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Original Article

Lower-back discomfort and ergonomic hazards among artisanal fishermen in Tamil Nadu, India: a cross-sectional study

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ABSTRACT

Introduction: Lower back discomfort is a prevalent occupational health issue among fishermen, substantially contributing to disability adjusted life years and reduced work performance. The primary aim of the study is to examine the lower back discomfort, occupational profile, ergonomic hazard exposure and overall health and wellbeing among artisanal fishermen.

Methods: The present study has been conducted among 400 randomly selected artisanal fishermen from coastal villages of Ramanathapuram District, Tamil Nadu, India between February 2024 and April 2025. Data has been collected using a pretested interview schedule, the standardized Nordic Musculoskeletal Questionnaire (2007), Perceive Stress Scale – 10 and adapted Workplace health and safety survey. Descriptive statistics, Spearmen correlation and regression have also been performed.

Results: Among the selected 400 artisanal fishermen, 269 (67.3%) reported lower back discomfort in the past 12 months with 68 (22%) have experienced interference in daily activities. Ergonomic hazards including lifting of heavy weights 172 (64%), repetitive movements 252 (91%), improper working postures 78 (29%) and prolonged standing (>2 hours) 105 (39%) have been significantly associated with Lower Back Discomfort. With frequent lifting showing adjusted odds ratios of 7.7 (always) and 6.4 (often), psychosocial factors such as poor sleep quality (aOR = 3.6), moderate perceived stress (aOR = 2) and alcohol consumption (22%, $p<0.05$) have also showed significant associations with Lower Back Discomfort. No significant relationships have been observed with demographics, body mass index and comorbidities. The coping strategies have included medication use (70%) and medical consultation (20%).

Conclusion: The study highlights that ergonomic hazards and psychosocial stressors are key determinants of lower back discomfort among artisanal fishermen. Tailored ergonomic interventions, occupational health education and stress management strategies are essential to mitigate musculoskeletal strain to improve their Quality of Life.

Keywords: Alcohol consumption, Artisanal Fishermen, Ergonomic Hazards, Lower back discomfort, Psychosocial stress

Introduction

Work-related musculoskeletal disorders or discomfort encompass a range of conditions affecting muscles, bones, joints, nerves, and other related tissues that arise from or are aggravated by occupational ergonomic exposures. Although these pains are non-fatal, they significantly contribute to disability. Globally, musculoskeletal pain accounts for about 150 million disability adjusted life years, with low back pain alone responsible for around 64 million disabilities adjusted life years.[1]

Small-scale artisanal fishermen are classified under ISCO Unit Group 6-41 (Subsistence fishers, hunters and gatherers), which includes individuals engaged in traditional, non-industrial fishing using manual or small-scale methods.[2] The fisheries sector plays a vital role in achieving Sustainable Development Goals 1, 2, and 3 by supporting food security, nutrition, and livelihoods. However, it is also associated with significant occupational risks that impact public health. According to the International Labor Organization, the fishing industry records one of the highest workplace mortality rates, with an estimated 120 million accidents and 200,000 fatalities annually.[3] Fishers face a range of distinct challenges as they are exposed to harsh environmental conditions, physical hazards and poor working environments.[4]

Musculoskeletal disorders result from a mismatch between work demands and the worker's functional capacity. Ergonomics seeks to minimize this mismatch by designing tasks, tools, and environments that align with individuals' physiological and psychological capabilities.[5] Failure in incorporating these principles often results in physical strain caused by ergonomic hazards among fishers, which elevates the likelihood of musculoskeletal disorders.[6]

The Indian Ocean has long been a vital source of nutrition and livelihood; however, fishermen continue to experience low social status and adverse living conditions, and limited research has highlighted the occupational hazards and health issues they face.[7,8] Occupational health of artisanal fishermen is influenced by both fatal and non-fatal injuries, ranging from musculoskeletal disorders to dermatological and sensory impairments in developing countries.[9] Many cross-sectional studies and systematic reviews,[10] show the higher prevalence of lower back discomfort among artisanal fishers in India,[11] Brazil,[12] Srilanka,[13] Denmark,[14] and other countries.

