.; Poochada, W.; Thinkhamrop, W.; Dacherngkhao, T. The Burden of Work-Related Diseases and Injuries among Agriculturists: A Three-Year Retrospective Study in Thailand. *Safety* **2022**, *8*, 78, doi:10.3390/SAFETY8040078/S1.
15. Hasheminejad, N.; Choobineh, A.; Mostafavi, R.; Tahernejad, S.; Rostami, M. Prevalence of Musculoskeletal Disorders, Ergonomics Risk Assessment and Implementation of Participatory Ergonomics Program for Pistachio Farm Workers. *Med Lav* **2021**, *112*, 292, doi:10.23749/MDL.V112I4.11343.
16. Sharifirad, M.; Poursaeed, A.; Lashgarara, F.; Mirdamadi, S.M. Risk Factors for Musculoskeletal Problems in Paddy Field Workers in Northern Iran: A Community-Based Study. *J Res Med Sci* **2022**, *27*, 77, doi:10.4103/JRMS.JRMS_1024_21.
17. Kim, J.; Youn, K.; Park, J.; Kim, J.; Youn, K.; Park, J. Risk Factors for Musculoskeletal Disorders in Korean Farmers: Survey on Occupational Diseases in 2020 and 2022. *Healthcare* **2024**, *12*, 2026, doi:10.3390/HEALTHCARE12202026.
18. Peungsuwan, P.; Chatchawan, U.; Puntumetakul, R.; Yamauchi, J. The Prevalence and Work-Related Physical Factors Associated with Knee Pain in Older Thai Farmers. *J Phys Ther Sci* **2019**, *31*, 466, doi:10.1589/JPTS.31.466.
19. Tonelli, S.; Culp, K.; Donham, K.J. Prevalence of Musculoskeletal Symptoms and Predictors of Seeking Healthcare among Iowa Farmers. *J Agric Saf Health* **2015**, *21*, 229–239, doi:10.13031/jash.21.10825.
20. Kadir, A.; Sunindijo, R.Y.; Widanarko, B.; Erwandi, D.; Nasri, S.M.; Satrya, B.A.; Sunarno, S.D.A.M.; Atmajaya, H.; Yuniar, P.; Yuantoko, T.D.; et al. Impact of Physical and Psychological Strain on Work-Related Musculoskeletal Disorders: A Cross-Sectional Study in the Construction Industry. *Inquiry (United States)* **2025**, *62*, doi:10.1177/00469580251315348.
21. Akbar, K.A.; Try, P.; Viwattanakulvanid, P.; Kallawicha, K. Work-Related Musculoskeletal Disorders Among Farmers in the Southeast Asia Region: A Systematic Review. *Saf Health Work* **2023**, *14*, 243, doi:10.1016/J.SHAW.2023.05.001.
22. Kongtawelert, A.; Buchholz, B.; Sujitrarath, D.; Laohaudomchok, W.; Kongtip, P.; Woskie, S. Prevalence and Factors Associated with Musculoskeletal Disorders among Thai Burley Tobacco Farmers. *Int J Environ Res Public Health* **2022**, *19*, 6779, doi:10.3390/IJERPH19116779.
23. Chicco, D.; Sichenze, A.; Jurman, G. A Simple Guide to the Use of Student's t-Test, Mann-Whitney U Test, Chi-Squared Test, and Kruskal-Wallis Test in Biostatistics. *BioData Min* **2025**, *18*, doi:10.1186/s13040-025-00465-6.

24. Martínez, M.; Alvarado, R. Validation of the Nordic Standardized Questionnaire of Musculoskeletal Symptoms for the Chilean Working Population, Including a Pain Scale. *Revista de Salud Pública* **2017**, 43–53.
25. González, E.L. Validity and Reliability Study of the Standardized Nordic Questionnaire, for the Detection of Muscular-Skeletal Symptoms in Mexican Population. *Ergonomía, Investigación y Desarrollo* **2021**, 8–17.
26. Dickinson, C.E.; Campion, K.; Foster, A.F.; Newman, S.J.; O'Rourke, A.M.T.; Thomas, P.G. Questionnaire Development: An Examination of the Nordic Musculoskeletal Questionnaire. *Appl Ergon* **1992**, *23*, 197–201, doi:10.1016/0003-6870(92)90225-K.
27. López-Aragón, L.; López-Liria, R.; Callejón-Ferre, J.; Gómez-Galán, M. Applications of the Standardized Nordic Questionnaire: A Review. *Sustainability 2017, Vol. 9, Page 1514* **2017**, *9*, 1514, doi:10.3390/SU9091514.
