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Original Article

Prevalence and associated factors of musculoskeletal disorders among aquaculture workers in Vietnam: A cross-sectional study

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ABSTRACT

Introduction: Aquaculture work is a physically demanding occupation with numerous risk factors for musculoskeletal disorders (MSDs), including exposure to cold water, heavy lifting, and repetitive tasks. This study aimed to determine the prevalence and associated factors of MSDs among aquaculture workers in Vietnam.

Methods: A cross-sectional descriptive study was conducted involving 768 aquaculture workers aged 20 to 65 years. Participants were interviewed and clinically examined to assess their MSD status. The Nordic Musculoskeletal Questionnaire (NMQ) was utilized to assess symptoms of MSDs.

Results: The prevalence of MSDs within the past seven days among aquaculture workers was 472/768 (61.5%), (95%confidence interval [CI]: 58.1%–64.9%). The most commonly affected body regions were the lower back 206 (43.6%), knee joints 166 (35.2%), and wrists/hands 149 (31.6%). Identified associated factors for MSDs included female gender (adjusted odds ratio [AOR] = 2.21, 95%CI: 1.64–2.97), work experience of 10 to 19 years (AOR = 1.43, 95%CI: 1.01–2.05) and over 20 years (AOR = 2.17, 95%CI: 1.45–3.19) compared to less than 10 years, being overweight or obese (AOR =1.89, 95%CI: 1.26–2.79), working underwater (AOR =3.01, 95%CI: 2.17–4.16), frequently lifting heavy loads (AOR = 2.92, 95%CI: 2.07–4.03), and regularly feeding seafood (AOR =2.48, 95%CI: 1.83–3.33).

Conclusion: MSDs are common health problems among aquaculture workers. To alleviate the burden of MSDs among aquaculture workers, its prevention should be integrated into occupational health policies, and evidence-based ergonomic interventions and improvements in working conditions must be implemented. Particular attention should be given to high-risk groups, including female workers, those with prolonged work hours, overweight individuals, and those performing physically demanding tasks.

Keywords: aquaculture workers, associated factors, musculoskeletal disorders (MSDs), Vietnam.

Introduction

Musculoskeletal disorders (MSDs) are defined as diseases or injuries affecting the joints, bones, muscles, nerves, tendons, ligaments, soft tissues, cartilage, and spinal discs.[1] They are among the most common occupational health problems and have a significant impact on physical and mental health, quality of life, and work productivity.[1,2] According to the World Health Organization (WHO), MSDs are the leading cause of reduced or lost work capacity worldwide, particularly in occupations that involve intensive manual labor, such as agriculture, fishing, and aquaculture.[3]

The prevalence of MSDs varies across occupations and study populations. A systematic review by Akbar KA et al. found high rates of MSDs among farmers in Southeast Asia, reporting prevalence figures of 78.3% in Thailand, 81.27% in Indonesia, and 88.39% in Malaysia.[4] Among Brazilian fishermen, the prevalence was 93.5%, with the lower back (86.4%), wrists/hands (73.5%), and upper back (66.8%) being the most commonly affected areas.[5] MSD prevalence among fish processing workers was reported at 71.0%,[6] while among shoemakers, it was 45.6%.[7]

The development of MSDs is influenced by multiple interrelated factors. Individual risk factors include age, sex, high body mass index (BMI), and low physical fitness.[8] Occupational exposures such as repetitive tasks, forceful exertions, awkward postures, prolonged standing, and manual handling are strongly associated with MSDs.[9] Environmental conditions, including cold temperatures, vibration, and unstable surfaces, further increase the risk.[10,11]

The aquaculture industry encompasses fishing, farming, and processing of aquatic products. Labor in this sector is physically demanding, highly specialized, and often repetitive. Workers are frequently exposed to cold and humid conditions in the outdoors environment and perform tasks such as net pulling, feed carrying, harvesting, and pond renovation.[12,13] These factors are well-established contributors to various occupational diseases, particularly MSDs.[14–16]

Although MSDs are a prevalent and significant occupational health concern among aquaculture workers, research on their epidemiology and associated risk factors remains limited, especially in developing countries.[17] In Vietnam, no official data are currently available on MSDs in this workforce. Therefore, it is essential to determine the prevalence and associated risk factors of MSDs among aquaculture workers. Generating such evidence will help inform appropriate intervention strategies to protect workers' health and improve working conditions.

Methods

This was a cross-sectional descriptive epidemiological study.

A total of 768 aquaculture workers aged 20–65 years, employed in lagoons, sea cages, and coastal areas in Hai Phong, Vietnam, were recruited for the study between February and October 2023.

