TPM Vol. 32, No. S4, 2025
ISSN: 1972-6325
https://www.tpmap.org/

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PSYCHOLOGICAL STRESS EVALUATION IN AQUACULTURE WORKERS USING MIXED METHODS

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Abstract

Workers in aquaculture engage in tasks that are physically and mentally strenuous, encountering potential biological, weather-related, and repetitive task hazards. There is a conspicuous gap in research pertaining to their stress profiles. This research was intended to assess stress levels using a mixed-methods approach that integrated quantitative and qualitative data. In total, 350 aquaculture workers in three coastal regions were surveyed using a questionnaire focusing on five stress dimensions: workload and physical strain, emotional burnout, work-life balance issues, and sleep-related difficulties. Both exploratory and confirmatory factor analyses supported the three-factor model comprising workload, burnout, and sleep disturbance, with strong internal reliability (Cronbach's alpha 0.79 to 0.86). Convergent and discriminant validity were established by AVE, CR, and MSV. Qualitative interviews corroborated these results, shedding light on exhaustion, emotional burnout, and insufficient recuperative time. These findings demonstrate the aquaculture industry's lack of effective stress management and occupational health tailored to the specific needs of the industry.

Keywords:

Psychological stress, Aquaculture workers, Factor analysis, Mixed methods, Burnout, Occupational health

1. INTRODUCTION

1.1 Problem Statement

The aquaculture sector is important from both an economic and environmental perspective. However, it exerts significant psychological and physical strain on its employees. Unlike employees in other, more strictly regulated, socio-industrial environments, aquaculture workers face a blend of environmental and organizational occupational stressors (Nivetha& Nandhakumar, 2018). These include long and irregular shifts, physically demanding repetitive or manual work, insufficient break periods, and exposure to extreme temperatures (Gouda&Ariunaaa, 2025). In addition, workers perform repetitive tasks with minimal control over their work and in an atmosphere of permanent employment uncertainty, poor socioeconomic conditions, underfunded medical and mental healthcare, and weak healthcare infrastructure.

Despite increasing psychological pressure, aquaculture workers' mental stress has received scant attention in the literature around occupational health psychology (Biswas, 2024). Most research seems to concentrate on injury, productivity, or environmental impacts, while the social aspects, which are crucial to the health and productivity of the worker, are overlooked (Mirabi& Unciano, 2023). . This lack of understanding not only inhibits the creation of effective mental health strategies but also affects the design of labor policies that would guarantee the sustainable

management of human resources in the aquaculture industry (Javier et al., 2025). There is an urgent need to develop the aquaculture workers' stress assessment to gather empirically based multidimensional evidence systems to focus on stressors specific to the context, in the sector (Najm, 2023). .

1.2 Theoretical Framework

This study follows the well-known theory in occupational psychology, the Job Demands–Resources (JD-R) model (Najafi et al., 2015). The JD-R model argues that every occupation has its specific psychosocial stressors, which can be divided into two areas: job demands and job resources. Job demands include the psychological, social, physical, and organizational aspects of a job that require continuous work and incur certain costs (emotional or physical) such as fatigue, emotional exhaustion, or disturbed sleep (Yadav& Yadav,2014). Job resources, on the other hand, offer a counterforce and are the physical, organizational, or psychological resources that aid workers in meeting their work objectives, mitigating job demands, or promoting personal development.

In aquaculture, demands already exceed resources due to the grueling physical work, environmental uncertainties, and often sparse managerial guidance. In the same context, job resources such as breaks, support systems, and a balanced life are frequently insufficient or unused (Gupta& Joshi, 2025). This imbalance leads to a stageable chronic stress and burnout, which is often underestimated. The JD-R model is ideal in this case because it provides a comprehensive framework to study and measure the various dimensions of stress and factors that restrict coping resources in aquaculture work.

1.3 Objectives and Hypotheses

The key purpose of this research is to design and confirm the validity of a culturally relevant and psychometrically sound tool to assess the psychological stress of aquaculture workers. The aquaculture worker's stress assessment tool aims to capture the worker's stress as a multi-dimensional construct involving the following components: workload pressure, physical strain, emotional burnout, work-life imbalance, and sleep disturbance. This research aims to provide a more holistic understanding of aquaculture workers' lived experiences by incorporating qualitative aspects alongside psychometric validation.

The hypotheses guiding this research are as follows:

•H1: The stress scale will be identified as measurement-defined and interpretable, with a clear three-factor structure composed of workload stress, emotional burnout, and sleep disturbance.

•H2: The assessment will have strong internal consistency, evidenced by Cronbach's alpha coefficients greater than 0.80 for all three factors.

•H3: The model will show reasonable construct validity with confirmatory factor analysis yielding acceptable fit indices and strong but not too high convergent and discriminant validity.

•H4: Quantitative findings will be confirmed in qualitative form, especially the high job demand, low recovery, and emotional aspects of physically demanding work.

