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Original Article

Prevalence and Associated Risk Factors of Musculoskeletal Disorders among Agricultural Workers

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ABSTRACT

Background: Musculoskeletal disorders (MSDs) are one of the major contributors to disability worldwide. Agricultural workers encounter different problems while doing their farming activities. These conditions may predispose them to a possible risk of MSDs. **Aim:** Assess the prevalence and associated risk factors of MSDs among agricultural workers. **Methods:** A descriptive cross-sectional study was conducted at El-Ismailia village affiliates to Minia district at Minia governorate in Upper Egypt; involving 346 subjects selected using systematic random sampling. Data were collected through two tools; the 1st tool was a structured questionnaire to assess demographic, physical, work-related, psychosocial, and behavioral characteristics, and the 2nd tool was the Nordic musculoskeletal questionnaire (NMQ) to assess MSDs. **Results:** there was a high prevalence of MSDs among agricultural workers, with approximately three-quarters (75.4%) suffering such conditions. A high prevalence was reported in specific body parts such as the lower back, knees, wrists, and shoulders (67.1%, 44.6%, 34.1%, and 28.7%, respectively). Several factors significantly increase the odds of MSDs prevalence. Males, prolonged working hours, routine heavy lifting, and working in chronic flexion positions are all associated with higher MSDs prevalence. Repetitive forceful tasks, lack of breaks, and time pressure, as well as self-medication usage, also correlate with increased MSDs prevalence. Additionally, age, lower education levels, marital status (especially widowed individuals), increase in Body Mass Index, and extensive work experience are significant factors. Psychological and behavioral characteristics, such as high levels of perceived work fatigue, low-income satisfaction, and smoking status, particularly among ex-smokers, further contribute to MSDs occurrence. **Conclusion**: The study reveals that MSDs are a significant occupational health issue among agricultural workers, with high prevalence in the lower back, knees, wrists, and shoulders, influenced by various personal, work-related, psychological, and behavioral factors. **Recommendations**: Implementing ergonomic measures, early screening of MSDs, and educational programs on body mechanics are essential to reduce the prevalence of MSDs among agricultural workers.

Keywords: Agricultural Workers, Musculoskeletal Disorders, Prevalence, Risk Factors

Introduction

Musculoskeletal disorders (MSDs) are one of the major contributors to disability worldwide **(WHO, 2019)**. Injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and other supporting structures of the neck, lower back, and upper and lower limbs are known as musculoskeletal disorders. These conditions can be brought on by abrupt physical exertion or by prolonged exposure to physical factors like force,

vibration, repetition, or awkward posture. It generally refers to soft tissue injuries occurring gradually over time. It is prevalent in rural areas where people are more commonly involved in strenuous physical activities **(Gopalakrishnan et al., 2015).** Musculoskeletal disorders significantly restrict the movement and agility of an individual, eventually causing decreased productivity due to early fatigue and retirement. They also affect the capacity to share in social roles. These injuries or pain can develop when the same muscles are used over extensive periods without enough rest. They also impact the health-related quality of life **(Ramanathan et al., 2020)**.

An essential sector of every country's economy and exports is agriculture. Furthermore, agriculture is an occupation that involves risky activities that predispose individuals to health problems including MSDs (**Sarker et al., 2016).** Because of technical advancements in wealthy countries, agricultural production is now easier than in the past. However, the application of agricultural technology is limited in less developed nations. As a result, farmers in developing countries use traditional techniques to do their agricultural activities **(Wahba et al., 2024)**. There have been documented farming-related deaths and accidents as a direct result of working in dangerous and hazardous situations, especially in less developed nations. This is because agriculture involves several responsibilities and settings. Most of these responsibilities happen to be outdoors, thus exposing agricultural workers to many harmful risk factors **(Radwan et al., 2023).**

Agricultural workers encounter different problems while doing their farming activities such as repetitive tasks, lifting and carrying heavy objects, commonly working with a flexed back, chance of injuries produced, and suffering from vibrations from village automobiles and mechanical hand tools. These conditions may predispose them to a possible risk of MSDs such as osteoarthritis (OA) of the knee and hip, lower back pain, upper limb and neck complaints, and syndrome of hand-arm vibration **(Sombatsawat et al., 2019).**

Nurses play a crucial role in addressing MSDs among agricultural workers, who are particularly vulnerable due to the physically demanding nature of their work. Nurses are often at the forefront of implementing preventive measures, such as educating workers on proper lifting techniques and the importance of regular breaks to reduce strain **(Benos et al., 2020)**. They also conduct ergonomic assessments to identify risk factors and recommend modifications to work practices and equipment. Additionally, nurses provide early intervention and treatment for MSDs, helping to manage pain and prevent further injury **(Shivakumar et al., 2024).** By promoting health and safety practices, nurses contribute significantly to reducing the incidence and severity of MSDs in the agricultural sector **(Benos et al., 2020).**

Musculoskeletal disorders not only affect the individual physically but also impact the psychosocial status of individuals, their families, and occupations. A survey of 15 European countries presented that one of the industries with

the utmost exposure to substantial physical burdens is agriculture. A list of studies nationally and internationally has shown that agriculture is a physically challenging profession with work responsibilities that can predispose to MSDs. In a Swedish study, it has been revealed that farmers were 51% more likely than non-farmers to experience musculoskeletal issues. Agriculture is a physically demanding occupation that involves uncomfortable working postures, transporting and transporting equipment, and lifting large supplies. These physically demanding tasks in the short and long term can cause MSDs and work disability (**Sarker et al., 2016).**

In Egypt, agriculture plays a crucial role in the economy, representing 11.3% of the nation's overall production. Additionally, farmers account for 28% of the total job market and makeup over 55% of the agricultural workforce in southern Egypt. **((USAID,2020).** The farming sector in Egypt mostly operates informally, with farmers essentially managing their own private lands in rural regions. Currently, there isn't a structured system in place for monitoring and reporting accidents and hazards related to farming **(Radwan et al., 2023).** The existing literature offers limited insights into the prevalence of MSDs and their associated risk factors among agricultural workers in Egypt. This is particularly true for the Minia governorate, which is one of the largest agricultural regions in the country. In light of this gap, our objective was to assess the prevalence of MSDs and recognize the associated risk factors among agricultural workers in a rural area of the Minia district within the Minia governorate.