28. Marval Echezuría, L.; Silano Fernández, M.; Rísquez Parra, A.; Rodríguez Morales, A. *Epidemiología de Los Trastornos Músculo-Esqueléticos de Origen Ocupacional*; Caracas, **2013**.
29. Márquez Gómez, M. Theoretical Models of Musculoskeletal Disorders Causation. *Ingeniería Industrial. Actualidad y Nuevas Tendencias* **2015**, *IV*, 85–102.
30. Almeida Duarte, N.E.; López Reyes, S.L.; Chicaiza Olivarez, A.C.; Chapi Chandi, M.M.; Flores Alarcón, J.O. Ergonomic Risks and Musculoskeletal Disorders among Agricultural Workers: An Analysis of Working Conditions and Occupational Health. *Latam: revista latinoamericana de Ciencias Sociales y Humanidades, ISSN-e 2789-3855, Vol. 6, Nº. 3, 2025 (Ejemplar dedicado a: LATAM; 1 – 23)* **2025**, *6*, 1–23, doi:10.56712/latam.v6i3.3948.
31. Ramirez Jaramillo, P.; Bonilla Mendoza, L.F.; Buitrago Salazar, J.C.; Munera Ramirez, S.; Uribe Quintero, M.L.; Noguera Cabrales, M.D.; Molina Restrepo, I.; Garzon Duque, M.O. Musculoskeletal Disorders in Coffee Collectors. *Revista Colombia de Salud Ocupacional* **2022**, *12*, doi:10.18041/2322-634X/rcso.1.2022.7143.
32. Chamba Chalán, L.J.; González Carrión, E.L.; González Aguilera, D.A.; Toapanta-Mendoza, E.O. Ergonomic Risk Assessment in Agricultural Processes: Mishili Experimental Farm Case, 2024. *Green World Journal* **2024**, *7*, 099–099, doi:10.53313/gwj71099.
33. Shivakumar, M.; Welsh, V.; Bajpai, R.; Helliwell, T.; Mallen, C.; Robinson, M.; Shepherd, T. Musculoskeletal Disorders and Pain in Agricultural Workers in Low- and Middle-Income Countries: A Systematic Review and Meta-analysis. *Rheumatol Int* **2024**, *44*, 235–247, doi:10.1007/S00296-023-05500-5/FIGURES/5.
34. Villavicencio-Soledispa, J.I.; Espinoza-López, S.E.; Pimentel-Pulgar, J.R.; Muñoz-Riofrío, F.P. Forced Posture, Whole Body Vibrations and Low Back Pain in Technicians of an agricultural Company. *Dominio de las Ciencias* **2020**, *6*, 128–137, doi:10.23857/dc.v6i5.1585.
35. Maradei, F.; Ardila Jaimes, C.P.; Sanabria Sarmiento, S.J. Muskuloskeletal Symptoms in the Harvest Activities of Andean Raspberry (Rubus Glaucus Benth) in Piedecuesta, Colombia. *Hacia la promoción de la salud* **2019**, *24*, 91–106, doi:10.17151/HPSAL.2019.24.2.8.
36. Gastal Fassa, A.; Spada Fiori, N.; Dalke Meucci, R.; Xavier Faria, N.M.; Peres de Carvalho, M. Neck Pain among Tobacco Farm Workers in Southern Brazil. *Salud Colect* **2020**, *16*, e2307, doi:10.18294/SC.2020.2307.
37. Heuch, I.; Heuch, I.; Hagen, K.; Zwart, J.A. Overweight and Obesity as Risk Factors for Chronic Low Back Pain: A New Follow-up in the HUNT Study. *BMC Public Health* **2024**, *24*, doi:10.1186/s12889-024-20011-z.
38. Lucha-López, M.O.; Hidalgo-García, C.; Monti-Ballano, S.; Márquez-Gonzalvo, S.; Ferrández-Laliena, L.; Müller-Thyssen-Uriarte, J.; Lucha-López, A.C. Body Mass Index and Its Influence on Chronic Low Back Pain in the Spanish Population: A Secondary Analysis from the European Health Survey (2020). *Biomedicines* **2023**, *11*, doi:10.3390/biomedicines11082175.
39. Chokprasit, P.; Yimthiang, S.; Veerasakul, S. Predictors of Low Back Pain Risk among Rubber Harvesters. *Int J Environ Res Public Health* **2022**, *19*, doi:10.3390/ijerph191710492.
40. Seo, M.; Kim, H.; Jung, W. Ergonomic Improvements to Agricultural Harvest Baskets to Reduce the Risk of Musculoskeletal Disorders among Farmers. *Int J Environ Res Public Health* **2022**, *19*, doi:10.3390/ijerph191710669.