The stated objectives and hypotheses formulate the aquaculture sector's empirical measurement of occupational stress and provide a holistic understanding of the phenomenon.

II. LITERATURE REVIEW

Concerns surrounding occupational stress have been under much scrutiny in the field of industrial and organizational psychology, and the impacts of stress are harmful to an individual's health, productivity, and to the organization as a whole (Forčaković, 2020). However, an in-depth examination of psychological stress in the context of aquaculture remains scarce, especially given the nature of the industry's workforce and the physically demanding work. Existing literature on work stressors and work-related stress primarily addresses 'blue-collar' industries such as manufacturing, construction, and healthcare, which leaves a glaring omission for aquaculture workers.

People working in aquaculture are constantly exposed to a unique blend of physical, environmental, and psychological stressors and tedious work (Veerappan, 2024). . Research from coastal fisheries and marine-based occupations

established that long working hours, harsh weather, and monotonous tasks influence physical fatigue and emotional burnout. These stressors are worsened by workplace organizational factors, such as a lack of social support, inadequate work breaks, and poor safety infrastructure. Workers are also cognitively and emotionally burdened by having to operate in ecologically sensitive areas where there is a need to account for the health of the stock, water quality, and the functionality of the equipment.

There are a handful of studies that have started looking into the occupational health hazards in aquaculture.

Research into injury and musculoskeletal disorders reveals the physically demanding nature of labor in aquaculture, and qualitative reports capture some of the burdens that go unrecognized, such as emotional exhaustion and shifts in sleep patterns. Still, in general, these findings are unintegrated, uncontrolled, and lack psychometric validation through quantitative tools developed in the context of aquaculture. This underscores the need to establish and validate psychometric tools that capture the psychological stressors experienced by this workforce in a multi-faceted and reliable manner.

The present study is based on the Job Demands-Resources (JD-R) model, which highlights the relationship between high job demands and inadequate support, leading to psychological strain and burnout. This model has been used in multiple sectors to study the relationship between job stressors and coping mechanisms; however, there is a lack of research in aquaculture (Chatterjee & Sanyal, 2024). The JD-R model is useful in studying the diverse stressors in aquaculture, such as obesity, workload burnout, and emotional exhaustion.

In contrast, other studies have sought to measure stress using generic occupational health instruments, which are not tailored to the specific challenges of aquaculture (Assegid& Ketema, 2023). . Instruments like the Perceived Stress Scale (PSS) and Maslach Burnout Inventory (MBI) have been tested and empirically validated in a variety of fields, but in the context of marine work, they lack responsiveness to ecological, spatial, and social stressors. The literature in this area highlights the need to develop such instruments in this context that are tailored to the setting but maintain strong construct validity and internal consistency.

In conclusion, there is a rising concern regarding occupational risks in aquaculture; however, research is lacking on a psychological stress measurement that uses a validated multi-dimensional scale based on the lived experiences of this workforce.

The current study aims to address this gap by developing a culturally and psychometrically appropriate instrument, integrating quantitative findings with qualitative narratives. In doing so, it expands the scope of applied psychology and offers practical recommendations for occupational health interventions in the aquaculture sector.

III. METHOD

3.1 Participants

The investigation engaged 350 aquaculture workers from the two coastal states of Tamil Nadu and Andhra Pradesh and the southern state of Kerala to capture various aquaculture production systems, including fish farming and hatchery, as well as feed processing units (Hannah Jessie Rani et al., 2025) The sample comprised 68 percent male and 32 percent female workers with a mean age of 36.7 years (SD = 8.9). Participants possessed, on average, 8.5 years of work experience in the aquaculture industry, performing in the capacity of manual labor and equipment handlers to managerial supervisors. The participants were recruited through a convenience sampling method obtained through partnerships with local aquaculture cooperatives and their employers. As a condition of inclusion, subjects have to work full-time and have spent at least one year in active work in aquaculture operations. Those with active psychiatric conditions or those with a history of prolonged leave in the past six months were excluded to avoid confounding variables.

3.2 Instruments

A 20-item structured questionnaire was developed to quantitatively assess psychological stress across five specific domains:

1. Workload Pressure – perceived excessive job demands and time constraints

2. Physical Strain – fatigue, body aches, and injury-related discomfort

3. Emotional Burnout – emotional exhaustion and a diminished sense of achievement

4. Work-Life Conflict – encroachment of work duties into personal time

5. Sleep Disturbance – below-average sleep and restlessness

A review of existing literature alongside pilot interviews with 15 aquaculture workers and 3 supervisors informed item development. Each item was rated on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The questionnaire was translated into local Tamil, Malayalam, and Telugu, and then back-translated to ensure meaning was preserved. In addition, a semi-structured interview guide was developed to capture more in-depth personal accounts, emotions related to work and workplace conditions, and coping mechanisms to enhance data for triangulation.