Subject and Methods

Study design:

A cross-sectional descriptive- research was utilized to fulfill the aim of this study.

Setting: -

The study was conducted at El-Ismailia village affiliates to Minia district at Minia governorate in Upper Egypt. Minia governorate is one of the largest agricultural governorates in Egypt, with a cultivated area reaching about 540,247 acres. In contrast, 58% of the workforce in the governorate works in agriculture (**Electronic Portal of Minya Governorate, 2023).** Families at El-Ismailia village derive their livelihoods mainly from agriculture while growing food crops and animal breeding is their main source of income.

Sample size and technique

The sample size was calculated using the Cochran formula, (1963) n= t2×p (1-p)/ m2, Where: *n* stands for the calculated sample size, *t* is the confidence level at 95% (standard value of 1.96), *p* stands for prevalence and it was set as 65.6% (prevalence of low back pain as one of the most common MSDs among agricultural workers in Egypt according to a study done by **Wahba et al., (2024)**, *m*= margin of error at 5 %(standard value of 0.05) Therefore, n= (1.96)2 × 0.656(1-0.656)/ (0.05)2. So, the required sample size was determined to be 346 participants.

The sampling technique employed was randomized cluster sampling, executed in three main steps:

1. A district was randomly selected from the governorate.

2. A village within that chosen district was then randomly picked.

3. Since there was no established sampling frame in the village, families were chosen using systematically random sampling. The sample interval was calculated by dividing the village's total number of families (2600 families based on the last national Egyptian census done by the Central Agency for Public Mobilization and Statistics in 2017) by the desired sample size (346), resulting in an interval of 7. A road extending from El Mustafa Mosque, which served as the village's starting point, was randomly selected. From there, one family was randomly chosen as the starting point for the systematic selection process. Subsequently, every 7th family along that road and its adjacent side streets were included in the study.

Inclusion criteria:

- Male or female farmers.
- Aged 18-65years old
- Doing farm work by themselves
- Participate in all farming-related activities.
- Possess a minimum of one year of work experience; additionally, they should not have had their musculoskeletal systems' operating history reviewed by medical records.

Exclusion criteria

- Not providing informed consent
- Being younger than 18 or older than 65
- Having a history of congenital diseases or severe injuries.
- Having a history of previous surgeries or a significant impairment.
- Pregnant women and subjects who were very sick.

Tools of data collection:

The 1st tool: A structured questionnaire was designed by researchers in the Arabic language based on reviewing the following literature Wahba et al., (2024); Sarker et al., (2016); Ramanathan et al., (2020); Munala et al., (2021). This tool assessed the following three parts:

Part I: Demographic, and physical characteristics of participants: Demographic characteristics included, age, education, marital status, gender, and type of family, Physical characteristics included height, weight, body mass index, and hand domination.

Part II: Work-related characteristics such as working experience, daily working hours, routine lifting of heavy objects, work with the neck, back, and knee in chronic flexion position, working too long without a break, time pressures, performing repetitive forceful tasks, and doing overhead activities

Part III: Psychosocial and behavioral characteristics including income satisfaction, perceived work fatigue, smoking, use of self-

medication for MSDs, and practicing physical exercise.

The 2nd tool: The Nordic Musculoskeletal Questionnaire (NMQ)

The Nordic Musculoskeletal Questionnaire (NMQ) is widely utilized in the field of musculoskeletal as a valid and reliable screening tool for musculoskeletal pain in many epidemiological research and clinical settings worldwide. The development of NMQ originated in 1987 by Kuorinka et al. (1987) with the specific purpose of assessing musculoskeletal pain in the context of ergonomic work-related health conditions. The questionnaire consists of a series of binary questions that are structured and forced to be answered in a yes/no format. The NMQ can be used as a self-administered questionnaire or in interviews with the targeted population as in the current study. In addition, it is a relatively simple and quick assessment tool for identifying musculoskeletal pain prevalence in nine specific areas of the body including the neck, back, shoulders, elbows, wrists, hands, hips, thighs, and feet. It considers these nine anatomical sites for symptoms like pain, weakness, discomfort, ache, numbness, etc on either side or one. The pain was classified into four levels 1= very mild (annoying but does not interfere with work), 2= mild (annoying, interfering little with working), 3=moderate (pain of short duration interfering significantly with posture adaptation), 4= severe (persistent pain affecting the ability to work, 5= very severe (persistent pain (>24 h) causing inability to perform work and affecting quality of life). The agricultural workers were asked about those symptoms and the resulting restriction in performing their daily living activities in the previous 12 months or in the recent seven **(Kuorinka et al., 1987; Kakaraparthi et al., 2023).** This tool is translated into Arabic since Arabic is the national language of the country.