Low back pain is the most prevalent occupational health issue among fishermen, reducing their work capacity and quality of life. In 2020, it affected about 619 million people globally and is projected to rise to 843 million by 2050, of which 38.8 percent of disability adjusted life years are linked with occupational factors, smoking, and high body mass index.[15] The development of work-related musculoskeletal low back pain is multifactorial, involving ergonomic, biomechanical, functional, and psychosocial components. Sustained mechanical loading and poor postures often cause paravertebral muscle injury and pain, increasing the risk of chronic low back discomfort.[16,17]

Although several studies investigate musculoskeletal lower back discomfort and its ergonomic risk factors, only a few have been conducted among artisanal fishermen in the south coast district of Tamil Nadu. The primary aim of this study is to examine the association between lower back discomfort, occupational profile, ergonomic hazard exposure, health, and well-being among the selected artisanal fishermen in Ramanathapuram District of Tamil Nadu, India.

Methods

This cross-sectional study investigated the occupational profile, ergonomic hazard exposure, and prevalence of musculoskeletal low back pain among the selected artisanal fishermen (n=400) in Ramanathapuram District of Tamil Nadu, India. For simple random sampling, the sample

size is calculated using the Yamane et al. (1967) formula.[18]

Sample size formula (n) = N / 1 + N*(e²)

The total number of fisherfolk in Ramanathapuram District: 1,88,915

The total number of fishermen in Ramanathapuram District: 66,884

(Marine Fisheries census, 2016)

According to Yamane et al (1967),

N : Population size
e : Margin error (5% - 0.05)
(n) = N / 1 + N*(e²) = 66,884 / 1+ 66,884*(0.05)²
Sample size (n) = 400

The inclusion criteria is

- Male artisanal fishermen aged between 18 – 60 years in Ramanathapuram District of Tamil Nadu.
- Actively engaged in fishing for more than one year.

Exclusion criteria

- The fisherman with pre-existing spinal injuries, chronic illness unrelated to occupation and
- Those unwilling to participate.

About 420 - 430 fishermen have been interviewed; incomplete and missing data are excluded from analysis resulting in a final sample of 400 participants for analysis.

The study has been approved by the Institutional Human Ethical Committee of Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India (Approval number: AUW/XMT-038, FSMD/IHEC/23–24). Before the interview, the researcher explained the purpose of the study, and informed consent was obtained from all participants prior to data collection. The study has been conducted in accordance with the principles of the Declaration of Helsinki. The interview has been conducted in face-to-face mode, held for about 25 to 30 minutes. The interview schedule for the study has been formulated and validated for the collection of data. The data collection has been carried from February 2024 to April 2025 in fifteen coastal villages (Devipattinam, Rameshwaram, Mandapam, Pamban, Pudumadam, Muthupettai, Kuthukkalvalsai, Thondi, Tiruppalaikudi, Kadaladi, Alagankulam, Sethukarai, Keelakarai, Ervadi and Valinokkam) of Ramanathapuram District of Tamil Nadu, India.

The occupational profile of the interview schedule has investigated the variables such as age, occupational structure, nature of fishing, number of hours spent fishing, and experience of selected artisanal fishermen. The standardized and self-reported Nordic Musculoskeletal Questionnaire (2007),[19] and Perceived Stress Scale – 10,[20] is used for the assessment of low back discomfort and stress respectively, the Nordic musculoskeletal questionnaire assesses the musculoskeletal discomfort across different body parts, however, the present study specifically focuses on lower back discomfort experienced over the 12 months and the previous seven days, its impact on daily activities and he use of medications and medical treatments.