Participants were eligible for inclusion if they had at least two years of experience in aquaculture work and provided informed consent to participate in the study.

The sample size was calculated using the following formula for estimating the sample size for a proportion:

$$n = Z^2_{1-\frac{\propto}{2}} \frac{p(1-p)}{(d)^2}$$

In this formula, Z represents the confidence level (CI) of 95% (Z = 1.96), and p is the estimated prevalence of MSDs from a previous study. Due to the lack of data on the prevalence of MSDs among aquaculture workers in Vietnam, we chose p = 0.5, and d = 0.05 as the margin of error. The minimum sample size (n) was calculated to be 384 participants. To enhance the reliability and precision of the study, the sample size was doubled to 768. This adjustment accounts for potential issues such as non-response and incomplete data, allowing for more robust subgroup and multivariable analyses. Increasing the sample size in this manner is a widely accepted practice in public health and occupational epidemiology to ensure that findings are generalizable and statistically valid, particularly in populations with potential heterogeneity in exposure and outcome.[18]

A simple random sampling method was employed. A complete list of households with aquaculture workers in Hai Phong was prepared, and 768 households were randomly selected using a random number table. One aquaculture worker from each selected household was invited to participate. If a household was absent or declined to participate (97 households), it was replaced by another randomly selected household from the remaining list to maintain the planned sample size. Consequently, a total of 768 aquaculture workers were successfully enrolled in the study.

Participants underwent a clinical examination to assess MSD conditions. Height and weight were measured, and BMI was calculated. A structured face-to-face interview was conducted to collect information on the following variables:

Demographic characteristics: Gender, age, work experience, and education level.

Work-associated factors: Working underwater (yes/no), carrying heavy loads (yes/no), and regular seafood feeding duties (yes/no).

Musculoskeletal symptoms: Classification of patients as symptomatic or asymptomatic (for each region) based on self-reported pain, discomfort, or limited mobility in the past seven days in any of the

nine anatomical regions: neck, shoulders, upper back, elbows, lower back, wrists/hands, hips/thighs, knees, and ankles/feet.

Diagnosis of musculoskeletal disorders: MSDs were assessed using the Nordic Musculoskeletal Questionnaire (NMQ), a standardized instrument developed by Kuorinka et al. in 1987. The questionnaire demonstrates high internal consistency, with a Cronbach's alpha > 0.945, and excellent inter-rater reliability, with a Cohen's Kappa ranging from 0.88 to 1.00.[19] The NMQ has been validated and widely used in Vietnam.[20] The instrument consists of 40 forced-choice questions targeting musculoskeletal symptoms in various anatomical regions, supported by a body map illustrating nine specific areas: neck, shoulders, upper back, elbows, lower back, wrists/hands, hips/thighs, knees, and ankles/feet. Respondents were asked whether they had experienced musculoskeletal symptoms in the past seven days and whether these symptoms interfered with their normal daily activities. MSDs were defined as pain, discomfort, or limited movement in at least one of the nine anatomical locations.

The assessment of overweight and obesity was based on BMI, calculated using the formula weight (kg)/height (m^2) according to WHO standards for Asian adults.[21] Underweight is defined as BMI < 18.5 kg/m^2, normal weight as BMI 18.50–22.9 kg/m^2, overweight as BMI 23.00–24.9 kg/m^2, and obesity as BMI ≥ 25 kg/m^2.

The study data were analyzed using biomedical statistical methods with SPSS for Windows, version 22.0 (SPSS Inc., Chicago, IL, USA). Categorical variables were represented by frequency and percentage (%), while continuous variables were expressed as mean and standard deviation (SD). Multivariable logistic regression analysis was employed to calculate odds ratios (ORs) along with 95% CIs to assess the relationship between risk factors and MSDs among aquaculture workers. Statistical significance was determined at $p < 0.05$. Risk factors were identified through multivariable logistic regression analysis, utilizing binary dependent variables representing MSDs. The model included potential risk factors such as gender, working experience, education level, BMI, working underwater (yes/no), heavy lifting (yes/no), and frequent seafood feeding (yes/no).

This study was approved by the Ethics Committee in Biomedical Research of the Maritime Medical Institute under Decision No. 08/2024/QĐ-YHB, dated February 5, 2024. Participation in the study was entirely voluntary for all seafarers, and written informed consent was obtained prior to enrollment.