Validity and Reliability:

The content validity of these tools was tested by three experts in community health nursing. The tools' content coverage, item order, clarity, applicability, relevance, phrasing, length, format, and overall appearance were all evaluated. Changes are made in response to experts' feedback and suggestions. Cronbach's coefficient result for the questionnaire's reliability was 0.756.

Data collection procedure:

The interviews were conducted between April 2024 and August 2024 by researchers and two research assistants. Data was collected face to face from the main person responsible for agricultural activities in the family, three days/week in the afternoon from 3 pm: to 6 pm as this is the time the subjects were supposed to be at home while most of them were at the farm in the morning. The participants lived in a village, and the mayor granted permission to conduct the interviews. Notifications of the study's date and timing were disseminated among the village leaders and community networks. The investigator conducted home visits to the village to explain the aims of the study to the subjects to gain their cooperation and consent to share in the study. After oral explanation, oral consent was obtained from every

subject who agreed to participate in the study. The questionnaire was filled out by the researchers and research assistants. Depending on the necessary explanation, the time required to fill out the tools varied from 10 to 15 minutes. Height and weight were recorded barefoot and minimal clothing. Then BMI was calculated by using the formula BMI (Kg/ m2) = Weight (kg) / Height2 (m2).

Pilot study:

A pilot study was conducted on 10% of subjects (34). It was conducted to test the clarity and applicability of the study tools and to estimate the time needed to fill in the tools. No changes were made to the questionnaire in light of the pilot study's results. Consequently, the pilot study sample was incorporated into the whole study sample. The Pilot study was carried out from the med of April (2024) to the beginning of May (2024).

Ethical considerations:

Informed oral consent was obtained from all subjects prior to participation to gain their cooperation; this consent included information about the purpose of the work, study design, time, subject, and study tools. Ethical approval with code number REC202442 was obtained from the Ethics and Research Committee at the Faculty of Nursing at Minia University before the study began. The freedom to leave the study at any moment and the participants' voluntary participation were guaranteed.

Statistical analysis:

Data entry and statistical analysis were conducted using the SPSS version 24.0 software. The data were summarized with descriptive statistics, presenting qualitative variables as frequencies and percentages, and quantitative variables as means and standard deviations. A significance level of less than 5% ($p < 0.05$) was set to determine statistical significance. To identify the variables that could predict MSDs among the participants, logistic regression analysis was performed.

Results

Table (1) indicates more than half of the participants aged between 38-58 years (51.5 %) with mean ± standard deviation equals 43.11± 12.69. Most participants have a secondary education (39.3%) and are married (63.6%). The gender distribution shows a higher proportion of males (75.4%) compared to females (24.6%). Additionally, a significant portion of the participants belong to extended families (62.4%) and are classified as pre-obese (68.7%).

Table (2) shows that over half of the participants have more than 15 years of working experience (52.0%) and work more than 7 hours daily (53.8%). A significant number of participants routinely lift heavy objects (72.0%) and work in chronic flexion positions (74.0%). Additionally, the majority perform repetitive forceful tasks (70.8%) and work too long without breaks (56.4%). Furthermore, more than half (58.4%) reported suffering time pressure while doing their agricultural activities.

Table (3) examines the psychosocial and behavioral characteristics of the studied participants. A large proportion reported high

perceived work fatigue (46.2%) and low income satisfaction (48.0%). The majority use self-medication for MSDs (78.0%) and do not do physical exercise (79.5%).

Figure (1) shows that the majority (74.5 %) of the participants reported experiencing MSDs, while 25.5% did not report such complaints.

Figure (2) offers insight into the prevalence of MSDs among the study participants in the 9 anatomical sites assessed by the NMQ in the past 12 months. A high prevalence was reported in specific body parts such as the lower back, knees, wrists, and shoulders (67.1%, 44.6, 34.1%, and 28.7% respectively).

Figure (3) shows that the lower back (33.5%) and one or both knees (30.4%) are prominently affected by severe pain, whereas one or both ankles and feet (47.6%) and the shoulder (34.7%) exhibit the highest occurrences of moderate pain. In addition, the elbow and neck represent the highest levels of mild pain, at 51.5% and 45.8%, respectively.

Table (4) indicates that several factors significantly increase the odds of MSD prevalence among agricultural workers while males show a higher prevalence (78.9%) than females, with a significant odds ratio (OR = 1.266, $p = 0.002$). Prolonged working hours (more than 7 hours daily) greatly increase MSD odds (OR = 0.708, $p < 0.0001$), as does routine heavy lifting (OR = 1.264, $p = 0.001$) and working in chronic flexion positions (OR = 1.507, $p < 0.0001$). High-risk activities, including repetitive forceful tasks (OR = 1.283, $p = 0.001$), lack of breaks (OR = 1.406, $p < 0.0001$), and time pressure (OR = 1.512, $p < 0.0001$), also significantly correlate with MSD prevalence. Moreover, self-medication usage (OR = 1.414, $p < 0.0001$) is associated with increased MSD prevalence.

Table (5) presents a multivariate logistic regression analysis of factors associated with the prevalence of MSDs. Age emerges as a significant factor, with the prevalence of MSDs increasing notably with age, reaching 100% in individuals aged 59-65 (B = 18.209, $p < 0.0001$). Education level is also associated with MSDs; those with lower education levels, such as no formal education (92.5%), show higher prevalence. Marital status influences MSD prevalence, with widowed individuals showing the highest rates (87.5%, B = 0.223, $p < 0.0001$). Moreover, pre-obesity (B = 3.784, $p = 0.001$) and extensive work experience (over 15 years, B = 17.010, $p < 0.0001$) are significantly associated with higher MSD prevalence.

