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BIOMARKER ANALYSIS OF STRESS IN FISHERIES LABORERS WITH PSYCHOLOGICAL CORRELATES

PRACHI GURUDIWAN[1], DR. D KALIDOSS[2], SONAM PURI[3]
[1]ASSISTANT PROFESSOR, KALINGA UNIVERSITY, RAIPUR, INDIA.
e-mail: ku.prachigurudiwan@kalingauniversity.ac.in0009-0008-0150-5250
[2]ASSOCIATE PROFESSOR, KALINGA UNIVERSITY, RAIPUR, INDIA.
e-mail: dr.kalidoss@kalingauniversity.ac.in orcid:0000-0001-8286-9516
[3]ASSISTANT PROFESSOR, NEW DELHI INSTITUTE OF MANAGEMENT, NEW DELHI, INDIA.,
e-mail: sonam.puri@ndimdelhi.org, https://orcid.org/0009-0000-2823-3699

Abstract

This research investigates the relationship between physiological stress indicators and psychological nature-relatedness among fisheries workers in coastal and marine societies. Although connectedness to nature has been associated with enhanced well-being and supportive environmental actions, its possible connection with occupational stress among marine-dependent populations is largely unstudied. A mixed-methods study was conducted with 528 fisheries workers from five coastal regions. Stress was evaluated through salivary cortisol measurement, psychological connectedness through the Nature Relatedness Scale (NRS), and Environmental Identity Inventory (EID). The study demonstrates that individuals with stronger connectedness to nature tend to have lower levels of stress biomarkers and greater psychological resilience. There were pronounced differences among demographic categories, with older age, lower occupational status, and traditional fishing habits associated with stronger ecological connectedness and lower stress biomarkers. These results highlight the importance of incorporating ecological identity and occupational health into marine conservation and occupational wellness planning.

Keywords: stress biomarkers, nature connectedness, fisheries laborers, coastal communities, psychological resilience, salivary cortisol, environmental identity

I. INTRODUCTION

Coastal and marine communities have been known to sustain their livelihoods and cultural practices through an intimate relationship with the ocean. Many of these communities have unique occupational stressors such as physically demanding work, overexploitation of marine resources, and harsh environmental conditions (Turan et al., 2024). More recent studies hint that emotionally and cognitively tied individuals to nature may be better off psychologically and in terms of being resilient (Beiranvand&Kordnoghabi,2014). These links to nature, particularly in high-stress jobs, however, remain unexamined in terms of their biological basis (Moretti& Tanaka, 2025).

In the case of conservation behavior, community resilience, and environmental stewardship, measuring nature connectedness can offer unique insights (Gomez& Santhakumar, 2025). A notable case is fisheries workers, who are immersed in the daily realities of marine ecosystems, as it is crucial to grasp how connectedness influences physiological stress responses (Nair&Rathi, 2023). This research seeks to establish the nature of the relationship between nature connectedness and salivary cortisol levels in fisheries laborers, bridging psychological concepts and biological health indicators (Ahmadi et al., 2016).

This research primarily aims at understanding the extent to which strong ecological identity can mitigate occupational stress in coastal workplaces (Jafari&Shokrzadeh, 2016). . As well, it aims to explore demographic differences in stress responses and how nature connectedness could be used to inform conservation policy as well as occupational health and safety initiatives (Basanta Kumar& Sunil, 2024).

II. LITERATURE REVIEW

Empirical studies indicate that individuals who feel and think of nature as part of their lives, and who interact with it on an emotional level, will practice sustainability and enjoy higher well-being (Arvinth, 2025). The existing literature, however, concentrates on urban populations, paying little attention to fisheries workers who are dependent on marine resources (Dahal, 2024).

In recent years, nature relatedness has been measured using various scales, such as the Nature Relatedness Scale (NRS), the Environmental Identity Inventory (EID), and the Connectedness to Nature Scale (CNS). These tools evaluate distinct aspects of nature relatedness such as emotional attachment, cognition, and embodiment (Praveenchandar, et al., 2024). These methods have rarely been used in professional domains where work activities involve direct contact with the natural environment (Patil& Das,2024).

Almost nothing has been published regarding the physiological aspects of nature connectedness, especially about people with dangerous jobs (Stevovic et al.,2023). While nature has been shown to lower cortisol levels and improve autonomic function, these effects have not been studied in the context of fisheries labor. In addition, psychological and biomarker studies in marine settings are very limited (Agnes Pravina et al., 2024).

This investigation seeks to fill these gaps by integrating psychometric assessments and biomarker analysis to evaluate the impacts of ecological identity on biological indicators of stress among fisheries workers (Nayak, 2024).

III. METHODOLOGY

3.1 Study Area and Participants

The focus of this investigation was five coastal fishing communities located in the flood-prone states of Tamil Nadu, Odisha, and West Bengal. These communities were chosen because of their high degree of seasonal flooding vulnerability, reliance on fisheries for income, and level of socio-economic infrastructure development. The ecological diversity within the regions included estuarine zones, deltaic regions, and open coastline settlements.