Results

In a study involving 768 aquaculture workers in Hai Phong, Vietnam, focusing on MSDs and associated factors, we obtained the following results:

Table 1: General characteristics of the study participants (n=768)

Variable		No. (%)
Gender	Male	339 (44.1)
	Female	429 (55.9)
Age (years)	mean (SD); min - max	41.7 ± 11.8; 20 - 65
	<30	142 (18.5)
	30-39	189 (24.6)
	40-49	228 (29.7)
	50-59	145 (18.9)
	≥60	64 (8.3)
Work experience (years)	mean (SD); min - max	16.2 ± 8.8; 2 - 41
	<10	206 (26.8)
	10-19	311 (40.5)
	20-29	165 (21.5)
	≥30	86 (11.2)
Education level	Illiteracy	4 (0.5)
	Elementary	121 (15.8)
	Secondary school	425 (55.3)
	High school	201 (26.2)
	College	17 (2.2)

Note: SD = standard deviation; No. = number

Study results (Table 1) indicated that most aquaculture workers were female 429 (55.9%), while males accounted for 339 (44.1%). The participants' ages ranged from 20 to 65 years, with a mean age of 41.7 ± 11.8 years. Age distribution was as follows: under 30 years 142 (18.5%), 30–39 years 189 (24.6%), 40–49 years 228 (29.7%), 50–59 years 145 (18.9%), and 60 years or older 64 (8.3%). The mean working experience was 16.2 ± 8.8 years, ranging from 2–41 years. Workers with less than 10 years of experience accounted for 206 (26.8%), those with 10–19 years for 311 (40.5%), 20–29 years for 165 (21.5%), and 30 years or more for 86 (11.2%). Participants' educational level was generally low, with most having completed secondary school 425 (55.3%), followed by high school 201 (26.2%), elementary school 121 (15.8%), and college 17 (2.2%). Only four participants (0.5%) were illiterate. The results (Figure 1) further revealed that the prevalence of MSDs among aquaculture workers was 472/768 (61.5%); (95% CI: 58.1%–64.9%).

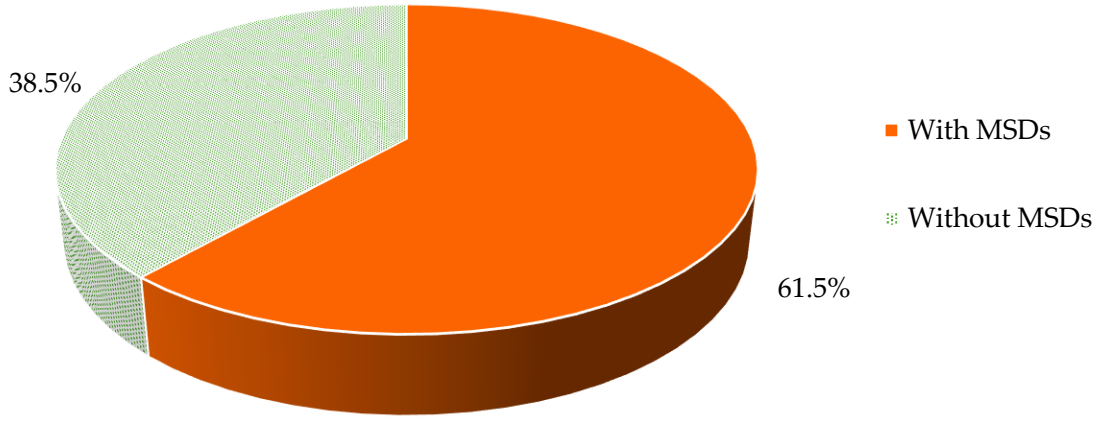

Figure 1: Prevalence of musculoskeletal disorders in study participants (n=768)

Table 2: Distribution of musculoskeletal disorders in the study participants by anatomical location (n = 472)

Location	No. (%)
Neck	140 (29.7)
Shoulder	93 (19.7)
Upper back	138 (29.2)
Elbow	129 (27.3)
Wrist/hand	149 (31.6)
Lower back	206 (43.6)
Hips/thighs	71 (15.0)
Knees	166 (35.2)
Ankles/feet	101 (21.4)

Regarding the distribution of MSDs by anatomical location, results (Table 2) showed that these disorders were most common in the lower back region 206 (43.6%), followed by the knees 166 (35.2%), wrists/hands 149 (31.6%), neck 140 (29.7%), upper back 138 (29.2%), elbows 129 (27.3%), ankles/feet 101 (21.4%), shoulders 93 (19.7%), and hips/thighs 71 (15.0%).