Psychological and behavioral characteristics also play a crucial role in the occurrence of MSDs while high levels of perceived work fatigue correlate strongly with MSDs (B = 48.556, $p < 0.0001$), as do low-income satisfaction (B = 11.829, $p < 0.0001$) and smoking status, with ex-smokers displaying the highest odds (B = 20.514).

Table (1): Demographic and physical characteristics of the study participants (N= 346).

	No.	%
Age/ years		
18 – 28	67	19.4
29– 38	56	16.1
39 – 48	95	27.5
49 – 58	83	24.0
59 - 65	45	13.0
Mean ± SD	43.11± 12.69	
Education		
Not read or write	80	23.2
Primary or preparatory	60	17.3
Secondary	136	39.3
University or higher	70	20.2
Marital status		
Single	69	19.9
Married	220	63.6
Widow	40	11.6
Divorced	17	4.9
Gender		
Male	261	75.4
Female	85	24.6
Type of family		
Single	130	37.6
Extended	216	62.4
BMI		
Underweight (<18.5)	4	1.2
Normal (18.5 – 22.99)	54	15.6
Pre-obese (23 – 24.99)	238	68.7
Obese (≥ 25)	50	14.5
Hand domination		
Left hand	32	9.2
Right hand	314	90.8

Table (2): Work-Related Characteristics of the study participants (N= 346).

	No.	%
Working experience		
<5	59	17.1
5– 15	107	30.9
>15	180	52.0
Daily working hours		
<6	160	46.2
>7	186	53.8
Routine lifting of heavy objects		
Yes	249	72.0
No	97	28.0
Work with the neck, back, knee in chronic flexion position		
Yes	256	74.0
No	90	26.0
Performing repetitive forceful tasks		
Yes	245	70.8
No	101	29.2
Working too long without a break		
Yes	195	56.4
No	151	43.6
Time pressures		
Yes	202	58.4
No	144	41.6
Overhead activities		
Yes	124	35.8
No	222	64.2

Table (3): Psychosocial and Behavioral characteristics of the study participants (N= 346).

Psychosocial and Behavioral characteristics	No.	%
Perceived work fatigue		
Low	64	18.5
Moderate	122	35.3
High	160	46.2
Income satisfaction		
Low	166	48.0
Moderate	146	42.2
High	34	9.8
Use of self-medication for MSD		
Yes	270	78.0
No	76	22.0
Smoking status		
Smoker	121	35.0
Non smoker	199	57.5
Ex-smoker	26	7.5
Practicing Physical exercise		
Yes	71	20.5
No	275	79.5

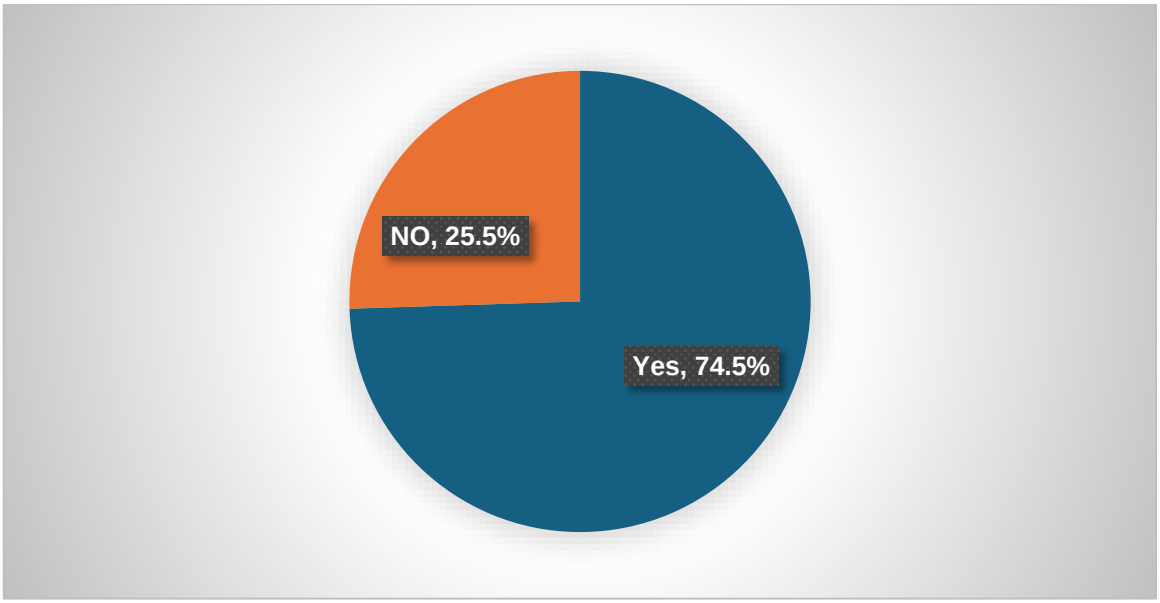

Figure (1): Frequency distribution of the prevalence of MSDs during the last 12 months among the studied participants (N= 346)