Ergonomic hazard exposure is an adapted tool from the Workplace Health and Safety Survey by the Institute for Work and Health.[21] It has eight questions investigating the frequency of exposure to lifting heavy items (>20kgs), repetitive movements at work, involved in unfamiliar tasks, interaction with hazardous substances such as chemicals and explosives, improper working postures, work at two meters above ground level, high noise pollution and standing more than two hours at stretch during work at a scale of one to four (1-Rarely to 4-Always). The prevalence of diseases such as diabetes, hypertension, comorbidity, quality of sleep (disrupted sleep: waking frequently during sleep; difficulty in sleep: difficulty in initiating sleep as well as maintaining continuous sleep for at least 6-7 hours), and addictive behavior is

collected through direct interviews with selected artisanal fishermen.

The Perceived Stress Scale – 10, with 10 questions assessing stress experienced over the past seven days, has been investigated. The presence or absence of lower back discomfort is treated as the dependent variable, with occupational profile, ergonomic hazard exposure, substance use, presence of non-communicable diseases, comorbidity, quality of sleep, and perceived stress being the independent variables. The chi-square analysis, Spearman correlation, and binomial regression with model fit are evaluated by the Hosmer and Lemeshow test ($p>0.05$) at 95% statistical significance using Statistical Package for Social Sciences version 21.

Descriptive statistics are presented within each group. Fishermen with lower back discomfort are tested using chi-square analysis (total sample n=400) with a dichotomous variable (1=presence of lower back discomfort, 0 = absence of lower back discomfort). Logistic regression analysis is used to examine associated factors; logistic regression coefficients (B) represent log-odds; adjusted odds ratios (AORs) are obtained by exponentiating B, with 95 percent confidence intervals.

Results

The present study has involved in the investigation of ergonomical hazard exposure and its impact on musculoskeletal low back discomfort among selected artisanal fishermen (n=400). Consistent with findings from previous studies, a considerable proportion of the selected fishermen (269; 67.3%) reported experiencing low back discomfort over the past 12 months. Among 269 selected artisanal fishermen, about 224 selected artisanal fishermen experienced low back discomfort during the past seven days, and it disturbed their day-to-day work and interfered with their ability to work (n=68).