Table 3: Multivariable analysis of factors associated with musculoskeletal disorders in aquaculture workers

Variable	n	With MSDs n (%)	Without MSDs n (%)	AOR (95%CI)	p-value
Gender					
Male (Ref)	339	167 (49.3)	172 (50.7)	1	
Female	429	305 (71.1)	124 (28.9)	2.21 (1.64-2.97)	<0.001
Working experience (years)					
<10 (Ref)	206	106 (51.5)	100 (48.5)	1	
10-19	311	189 (60.8)	122 (39.2)	1.43 (1.01-2.05)	0.047
≥ 20	251	177 (70.5)	74 (29.5)	2.17 (1.45-3.19)	0.001

Variable	n	With MSDs n (%)	Without MSDs n (%)	AOR (95%CI)	p-value
Education level					
High school, college (Ref)	218	127 (58.3)	91 (41.7)	1	
Secondary school	425	265 (62.4)	160 (37.6)	1.09 (0.78-1.53)	0.582
Elementary, illiterate	125	80 (64.0)	45 (36.0)	1.32 (0.83-2.08)	0.239
BMI (Body Mass Index):					
<23 (Ref)	610	356 (58.4)	254 (41.6)	1	
≥ 23	158	116 (73.4)	42 (26.6)	1.89 (1.26-2.79)	0.004
Working underwater					
No (Ref)	477	245 (51.4)	232 (48.6)	1	
Yes	291	227 (78.0)	64 (22.0)	3.01 (2.17–4.16)	<0.001
Carrying heavy loads					
No (Ref)	498	263 (52.8)	235 (47.2)	1	
Yes	270	209 (77.4)	61 (22.6)	(2.07-4.03)	<0.001
Feed seafood regularly					
No (Ref)	317	150 (47.3)	167 (52.7)	1	
Yes	451	322 (71.4)	129 (28.6)	2.48 (1.83-3.33)	<0.001

Note: AOR = Adjusted odds ratio, CI: Confidence Interval, Ref: Reference

Multivariable logistic regression analysis of factors associated with MSDs among aquaculture workers identified several factors (Table 3), including female gender (AOR = 2.21, 95%CI: 1.64–2.97, p < 0.01) and working experience of 10–19 years (AOR = 1.43, 95%CI: 1.01–2.05, p = 0.047) and 20 years or more (AOR = 2.17, 95%CI: 1.45–3.19, p = 0.01) compared to workers with less than 10 years of experience. Being overweight and obese (AOR =1.89, 95%CI: 1.26–2.79, p = 0.04), working underwater (AOR = 3.01, 95%CI: 2.17–4.16, p < 0.01), regularly carrying heavy loads (AOR = 2.92, 95%CI: 2.07–4.03, p < 0.01), and regularly feeding seafood (AOR = 2.48, 95%CI: 1.83–3.33, p < 0.01) were also significant.

Discussion

The study revealed that the prevalence of MSDs among aquaculture workers in Vietnam was 61.5%, highlighting the significant impact of these health issues on the workforce. The most commonly affected anatomical regions were the lower back (43.6%), followed by the knees (35.2%), wrists/hands (31.6%), neck (29.7%), upper back (29.2%), elbows (27.3%), ankles/feet (21.4%), shoulders (19.7%), and hips/thighs (15.0%). The prevalence of MSDs in our study was higher compared to some other occupational groups. For instance, MSDs were reported in 37.9% of office workers,[22] 62.56% of teachers,[23] and 45.6% of shoemakers.[7] Several factors may explain this higher prevalence among aquaculture workers. Research has shown that aquaculture work is physically demanding, with workers often exposed to cold water, high humidity, and strenuous outdoor labor. Additionally, tasks such as carrying heavy loads, feeding seafood, renovating ponds, working long hours, and performing repetitive movements contribute to the physical strain.[13]

A meta-analysis by Ngajilo D et al. found that MSDs are the most prevalent occupational health issue among aquaculture workers, with reported rates ranging from 21.0% to 63.0%. This was followed by respiratory symptoms and bronchial asthma (4.0%–65.0%), skin infections (2.2%–15.7%), and contact dermatitis (6.0%).[17] Similarly, a study by Yalamanchi V et al. on aquaculture workers in Visakhapatnam, India, found MSDs to be the most common health issue (56.3%), followed by neurological problems (48.1%), injuries (43.0%), and skin infections (23.0%).[24] These findings support the conclusion that the physical demands of aquaculture work are closely linked to a variety of health problems, particularly MSDs.