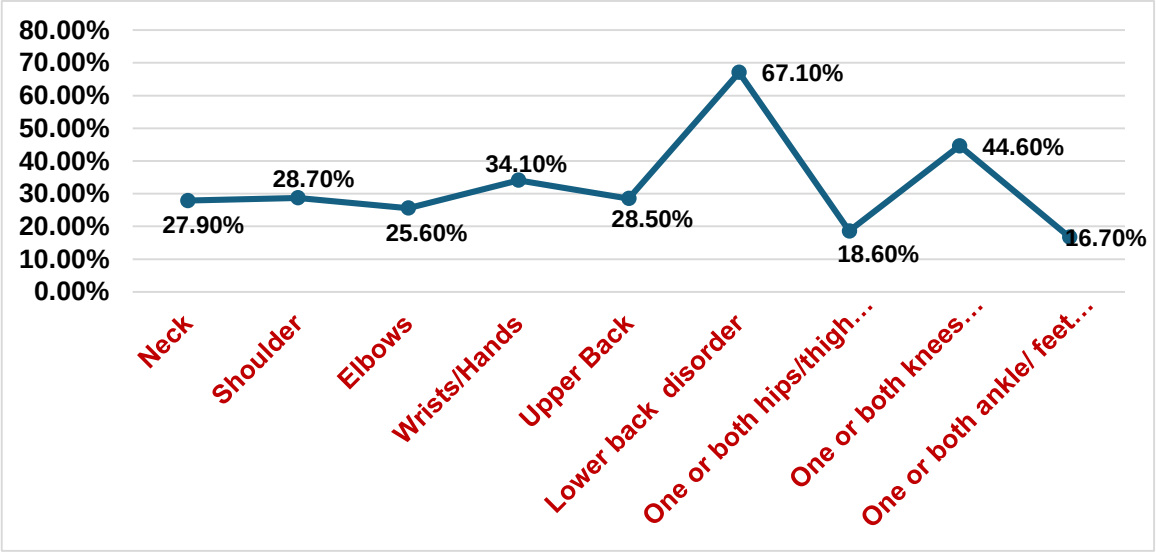

Figure (2): Prevalence of MSDs according to body parts in the past 12 months (n= 258)

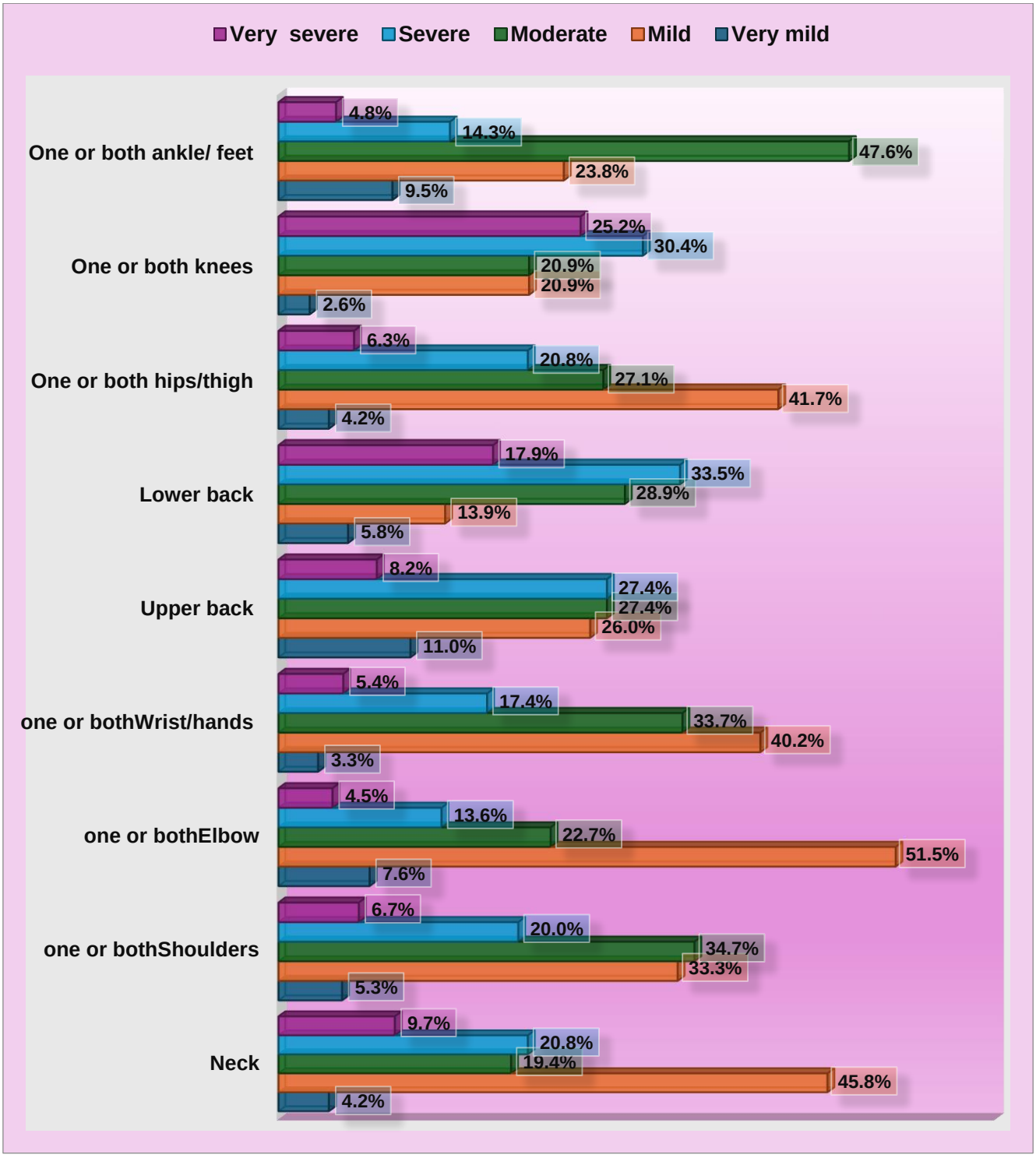

Figure (3): Distribution of pain severity levels across different body parts affected by MSDs among the studied participants