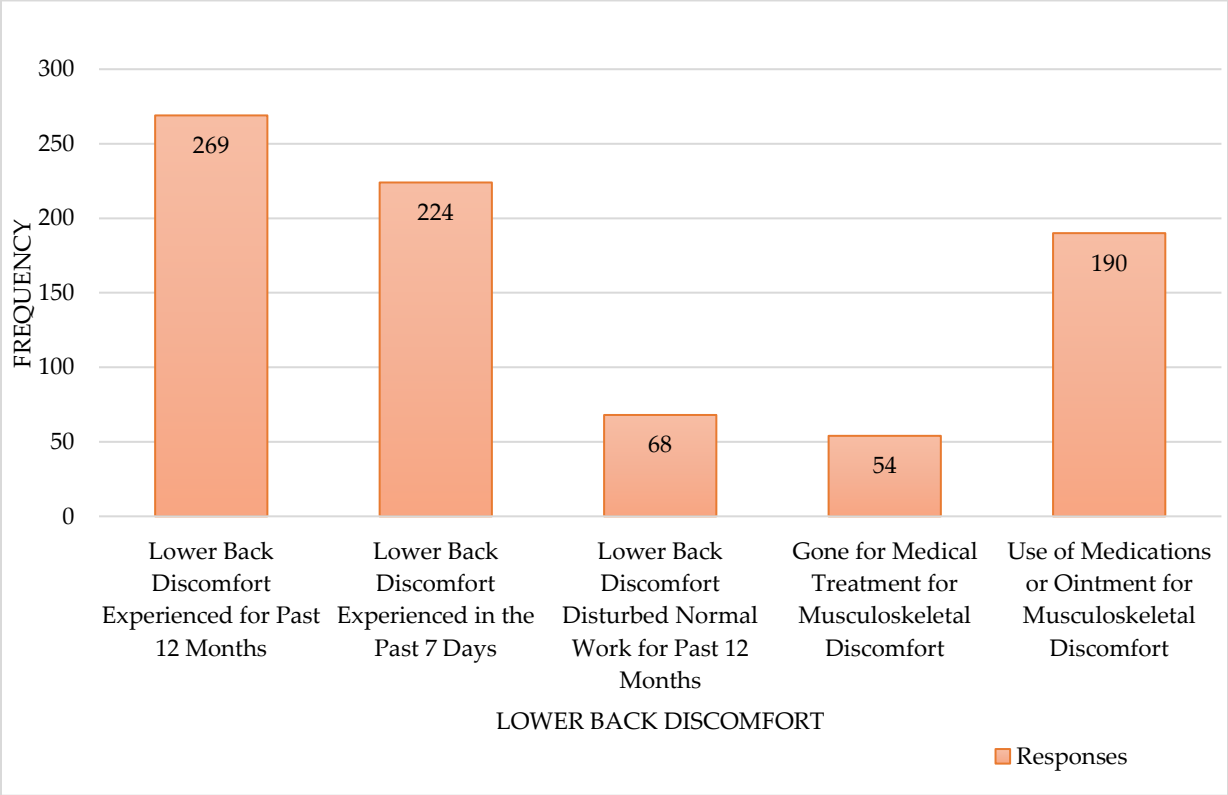

Figure 1: Prevalence of Lower Back Musculoskeletal Discomfort among Selected Artisanal Fishermen

Table 1: Association between the Presence of Lower Back Discomfort and the Occupational Profile of Selected Artisanal Fishermen

Background Information		Lower Back Discomfort Experienced by Selected Artisanal Fishermen (n=269) n(%)	Artisanal Fishermen without Lower Back Discomfort (n=131) n(%)	p value
Age (Years)	Below 24	14(5)	4(3)	0.666
	25-35	28(10)	19(15)	
	36-45	83(31)	37(28)	
	46-55	80(30)	40(31)	
	Above 56 (≤ 60)	64(24)	31(24)	
Occupational Structure	Self-employed (Own Vessel)	137(51)	77(59)	0.261
	Regular wages	132(49)	53(41)	
Socioeconomic Status	Upper class	0	0	0. 902
	Upper middle class	37(9)	24(18)	
	Middle class	307 (77)	94(72)	
	Lower middle class	56 (14)	13(10)	
	Lower class	0	0	
Nature of fishing	Shallow sea fishermen + Net knitting	190(71)	102(78)	0.308
	Deep-sea fishermen + Net knitting	70(26)	26(20)	
	Both	9(3)	3(2)	
Number of hours spent fishing	Below 8	182(68)	95(73)	0.323
	Above 8	87(32)	36(27)	
Experience in fishing (Years)	One to five	8(3)	3(2)	0.465
	Six to ten	24(9)	8(6)	
	Eleven to Fifteen	57(21)	29(22)	
	Sixteen to Twenty	108(40)	45(34)	
	Twenty-one years and above	72(27)	46(35)	

Percentages are calculated column-wise based on the presence or absence of lower back discomfort

Table 1 shows that across all variables of the occupational profile, including age, occupational structure, socioeconomic status, working hours, and experience, there is no significant association with lower back discomfort.

Furthermore, the association between lower back discomfort and the frequency of ergonomic hazard exposure is analyzed. Repetitive movements 252 (94%), lifting heavy items 172 (64%), and standing for more than two hours 105 (39%) are frequently experienced, and this is statistically significant.

Table 2: Occupational Ergonomic Hazard Exposure and Presence of Lower Back Discomfort among Selected Artisanal Fishermen

Ergonomic Hazards	Lower Back Discomfort Experienced by Selected Artisanal Fishermen n(%)				p value
	Always	Often	Sometimes	Never	
Lift, carry, or push items heavier than 20kg at least 10 times a day	172(64)	92(34)	2(1)	3(1)	0.007*
Repetitive movements of the body during work	252(94)	13(5)	1(0.4)	3(1)	0.016*
Unfamiliar tasks	2(0.7)	3(1)	30(11)	234(87)	0.947
Interact with hazardous substances	0	63(23)	135(50)	71(26)	0.755
Bent, twisted or improper position at work	79(29)	114(42)	74(278)	2(0.7)	0.044*
Working at a height of 2 meters or above the ground level	3(1)	29(11)	105(39)	132(49)	0.426
Working in high noise pollution	2(1)	10(4)	15(6)	242 (90)	0.545
Standing for more than 2 hours during work	105(39)	154(57)	4(2)	6(2)	0.004**

*p value<0.05, **p value<0.01.

