Original Research

DROWNING PATTERNS IN THE COASTAL REGION OF ODISHA: A RETROSPECTIVE STUDY

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ABSTRACT

Objective: To evaluate drowning patterns and associated demographic, environmental, and occupational factors in the coastal region of Odisha.

Study Design: Retrospective descriptive study.

Place and Duration of Study: PRM Medical College, Baripada, from March 2025 to February 2026.

Methodology: A total of 250 drowning cases were included. Data were collected retrospectively from medico-legal records, hospital records, and autopsy reports using a structured proforma. Variables analyzed included age, gender, residence, occupation, location of drowning, seasonality, circumstances of drowning, and associated risk factors.

Results: The mean age of drowning victims was 28.6 ± 16.4 years, with the highest frequency in the 20–39 year age group (38.4%). Males constituted 68.8% of cases. Accidental drowning accounted for 72.4% of incidents, while sea/coastal waters were the most common location of occurrence (36.4%). Monsoon season contributed the highest proportion of cases (41.6%). Swimming inability was identified in 38.0% of cases, lack of protective equipment in 24.4%, and adverse weather in 20.8%. Occupational drowning was significantly associated with fisherman/laborer occupation ($p<0.001$), while male gender showed a significant association with occupational drowning ($p=0.014$).

Conclusion: Drowning in coastal Odisha demonstrates distinct demographic, environmental, and occupational patterns, with young males, coastal exposure, and monsoon-related vulnerability representing major risk factors.

Keywords: Drowning, Coastal Region, Odisha, Occupational Risk, Water Safety, Injury Epidemiology.

INTRODUCTION

Drowning is a major yet often underrecognized public health problem and remains a significant cause of unintentional injury-related mortality worldwide [1]. Defined as the process of experiencing respiratory impairment from submersion or immersion in liquid, drowning may result in death, morbidity, or survival with long-term neurological consequences. Despite being largely preventable, drowning continues to impose a substantial burden, particularly in low- and middle-income countries where environmental exposure, inadequate safety infrastructure, and limited preventive strategies increase vulnerability [2].Globally, drowning accounts for hundreds of thousands of deaths annually and disproportionately affects children, adolescents, and economically productive age groups.

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The burden is particularly high in regions with extensive water exposure, including coastal communities, riverine areas, and flood-prone settings. In many developing countries, drowning may be underreported, causing its true burden to be underestimated [3]. This under-recognition has historically limited preventive policy responses. The epidemiology of drowning is shaped by environmental, demographic, occupational, and behavioral factors [4]. Age, gender, seasonality, alcohol use, occupational exposure, recreational water activities, weather conditions, and access to water safety measures all influence drowning risk. Males are frequently reported to have higher drowning risk, while children may be especially vulnerable due to inadequate supervision and environmental hazards. Understanding these patterns is essential for targeted prevention [5].

Coastal regions present unique drowning risks because of sea exposure, tidal variation, currents, storms, fishing-related activities, tourism, and disaster-related events. In such settings, drowning may occur during occupational activities, domestic exposure, accidental falls, recreational activities, or natural calamities [6]. Coastal populations may

therefore have distinct risk patterns compared with inland populations. Odisha, located on the eastern coast of India, has extensive coastline, fishing communities, cyclonic vulnerability, and numerous water bodies, making drowning an important public health concern. In addition to routine exposure related to occupational and domestic activities, the region's susceptibility to cyclones, floods, and seasonal environmental hazards may further contribute to drowning risk [7]. However, the epidemiological patterns and contributing factors may vary across settings and remain incompletely characterized [8].Several studies have highlighted that drowning prevention requires a combination of surveillance, community awareness, environmental modification, swimming education, rescue preparedness, and policy-level interventions [9]. However, preventive strategies must be informed by local epidemiology, as drowning risk profiles may differ substantially across regions. Local data are therefore essential for context-specific planning [10].