Table (4): Bivariate logistic regression analysis of MSDs prevalence with various characteristics of the studied participants

	No.	Prevalence of MSDs No.(%)	Odd ratio (upper – lower)	P – value
Gender				
Male	261	206 (78.9)	1.266 (1.510 – 1.061)	0.002**
Female	85	53(62.4)	1	
Type of family				
Single	130	94(72.3)	1	
Extended	216	165(76.4)	0.947 (1.078 – 0.831)	0.397
Hand domination				
Left hand	32	24(75.0)	1	0.984
Right hand	314	235(74.8)	0.998 (1.231 – 0.809)	
Daily working hours				
<6	160	98(61.2)		0.0001**
>7	186	161(86.6)	0.708 (0.810 – 0.618)	
Routine lifting of heavy objects				
Yes	249	198 (79.5)	1.264 (1.492 – 1.072)	0.001**
No	97	61(62.9)		
Work with the neck, back, knee in chronic flexion position				
Yes	256	210(82.0)	1.507 (1.836 – 1.237)	0.0001**
No	90	49(54.4)		
Performing repetitive forceful tasks				
Yes	245	196(80.0)	1.283 (1.511 – 1.089)	0.001**
No	101	63(62.4)		
Working too long without a break				
Yes	195	167(85.6)	1.406 (1.617 – 1.222)	0.0001**
No	151	92(60.9)		
Time pressures				
Yes	202	176(87.1)	1.512 (1.756 – 1.301)	0.0001**
No	144	83(57.6)		
Overhead activities				
Yes	124	101(81.5)	1.144 (1.289 – 1.016)	0.035*
No	222	158(71.2)		
Use of self-medication for MSD				
Yes	270	216(80.0)	1.414 (1.737 – 1.151)	0.0001**
No	76	43(56.6)		
Practicing Physical exercise				
Yes	71	47(66.2)	0.859 (1.026 – 0.718)	0.059
No	275	212(77.1)		

Table (5): Multivariate logistic regression analysis of MSDs prevalence with various characteristics of the studied participants

	No.	Prevalence of MSDs No.(%)	B (upper – lower)	P – value
Age/ years				
18 – 28	67	38(56.7)	1	0.0001**
29– 38	56	31(55.4)	0.148 (1.934 – 0.463)	
39 – 48	95	65(68.4)	0.034 (3.163 – 0.864)	
49 – 58	83	80(96.4)	2.269 (71.019 – 5.832)	
59 - 65	45	45(100.0)	18.209(98.125 – 54.218)	
Education				
Not read or write	80	74(92.5)	0.693 (7.209 – 0.903)	0.0001**
Primary or preparatory	60	49(81.7)	0.087 (2.272 – 0.374)	
Secondary	136	78(57.4)	1.576 (0.374 - 2.272)	
University or higher	70	58(82.9)	1	
Marital status				
Single	69	38(55.1)	2.048 (1.274 – 0.112)	
Married	220	173(78.6)	2.464 (3.635 – 0.353)	
Widow	40	35(87.5)	0.223(9.282- 0.500)	0.0001**
Divorced	17	13(76.5)	1	
BMI				
Underweight (<18.5)	4	3(75.0)	1	0.001**
Normal (18.5 – 24.99)	54	32(59.3)	3.091(1.970 – 0.047)	
Pre-obese (25 – 29.99)	238	194(81.5)	3.784 (14.466 – 0.149)	
Obese (≥ 30)	50	30(60.0)	2.996 (5.154 – 0.049)	
Working experience				
<5	59	28(47.5)	1	0.0001**
– 15	107	62(57.9)	1.525 (2.890 – 0.805)	
>15	180	169(93.9)	17.010(37.692 – 7.676)	
Perceived work fatigue				
Low	64	18(28.1)	1	0.0001**
Moderate	122	89(73.0)	6.892 (13.545 – 3.507)	
High	160	152(95.0)	48.556 (118.922 – 19.825)	
Income satisfaction				
Low	166	138(83.1)	11.829 (27.459 – 5.095)	0.0001**
Moderate	146	111(76.0)	7.611 (17.542 – 3.320)	
High	34	10(29.4)	1	
Smoking status				
Smoker	121	105(86.8)	3.640 (6.637 – 1.996)	0.0001**
Non smoker	199	128(64.3)	1	
Ex-smoker	26	26(100.0)	20.514 (2.456 – 1.245)	

Discussion

Because most work in the agricultural industry is done by hand with traditional farming hand tools, it is seen as labor-intensive employment. Because these hand instruments are not ergonomically constructed, workers are subjected to excessive stress, which might result in MSDs. According to a systematic review of the literature, repetitive tasks, awkward postures, forceful exertion, vibration, and exposure to hot

weather, in addition to the use and design of hand tools, are the main causes of work-related injuries among farmers that result in severe chronic pain and workers' disability. (Bairwa et al., 2021). The current research aimed to assess the prevalence and associated risk factors of MSDs among agricultural workers.

Regarding the prevalence of MSDs in the last 12 months, about three-quarters of the participants reported experiencing MSDs. The high prevalence of MSDs among agricultural workers, with approximately three-quarters reporting such conditions, emphasizes a significant occupational health issue. The findings of the current research align with **Mrithula et al., (2023)** who studied "Musculoskeletal disorders and pain in agricultural workers in Low- and Middle-Income Countries: a systematic review and meta-analysis" while indicating a pooled prevalence of MSDs among agricultural workers in low- and middle-income countries (LMIC) at 76%. In the same context **Teeraphun et al., (2021)** who explored "Agricultural Risk Factors Related Musculoskeletal Disorders among Older Farmers in Pathum Thani Province, Thailand" found that the majority of farmers experiencing MSDs in the past year.