Table 3: Stratification of Health and Well-being based on the Presence of Lower Back Discomfort among Selected Artisanal Fishermen

Health Profile		Lower Back Discomfort Experienced by Selected Artisanal Fishermen (n=269) n(%)	Artisanal Fishermen without Lower Back Discomfort (n=131) n(%)	p value
Body Mass Index	Underweight (<18.5kg/m^2)	14 (5)	9(7)	0.827
	Normal (18.5 -24.9kg/m^2)	114 (42)	53(41)	
	Overweight (>24.9kg/m^2)	141 (52)	69(53)	
Smoking	Yes	61(23)	29(22)	0.904
	No	208(77)	102(78)	
Alcohol Consumption	Yes	60(22)	17(13)	0.026*
	No	209(78)	114(87)	
Diabetes Mellitus	Yes	93(35)	38(29)	0.255
	No	175(65)	93(71)	
Hypertension	Yes	93(35)	42(32)	0.295
	No	175(65)	89(68)	
Comorbidity	Yes	71(26)	26(20)	0.152
	No	198(74)	105(80)	
Perceived Stress	Low	8(3)	14(11)	0.002**
	Moderate	261(97)	117(89)	
Quality of Sleep	Good	169(63)	96(73)	0.043*
	Disrupted	88(33)	26(20)	
	Difficulty in sleep	12(5)	9(7)	

*pvalue<0.05, **pvalue<0.01. Percentages are calculated column-wise based on the presence or absence of lower back discomfort

About 60(22%) of the artisanal fishermen with lower back discomfort have reported both smoking and alcohol consumption, and a significant association has been observed between alcohol consumption and lower back discomfort (Table 3).

The prevalence of morbidities and comorbidities (20 – 35%) did not show a significant distribution with lower back discomfort. However, LBD is found to affect both the quality of sleep and the perception of stress among the selected artisanal fishermen. Further correlation and regression analysis have confirmed a positive relationship between ergonomic hazard exposure and experience of low back discomfort and stress.

Table 4: Correlation Analysis between Ergonomic Hazard Exposure and Other Variables

Variables	Age (Years)	Working hours	Perceived Stress	Quality of Sleep	Overall Ergonomic Hazard Exposure	Lower back discomfort
Age (Years)	1					
Working hours	0.636	1				
Perceived Stress	0.212	0.403	1			
Quality of Sleep	0.253	0.619	0.704	1		
Overall Ergonomic Hazard Exposure	0.269	0.349	0.004**	0.132	1	
Lower back discomfort	0.983	0.324	0.001**	0.075	0.334	1

*p-value<0.05, **p-value<0.01.

Table 5: Logistic Regression of Ergonomic Hazard Exposure with Lower Back Discomfort