MSDs among aquaculture workers in our study were most prevalent in the lower back (43.6%) and knees (35.2%), reflecting the physical demands of aquaculture work. Workers frequently perform tasks such as lifting heavy loads, bending over to pull nets, and feeding or transporting fish and shrimp.[25] These activities place significant strain on the lumbar spine and knees, especially when combined with risk factors like poor posture and prolonged working hours. Additionally, the prevalence of MSDs in the wrists and hands was notably high (31.6%). This may be attributed to repetitive tasks such as netting, scooping fish, and manually feeding seafood—activities associated with conditions like tendinitis, carpal tunnel syndrome, and degeneration of the small joints in the hand.[26]

The prevalence of MSDs in our study was lower

than that reported in some studies on fishing and seafood processing workers—industries known for their physically demanding labor, prolonged standing, and repetitive tasks. For example, among fishing workers, MSD prevalence was particularly high, with the lower back (92.4%), shoulders (64.8%), knees (31%), and hands (25%) being the most commonly affected regions.[27] Likewise, a study by Nag A et al. reported a 71% prevalence of MSDs among seafood processing workers, with the upper back (54%), lower back (33%), knees (35%), and shoulders (27%) being the most affected areas.[6]

Multivariate logistic regression analysis of factors associated with MSDs in aquaculture workers (Table 3) showed that women were at a higher risk of developing MSDs compared to men. This finding is consistent with results from several other studies.[22,28] In the aquaculture industry, women often perform highly repetitive tasks—feeding, harvesting, and processing seafood—that can contribute to conditions such as tendinitis and carpal tunnel syndrome.[6] Furthermore, hormonal changes also play a role. After menopause, the decline in estrogen levels has been linked to an increased risk of joint pain and osteoarthritis, particularly in the knees and lower back.[29]

Workers with 10–19 years of experience and those with 20 or more years had 1.43 and 2.17 times higher risks of developing MSDs, respectively, compared to workers with less than 10 years of experience. A study by Okezue OC et al. also identified significant factors associated with MSDs, including female gender ($p = 0.004$), long working hours ($p = 0.003$), and work experience ($p = 0.014$).[30] Similar findings have been reported in several other studies.[4,22] As work experience increases, prolonged exposure to mechanical and environmental stressors may elevate the risk of developing MSDs.[31]

The results (Table 3) also indicated that overweight and obesity were associated with an increased risk of MSDs ($p = 0.04$). This finding aligns with previous studies,[22,32] which have shown that excess body weight not only affects cardiovascular health but also impairs musculoskeletal function. Carrying extra weight places additional stress on weight-bearing joints, particularly the knees and hips, which can lead to diminished synovial fluid quality and increased joint pain.

Aquaculture workers who regularly worked underwater had a significantly higher risk of MSDs (OR = 3.01, $p < 0.01$). Previous studies suggest that underwater work often involves exposure to low temperatures, which can lead to muscle spasms, reduced blood circulation, and an increased risk of musculoskeletal injuries.[33] Moreover, working underwater typically requires repetitive movements, awkward postures, and carrying heavy loads in a high-resistance water environment—factors that contribute to conditions such as tendinitis, back pain, and knee osteoarthritis.[34] Similarly, workers who regularly fed seafood also faced a significantly elevated risk of MSDs (OR = 2.48, $p < 0.01$). This may be due to physically demanding tasks such as carrying feed, maintaining repetitive postures, and prolonged exposure to wet and cold environments, all of which can place considerable strain on the musculoskeletal system.[33,35]

Strengths and limitations of the study: This study has several strengths, including a large sample size and the use of a random sampling method, both of which enhance the generalizability of the findings. Further, it provides the first epidemiological evidence on MSDs among aquaculture workers in Vietnam, thus contributing valuable data to an under-researched population. However, some limitations should be noted. For instance, the cross-sectional design restricts the ability to draw causal inferences between exposures and outcomes. Additionally, the reliance on self-reported data may introduce recall bias and reporting bias, potentially affecting the accuracy of the findings.

Conclusions

MSDs are common occupational health issues among aquaculture workers, with a prevalence of 61.5%. The most frequently affected body regions were the lower back, knees, and wrists/hands. Several factors were associated with a higher risk of MSDs, including being female, having longer work experience, being overweight or obese, working underwater, heavy lifting, and frequently feeding seafood. To mitigate these risks, it is essential to improve working conditions and strengthen occupational healthcare. Integrating MSD prevention strategies into occupational health programs—particularly targeting high-risk groups such as female and older workers—should be prioritized.

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Conflicts of interest

There are no conflicts of interest.

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