These findings indicate that agricultural workers are particularly vulnerable to MSDs due to the physical demands of their work, including repetitive motions and heavy lifting. Furthermore, agricultural workers in Egypt utilize traditional or conventional techniques to do their farming activities while the applications of agricultural technology are limited which can expose them to risk factors in different farming processes, resulting in work-related injuries in different body regions.

Conversely to the current study finding, farmers engaged in manual paddy bagging tasks were found to have a much lower prevalence of MSDs, with specific body regions affected at rates ranging from 3.3% to 20% **(Thariq et al., 2023)**. This contradiction may be due to the difference in the nature and duration of farming activities between participants of the current study and farmers engaged in manual paddy bagging tasks which are practiced only in the season of rice cultivation using various specific tools and utensils manually.

Concerning the anatomical sites affected by MSDs during the past 12 months, a high prevalence was reported in specific regions such as the lower back (67.1%), knees (44.6%), wrists (34.1%), and shoulders (28.7%), which could indicate repetitive strain or the physical demands of certain tasks that target these areas. This trend is evident across various studies, indicating that specific anatomical sites are more susceptible to injury due to the nature of agricultural work.

This result is supported by **Mrithula et al., (2023)** who revealed that the 12-month prevalence of low back pain among agricultural workers in low- and middle-income countries (LMIC) was notably high (61.96% and 54.16% respectively) in Africa and in Asia. In the same context **Poochada, et al., (2022)** who explored "Musculoskeletal Disorders among Agricultural Workers of Various

Cultivation Activities in Upper Northeastern Thailand" stated that the top three body parts with the highest levels of MSDs were the knees/calves, the lower back, and the shoulders. Additionally, this result remains in agreement with **Mishra et al., (2024)** who investigated "Work-related musculoskeletal disorders among various occupational workers in India: a systematic review and meta-analysis" reported that the prevalence of low back pain (77%) and shoulder pain (44%) among agricultural workers was notably higher than in other sites.

Furthermore, **Munala et al., (2021)** reported that most of the Work-related musculoskeletal disorders (WMSD) cases were reported in the low back. The high prevalence of low back pain across different studies could be due to the occupational strain that the lower back is subjected to during the day-to-day work tasks. On the other hand, **Mbada et al., (2016)** study "Prevalence and Profile of Work-Related Musculoskeletal Disorders among Peasant Farmers in A Rural Community in South-Western Nigeria" indicated that the neck, shoulder, and lower Back were the worst-hit body regions by WMSDs in the past 12 months. This difference suggests that the anatomical sites affected by MSDs may vary significantly between agricultural worker populations, warranting further investigation considering posture analysis for different work postures.

Regarding the distribution of pain severity levels across different body parts affected by MSDs among agricultural workers, the lower back and one or both knees are prominently affected by severe pain, whereas one or both ankles and feet and the shoulder exhibit the highest occurrences of moderate pain. In addition, the elbow and neck represent the highest levels of mild pain. These results are advocated by **Poochada et al., (2022)** who found that through the levels of discomfort that were reported, the most reported level of discomfort was in the knees/calves, followed by the lower back, and mild pain was most prevalent in the elbow and neck. Additionally, this was consistent with the findings of **Mrithula et al., (2023)** who showed that moderate pain levels are notably high in the ankles and feet, as well as the shoulders. The variation of discomfort in various body regions may be attributed to the difference in the nature of the posture adapted or repetitive movements done by the study participants.

Despite the findings indicating severe pain in the lower back and knees in the current study, a study done by **Kalita et al., (2020)** who assessed "Musculoskeletal Disorder and Body Parts Discomfort of Farm Women in Paddy Storage Activity of Assam" suggests that upper body discomfort, particularly in the shoulders, is more pronounced which may be justified by the difference in factors such as the type of agricultural activity and the working posture highlighting the need for targeted ergonomic interventions based on the nature of farming activity and the anatomical sites affected.

Using the bivariate logistic regression analysis, the current research revealed that several factors significantly increase the likelihood of MSD prevalence, while males have a higher

prevalence than females. Prolonged working hours, routine heavy lifting, and working in chronic flexion positions also increase MSD odds. High-risk activities, such as repetitive forceful tasks, lack of breaks, and time pressure, are significantly correlated with MSDs prevalence. Additionally, self-medication usage is associated with increased MSDs prevalence. Collectively, these findings underscore the need for ergonomic interventions designed to prevent work-related MSDs among agricultural workers and promote health awareness to mitigate the risks of MSDs in this vulnerable population which can benefit their health and productivity.

In the same line with the current study, **Titaporn et al., (2013)** agreed that males are more affected by MSDs than females, with studies indicating a higher odds ratio for men in various agricultural tasks when they investigated "Factors Associated with Musculoskeletal Disorders among Rice Farmers: Cross-Sectional Study in Tarnlalord Sub-District, Phimai District, Nakhonratchasima Province, Thailand".

About work conditions, **Teeraphun et al., (2021)** stated in alignment with the results of the present study that prolonged working hours and routine heavy lifting significantly increase the likelihood of MSDs when examined "Agricultural Risk Factors Related Musculoskeletal Disorders among Older Farmers in Pathum Thani Province, Thailand". Additionally, **Poochada et al., (2022)** found that Chronic flexion positions are common in agricultural work, contributing to discomfort and injury.