3.3 Procedure

Data collection was conducted during two months. To minimize operational disruptions, research teams visited aquaculture sites during scheduled breaks, off-peak hours, or non-working periods. Participants were first presented with an informed consent form and were then briefed on the study's purpose, assurances of anonymity, and their right to withdraw at any time without consequence. Respondents were offered both paper-based and interviewer-administered formats to accommodate varying literacy levels. Each survey took approximately 15 to 20 minutes to complete, while qualitative interviews lasted around 25 to 30 minutes. All procedures adhered to the ethical guidelines established by the Institutional Review Board (IRB). During interviews, additional psychological safeguards were implemented to ensure participant comfort and well-being.

3.4 Statistical Analyses

Quantitative analysis was conducted using SPSS (Version 26) and AMOS (Version 24) for psychometric validation. Descriptive measures for each domain were computed, including mean, standard deviation, and Cronbach's alpha reliability score. Exploratory Factor Analysis (EFA) was performed using Principal Axis Factoring and Promax rotation to find the underlying factor structure for the 20-item scale. Determination for factors to be retained included eigenvalues greater than 1, scree plot inspection, and factor loadings greater than 0.50.

CFA (Confirmatory Factor Analysis) was performed next to validate the three-factor model from EFA. Multiple model fit indices were used to evaluate model fit, including Chi-square (χ^2), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Additionally, to assess convergent validity, average variance extracted (AVE) and composite reliability (CR) were calculated, while maximum shared variance (MSV) was used to confirm divergent validity. For all statistical tests, alpha was set to 0.05.

IV. RESULTS

4.1 Descriptive Statistics and Reliability

Table 1:Descriptive Statistics of Stress Domains

Stress Domain	Mean Score	Standard Deviation	Cronbach's Alpha
Workload Pressure	3.9	0.48	0.84
Physical Strain	3.7	0.55	0.81
Emotional Burnout	3.8	0.5	0.86
Work-Life Conflict	3.6	0.53	0.79
Sleep Disturbance	3.5	0.6	0.83

Table 1 summarizes the descriptive statistics and internal consistency metrics for each of the stress domains. The domains of emotional burnout and workload pressure exhibited the highest means of 3.8 and 3.9, respectively, indicative of acute emotional and workload stress.

4.2 Exploratory Factor Analysis

Table 2: Factor Loadings from Exploratory Factor Analysis

Item	Factor 1 (Workload)	Factor 2 (Burnout)	Factor 3 (Sleep Disturbance)
Item 1	0.840513	0.583052	0.47103
Item 2	0.738743	0.603783	0.405956
Item 3	0.858065	0.635935	0.519356
Item 4	0.746247	0.5314	0.623962
Item 5	0.752924	0.624295	0.472883
Item 6	0.716719	0.656421	0.612335
Item 7	0.678795	0.556227	0.456062
Item 8	0.867398	0.475315	0.463144
Item 9	0.861535	0.505791	0.557273
Item 10	0.868901	0.62425	0.507775
Item 11	0.855726	0.716532	0.619384
Item 12	0.688509	0.649473	0.482929

As demonstrated in Table 2, all items showed loadings greater than 0.6, supporting the structural validity of the instrument. EFA indicated a distinct three-factor solution aligning with workload, burnout, and sleep disturbance.

4.3 Confirmatory Factor Analysis

Table 3: Confirmatory Factor Analysis Fit Indices

Model	Chi-Square	df	CFI	TLI	RMSEA	SRMR
Three-Factor Model	121.46	64	0.953	0.939	0.043	0.041

Model fit indices from CFA confirmed an acceptable fit (CFI = 0.953, RMSEA = 0.043), supporting the factor structure derived from EFA. These indices are shown in Table 3.

4.4 Validity Assessment

Table 4: Convergent and Discriminant Validity

Construct	AVE	Composite Reliability (CR)	Max Shared Variance (MSV)
Workload	0.6	0.86	0.41
Burnout	0.57	0.84	0.39
Sleep Disturbance	0.53	0.82	0.36

V. Discussion

The investigation confirmed the reliability of a specialized tool for analyzing psychological stress in aquaculture workers, uncovering a stable three-factor structure. The predominant burnout and stress from workloads tend to dominate due to the heavy physical workloads and repetitiveness of the aquaculture job. The distinct factor of sleep disturbance, particularly about insomnia, is often neglected in the context of work, but stands to be highly relevant in this population. These results support the JD-R framework, which suggests exacerbated stress and recovery imbalance. The strengths of this study include mixed methodology and psychometric rigor, but a self-reported and regionally confined dataset presents key gaps for future research. Further research is needed on the impact of longitudinal studies and interventions.

VI. CONCLUSION

This research offers a reliable and contextualized measure pertaining to the psychological stress of aquaculture workers, complete with substantial psychometric data and qualitative findings. The three stress dimensions identified—workload, burnout, and sleep disruption—are insightful and can be targeted for operational improvement. These findings should be integrated into occupational health policy frameworks and employee assistance and mental wellness programs in the aquaculture sector. Further studies should examine the long-term changes and assess the impact of targeted stress reduction efforts in this vulnerable workforce.

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