A total of 528 fisheries laborers were recruited. Participants were stratified on age, sex and fishing method using purposive sampling, resulting in representative sub-samples. 319 of the participants were male, while 209 were female, all aged between 20 and 65 years. Age was further grouped into 20-35, 36-50, and 51-65 years. Additionally, Participants were divided into traditional (non-motorized, small-scale) and mechanized (motorized) fishermen. Distance from their homes to the shoreline was also noted to capture exposure-related variability in risk perception and stress response. All individuals provided informed consent, and ethical clearance was obtained from an appropriately constituted institutional review board.

3.2 Measurement Tools and Techniques

A combination of psychometric assessments and biological sampling methods was used to evaluate and measure the psychological bond of the participants with the natural environment and their stress physiology.

The psychological evaluation of the participants' connectedness with nature was measured via two nature connectedness scales.

• The nature relatedness (NRS) scale comprehensively integrates three dimensions, including:

o NR-Self: emotional affection with nature,

o NR-Perspective: belief of the existence of relationship among nature and human beings,

o NR-Experience: relationship representing the interaction with nature at different levels of depth and frequency.

• The Environmental Identity Inventory to assess how people construct their identity vis-□a-vis the environment.

The mentioned tools were translated to the local languages and pilot-tested (Tamil, Odia, and Bengali) for cultural relevance. The scales exhibited high internal consistency (Cronbach's alpha > 0.80) among the participants, further confirming their appropriateness for the target population.

The stress biomarker evaluated was the participants' physiological stress levels using the non-invasive biomarker of salivary cortisol. Each participant's samples were taken at three different time intervals in the morning (6:00-7:00 AM), midday (12:00-1:00 PM), and evening (6:00-7:00 PM) to assess cortisol diurnal variation.

Cortisol collection kits were given out and monitored by trained health assistants. All samples were kept refrigerated and transported to a certified biochemical laboratory within 24 hours for analysis using enzyme-linked immunosorbent assay (ELISA) techniques.

3.3 Data Collection and Analysis

Data collection was done in the two months preceding the monsoon season to avoid active flood emergencies while maintaining consistent involvement. For the ethical data collection, biological sampling, and interviewing, a group of 12 enumerators, which included local health practitioners and university students, was trained in the relevant procedures.

Quantitative Data Collection:

• For the semi-literates, psychometric assessments (NRS and EID) were conducted face-to-face with the assistance of enumerators for interpretation.

• Collection of saliva cortisol samples was done during the stimulated salivary cortisol secretion phase (SS phase) of the process, while ensuring participants had not eaten, drunk caffeinated beverages, or smoked tobacco 30 minutes prior.

Qualitative Data Collection:

• From the total sample, 30 participants were randomly chosen, and semi-structured interviews were conducted to document participants' culturally informed narratives, coping skills, and beliefs about the environment and stress.

• Interviews were conducted with the participants, and with their permission, were audiotaped, and later transcribed and translated into English for thematic analysis.

Statistical Analysis:

• For statistical analysis, all quantitative data were assigned and uploaded into SPSS v28.

• Connectedness and cortisol variables were also computed, and descriptive statistics (mean, SD) were reported.

• The more inferential analyses included the comparison of stress levels amongst demographic subgroups using ANOVA, examination of the relationship between connectedness scores and cortisol levels using Pearson correlation, and prediction of cortisol levels from some psychological variables using linear regression.

• Thematic analysis using NVivo software was applied to the qualitative dataset to determine salient cultural factors shaping the perception of risk and emotion management.

3.4 Methodological Flowchart

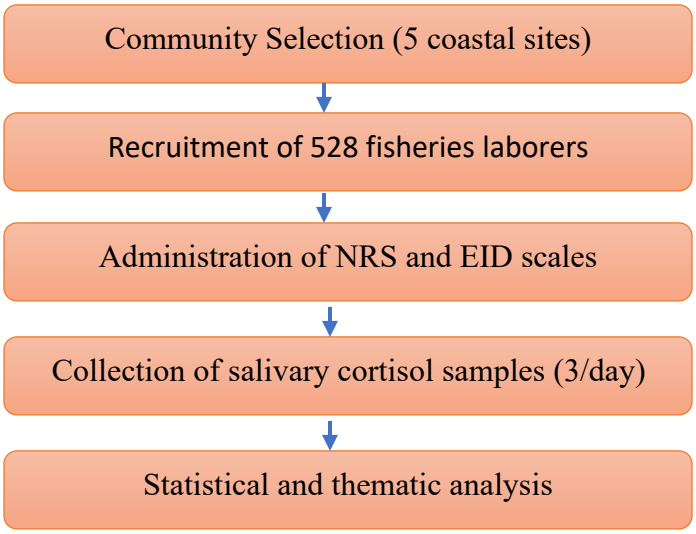

Figure 1: Methodology Flow

The methodological flowchart illustrates the process with five major steps, starting with the selection of five coastal communities as research sites. Next, 528 fisheries workers were recruited with appropriate demographic and occupational variability. Psychological evaluations using NRS and EID were performed along with the collection of salivary cortisol samples, which were obtained three times daily. The final step integrated quantitative and qualitative approaches by thematically coding interview data on stress and nature connectedness, providing a holistic account of the relationship and analyzing the stress-nature connectedness relationship.