Variables	Category	Lower Back Discomfort			
		B	aOR	CI	p value
Age (Years)	Below 24	0.69	1.99	0.54 – 7.37	0.30
	25-35	-0.42	0.66	0.3 – 1.44	0.29
	36-45	-0.10	0.90	0.48 – 1.68	0.75
	45-55	-0.14	0.87	0.47 – 1.61	0.66
	Above 56 (≤ 60)	RC			
Working Hours	Below 8	-0.21	0.811	0.49 – 1.324	0.40
	Above 8	RC			
Socio economic Status	Upper middle class	RC			
	Middle class	0.11	1.11	0.43 – 2.85	0.825
	Lower middle class	0.54	1.71	0.91 – 3.2	0.096
Lift, carry or push items heavier than 20kg at least 10 times a day	Always	2.04	7.77	2.2 – 26.4	0.001*
	Often	1.9	6.4	1.93 – 21.12	0.002*
	Sometimes + Never	RC			
Bent, twisted or improper position at work	Always	0.055	1.056	0.61 – 1.82	0.66
	Often	0.26	1.3	0.64 – 2.61	0.45
	Sometimes + Never	RC			
Stand more than 2 hours during work	Always	-0.41	0.66	0.22 – 1.99	0.46
	Often	-0.37	0.69	0.22 – 2.15	0.5
	Sometimes + Never	RC			
Perceived Stress	Low	RC			
	Moderate	1.27	3.57	1.28 – 9.89	0.014*
Quality of Sleep	Good	RC			
	Disrupted	0.73	2.06	1.21 – 3.52	0.008
	Difficulty in sleep	-0.43	0.65	0.25 – 1.66	0.65

*p-value<0.05, **p-value<0.01. RC – Reference category; B – logistic regression coefficients (log odds); AOR – adjusted Odds Ratio.

The negative B values indicate reduced odds of lower back discomfort compared with the reference category.

A binary logistic regression model is employed, and its fit is assessed using the Hosmer-Lemeshow test. As shown in Table 5, ergonomic hazards (lift/ carry/ push items heavier than 20kgs/ per day) are the predominant cause of lower back discomfort and it also significantly impacts stress and sleep.

Discussion

The National Institute for Occupational Safety and Health (NIOSH) has defined work-related musculoskeletal disorders as conditions in which the musculoskeletal system is worsened by ergonomic hazards. In the present study, the 12-month prevalence of lower back discomfort among the selected artisanal fishermen was 269 (67.3%), of whom 68 (22%) reported that it interfered with their daily activities. Exposure to occupational ergonomic hazards is the predominant cause of any musculoskeletal discomfort. Artisanal fishermen typically perform physically demanding tasks such as steering vessels, operating navigational tools, deploying and retrieving fishing gear like nets and traps, and frequently transferring heavy loads of 15 to 20kg.[11] In the study, significant associations are observed between lower back discomfort and specific ergonomic hazards such as lifting heavy loads (64%, $p<0.01$), retrieving wetted nets with fish, lifting of fish crates, and hauling anchors, which often demand high physiological workload.[22] In addition, low intensity frequent movements (91%,$p<0.05$) like net repairing and knitting of nets, unloading and sorting of fishes coupled with improper or twisted working postures (29%, $p<0.05$) such as bending, crouching, leaning forward and standing for more than two hours (39%, $p<0.01$) puts excessive strain on the lower back muscles as they often work in confined spaces limiting movements, forcing into awkward postures contributing to prolonged muscle contraction and biomechanical stress.[23] While earlier studies among Fishermen in Vietnam predominantly have highlighted the injuries over the upper extremities, followed by lower limbs, with head and systemic injuries being relatively less frequent. [24] Similarly, a study among informal fish vendors in Sri Lanka has also highlighted the influence of lifting and carrying of heavy loads on wrist musculoskeletal discomforts.[25]

Binary logistic regression has supported these findings through the Hosmer and Lemeshow test, yielding a p-value greater than 0.05, indicating good model fit. Fishermen frequently exposed to ergonomic hazards have had higher odds of experiencing lower back discomfort. Specifically, frequent exposure to lifting heavy loads has been associated with adjusted odds ratios of 7.7 and 6.4 for those reporting the activity 'always' and 'often', respectively. This underscores that each additional unit of exposure to heavy lifting is associated with a corresponding increase in the likelihood of lower back discomfort.