Observing high-risk activities, **Zahra et al., (2020)** analyzed "Work-related Musculoskeletal Symptoms among Agricultural Workers: A Cross-sectional Study in Iran". They noticed that repetitive tasks and lack of breaks are prevalent in agricultural settings, leading to higher MSDs rates. In the same line **Rahul et al., (2019)** evaluated "Effect of individual and work parameters on musculoskeletal health of manual agriculture workers" While it was detected that time pressure during peak seasons exacerbates the risk of developing MSDs. Regarding self-medication, **Teeraphun et al., (2021)** confirmed in alignment with the results of the present study that the use of self-medication among agricultural workers is associated with increased MSDs prevalence, indicating a potential lack of access to professional healthcare.

In the current research, additional key factors associated with the prevalence of MSDs were revealed using the multivariate logistic regression analysis, while age is a significant factor with older individuals showing a notable increase in MSDs prevalence. This finding is consistent with **Ayu et al., (2024)** who explored "Risk Factor Analysis of Lamentation of Musculoskeletal Disorders (MSDs) in Palm Oil Harvester Workers in South Labuhan Batu District" and found that older agricultural workers exhibit a higher prevalence of MSDs. This finding may be explained by the individuals' advance in age, they may experience decreased physical resilience and slower recovery from physical strain, further increasing their vulnerability to MSDs.

Education level also plays a role; with those having lower education levels experiencing higher rates of MSDs. The result of the present study agrees with **Rahul et al., (2019)** who reported that lower education levels are associated with higher MSDs prevalence. These results may be due to lower awareness of ergonomic practices and preventive measures among less educated participants, leading to higher rates of musculoskeletal issues, suggesting that educational interventions could mitigate the risks.

Marital status is influential in the provenance of MSDs, particularly among widowed individuals who show the highest prevalence. This finding is consistent with **Teeraphun et al., (2021)** who revealed that marital status, particularly being widowed, correlates with increased MSDs rates, highlighting the potential psychosocial stressors and its effect on health.

Furthermore, the current research revealed that increasing in BMI and extensive work experiences are significantly linked to higher MSDs prevalence. In the same line with the current study, **Laura et al., (2013)** approved that higher BMI is associated with an increased risk of developing musculoskeletal symptoms. Specifically, obesity correlates with a 28% higher prevalence of these symptoms compared to normal-weight individuals when they investigated "The relation between body mass index and musculoskeletal symptoms in the working population". An explanation of this finding is that excess weight can increase mechanical load on joints and muscles, heightening the risk of injury. Obesity has been identified as a risk factor for a variety of musculoskeletal issues, including LBP, hip, and knee difficulties which may be explained by the fact that gaining weight exerts strain on the spinal parts (**Wahba et al., 2024)**.

The association between extensive work experience and higher MSDs prevalence suggests that long-term exposure to physically demanding tasks contributes significantly to cumulative injuries. This result is consistent with **Rahul et al., (2018)** who studied "Association of risk factors with musculoskeletal disorders in manual-working farmers" and showed that extensive work experience also contributes to increased MSDs rates, as prolonged exposure to manual labor exacerbates physical strain. Further results are consistent with the current study detected **by Wahba et al., (2024)** in their study to investigate the Prevalence of Mechanical LBP among Field Farmers in Giza-Egypt.

Psychological and behavioral characteristics are crucial as well in the association with MSDs while high levels of perceived work fatigue, low-income satisfaction, and smoking status, especially among ex-smokers, are strongly correlated with MSDs. The current study's findings coincide with **Yi et al., (2021**) who examined "Factors Associated with Musculoskeletal Discomfort in Farmers and Ranchers in the U.S. Central States" and exposed that high perceived work fatigue, low-income satisfaction, and smoking status, especially among ex-smokers, are strongly linked to MSDs. Also, they found that psychological stressors, such as high-stress levels and sleep deprivation,

significantly increase the likelihood of experiencing musculoskeletal pain. The association between these Psychological and behavioral characteristics and the prevalence of MSDs provides opportunities to prevent these discomforts through modification in the lifestyle of agricultural workers.

Limitations of the study

The evaluation of postural and ergonomic strain on various muscle groups engaged in agricultural tasks was not included in this study due to a lack of available resources which should be considered in future research.

Conclusion

The study emphasized that MSDs are a significant occupational health problem among agricultural workers. A high prevalence of MSDs was reported in the lower back, knees, wrists and shoulders. Several personal and work-related factors significantly increase the likelihood of MSDs among participants including age, gender, education level, marital status, extensive work experience, prolonged working hours, routine heavy lifting, working in chronic flexion positions, time pressure, and repetitive forceful tasks. Psychological and behavioral characteristics also play a crucial role in the occurrence of MSDs while high levels of perceived work fatigue, low-income satisfaction, and smoking status correlate strongly with the prevalence of MSDs**.**

Recommendations

1 Suitable ergonomic measures, such as workplace and equipment design, should be employed. Moreover, early screening and treatment for existing MSDs should be done to decrease the prevalence of MSDs among agricultural workers.

2 Educational programs to teach good body mechanics and organize adequate rest intervals are highly recommended. Ergonomics education and training are critical in keeping workers safe, reducing MSDs, and teaching proper ways to perform work activities.

3 Collaborative efforts among health and safety professionals, epidemiologists, engineers, social scientists, and ergonomists are necessary to share their experiences about what makes agriculture a safer industry.

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