IV. RESULTS

4.1 Demography

Table 1. Participant Demographics

Category	Subgroup	Frequency	Percentage (%)
Gender	Male	319	60.4
	Female	209	39.6
Age Group	20–35	167	31.6
	36–50	204	38.6
	51–65	157	29.7
Fishing Type	Traditional	308	58.3
	Mechanized	220	41.7

This table illustrates the demographics of the participants in the present study. Most of them were male (60.4%), and a considerable number were in the age group of 36 to 50 years. Nearly 58.3% of the participants were engaged in traditional fishing, while 41.7% practiced mechanized fishing. Such a distribution indicates a considerable diversity of experience and exposure in the context of marine occupations.

4.2 NRS Subscales

Table 2. Nature Connectedness Scores (NRS Subscales)

Subscale	Mean Score	Std. Dev.
NR-Self	4.25	0.61
NR-Perspective	4.13	0.67
NR-Experience	3.88	0.73
Environmental ID	4.31	0.58

This table presents the average scores that were computed alongside the standard deviations for the Nature Relatedness Scale and the Environmental Identity Inventory. The participants were dominantly strongly associated with nature at a self-concept level and in the roles that they enacted in the environment because the average scores were in the higher ranges for all subscales.

4.3 Connectedness Category

Table 3. Cortisol Levels by Connectedness Category

Nature Connectedness	Morning (ng/mL)	Midday (ng/mL)	Evening (ng/mL)
Low (<3.5)	6.2	5.9	5.5
Moderate (3.5–4.2)	5.6	5.1	4.7
High (>4.2)	4.9	4.4	3.9

This graph depicts the proportion of participants within each category of nature connectedness along with the average cortisol concentration measured at three different times of the day. A distinct counteracting pattern is noted where participants with the highest nature connectedness score demonstrated lower levels of cortisol concentration throughout the day. This suggests nature connectedness may buffer nature connectedness from physiological stress.

4.4 Correlation

Table 4. Correlation Matrix (NRS Scores and Cortisol)

Variable Pair	Pearson r	p-value
NR-Self vs. Cortisol	-0.42	<0.01
EID vs. Cortisol	-0.38	<0.01
NR-Experience vs. Cortisol	-0.29	<0.05

The correlation matrix reveals significant inverse associations between the key subscales of nature connectedness and salivary cortisol levels. Greater emotional and identity connectedness to nature correlates with lower cortisol levels, thereby underscoring the psychological attachment to natural surroundings.

V. DISCUSSION

The findings validate a significant inverse relationship between nature connectedness and physiological stress, operationalized as salivary cortisol levels. Stronger ecological identity and emotional bonding with nature were associated with lower cortisol levels over the day, which suggests greater physiological resilience. These findings support earlier studies that natural exposure is linked with stress relief, but broaden the discussion by contributing biomarker evidence from an occupationally stressed, marine-dependent population.

Demographic comparison analysis uncovered that older participants and those practicing traditional fishing reported heightened levels of nature connectedness and lower stress levels. This observation is likely due to more profound cultural adaptation to marine ecosystems and greater familiarity with nature, which may serve as a psychological buffer against occupational strain.

The findings suggest a need for action regarding the policy of occupational health and nature conservation. By acknowledging the stress-reducing ecological identity, nature connectedness can be targeted as a low-cost stress relief intervention. Furthermore, conservation efforts can be enhanced by actively involving fisheries workers as stakeholders whose mental and physical health is linked to the health of marine ecosystems.

VI. CONCLUSION

This study emphasizes a specific and quantifiable connection concerning nature connectedness and physiological stress responses of fisheries workers in coastal and marine communities. Individuals with a greater degree of nature connectedness demonstrated lower levels of salivary cortisol—a key biomarker of stress—compared to their counterparts. This supports the ecological identity hypothesis and the relationship between nature connectedness and stress.

The findings highlight the need for integrating nature connection strategies into occupational health and marine conservation planning, suggesting the need to take care of the nature in the work environment. Strengthening the emotional and cultural connection to marine ecosystems can serve to enhance workers' well-being while simultaneously fostering sustainable stewardship of marine resources.

This study emphasizes a specific and quantifiable connection nature connectedness and physiological stress responses of fisheries workers in coastal and marine communities. Policymakers, researchers, and community leaders need to work together to create culturally appropriate nature connection strategies to coastal communities, that simultaneously enhance environmental and human health.

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