Psychosocial factors have been shown to significantly influence lower back discomfort. Poor sleep quality ($p<0.01$) and moderate perceived stress (97%, $p<0.01$) are significantly associated, with adjusted odds ratios of 3.6 and 2; underscoring the impact of poor-quality sleep and stress on musculoskeletal pain. Fishermen with lower back discomfort have reported significantly higher perceived stress and a greater proportion experiencing disrupted sleep. These findings are consistent with previous studies, which have shown that mental health issues, poor sleep and stress are cofactors, affecting over half of the fishermen and contributing to the development of musculoskeletal discomforts. [6,26,27,28]

Alcohol consumption (22%,$p<0.05$) has shown a significant association with lower back discomfort; substance usage is reportedly higher among fishermen with lower back discomfort, often adopted as a coping mechanism, which may exacerbate physical health issues.[29,30] Conversely, no significant association has been found between body mass index or comorbid conditions such as diabetes mellitus and

hypertension with lower back discomfort which aligns with similar findings in the literature.[23,31]

Most of the fishermen with lower back discomfort 213(79%) in the present study belong to the middle socioeconomic class, often owning their fishing vessel and receiving regular wages. Notably, working hours are not associated with lower back discomfort; this may be attributed to the seasonal and variable nature of artisanal fishing schedules that are frequently adjusted based on marine ecosystems, fish availability, potentially acting as a confounding factor.[32]

The prevalence and patterns observed are consistent with studies from Brazil, reporting high lower back discomfort among fishers engaged in direct fishing activities,[22] while a study on industrial fishermen also reported even higher prevalence of lower back discomfort (92%).[11] However, the findings of the present study show an insignificant association with demographic and occupational profile, which contradicts a review highlighting that age, duration of occupation, type of fishing, and gear used are linked with low back pain.[8] In line with findings from Nigeria[17], where middle-aged artisanal fishermen have shown a higher prevalence of lower back discomfort, although the association has been insignificant. This aligns with a Korean study where age did not significantly predict musculoskeletal discomfort.[26] A North Carolina cohort study suggested higher rates of lower back discomfort among younger or less experienced fishermen.[16] Similarly, a report from Egypt had also suggested a higher prevalence of lower back discomfort among younger fishermen.[33] These inconsistencies may be due to methodological variations and occupational differences.

Although previous studies linked lower income,[34] work-family imbalance, and job insecurity,[35] which may adversely impact fishermen's occupational functioning by reducing work capacity, leading to increased absenteeism and limited performance. These factors are not significant in the study, possibly due to divergent sample sizes, characteristics, occupational practices, and reporting behaviors.

Coping strategies among selected fishermen have included medications use (70%) and medical consultation (20%). The higher prevalence of self-medication suggests a need for improved access to occupational health services. Non-pharmacological interventions such as moderate to high intensity exercises for low back pain, trunk coordination, and strengthening exercises can be effective in managing lower back discomfort, in line with 2021 Academy of Orthopedic Physical Therapy guidelines, and should be tailored to the occupational demands of fishermen.[36,37] Preventive strategies, including task design, lifting aids, posture and handling training, sleep and stress interventions, are essential to mitigate the cumulative impact of ergonomic hazards and psychosocial stressors.

Despite several global studies on musculoskeletal discomfort among fishermen, few detailed investigations exist from south coastal India, particularly from Ramanathapuram, Tamil Nadu, which lies in the Exclusive Economic Zone. Further, the study offers relevant insights into the associations among multiple domains, drawing on several literature reviews and recommendations, along with evidence-based guidelines for understudied vulnerable populations.

Limitations

The cross-sectional study design limits causal inference; additional limitations include self-reported outcomes, lack of severity grading for lower back discomfort, and absence of clinical and radiological confirmation. Also, data collection spans the pre- and post-monsoon seasons, coinciding with variable fishing cycles that may have influenced the reported ergonomic exposures. Also, the analysis did not adjust for village level clustering, which could have led to minor underestimation of standard errors.

Conclusion

Artisanal fishermen are predominantly exposed to multiple ergonomic hazards and psychosocial stressors, which significantly increase the likelihood of lower back discomfort. A tailored ergonomic and psychosocial intervention focusing on lifting aids, posture training, stress, and sleep management is urgently needed to reduce musculoskeletal risk and improve the occupational health of artisanal fishermen.

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Conflict of Interest

None

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