Objective

To evaluate drowning patterns and associated demographic, environmental, and occupational factors in the coastal region of Odisha.

METHODOLOGY

This was a retrospective descriptive study conducted at PRM Medical College, Baripada, from March 2025 to February 2026.A total of 250 drowning cases were included in the study.Non-probability consecutive sampling was used to include all eligible drowning cases meeting the inclusion criteria during the study period.All medico-legal drowning cases reported to PRM Medical College, Baripada during the study period, with confirmed history or evidence suggestive of drowning and complete available records, were included. Cases of accidental, occupational, recreational, disaster-related, and suspected drowning events from the coastal region of Odisha were eligible.Cases with incomplete medico-legal records, decomposed bodies with inconclusive cause of death, doubtful diagnosis, non-drowning causes of death, or records lacking essential demographic or incident-related information were excluded.

Data Collection

Data were collected retrospectively from medico-legal records, hospital records, autopsy reports, and relevant case documentation using a structured proforma. Variables recorded included age, gender, residence, occupation, month and season of incident, location of drowning, circumstances of occurrence, suspected contributing factors, and outcome-related findings.

Statistical Analysis

Data were entered and analyzed using SPSS version 26. Quantitative variables were presented as mean ± standard deviation, while qualitative variables were expressed as frequencies and percentages. Associations between demographic factors and drowning patterns were assessed using Chi-square test where applicable. A p-value ≤0.05 was considered statistically significant.

RESULTS

Table 1 presents the baseline demographic characteristics of 250 drowning victims. The mean age was 28.6 ± 16.4 years, indicating that drowning predominantly affected younger individuals. The highest proportion of cases occurred in the 20–39 year age group, accounting for 96 (38.4%) victims, followed by 10–19 years in 48 (19.2%) and 40–59 years in 49 (19.6%), while children under 10 years constituted 34 (13.6%) cases. Male victims predominated, comprising 172 (68.8%) cases compared with 78 (31.2%) females. Most victims belonged to rural areas, with 161 (64.4%) cases, while 89 (35.6%) were from urban settings.

Table 1. Baseline Demographic Characteristics of Drowning Victims (n=250)

Variable	Category	n (%) / Mean ± SD
Age (years)	—	28.6 ± 16.4
Age Group	<10 years	34 (13.6)
	10–19 years	48 (19.2)
	20–39 years	96 (38.4)
	40–59 years	49 (19.6)
	≥60 years	23 (9.2)
Gender	Male	172 (68.8)
	Female	78 (31.2)
Residence	Rural	161 (64.4)
	Urban	89 (35.6)
Occupation	Fisherman/Laborer	58 (23.2)
	Student	66 (26.4)
	Homemaker	39 (15.6)
	Unemployed/Other	87 (34.8)

Accidental drowning was the dominant mode of occurrence, accounting for 181 (72.4%) cases, while occupational drowning contributed 34 (13.6%), recreational drowning 22 (8.8%), and disaster-related drowning 13 (5.2%). Sea/coastal waters were the most frequent site of drowning in 91 (36.4%) cases, followed by rivers/canals in 74 (29.6%) and ponds/lakes in 57 (22.8%). Seasonal variation was evident, with monsoon contributing the highest number of cases, 104 (41.6%), compared with summer 78 (31.2%) and winter 68 (27.2%), suggesting a strong environmental influence on drowning occurrence.

Table 2. Circumstances and Patterns of Drowning (n=250)

Variable	Category	n (%)
Type of Drowning	Accidental	181 (72.4)
	Occupational	34 (13.6)
	Recreational	22 (8.8)
	Disaster-related	13 (5.2)
Place of Incident	Sea/Coast	91 (36.4)
	River/Canal	74 (29.6)
	Pond/Lake	57 (22.8)
	Floodwater	28 (11.2)
Season	Monsoon	104 (41.6)
	Summer	78 (31.2)
	Winter	68 (27.2)

Swimming inability was the most frequent identified risk factor, present in 95 (38.0%) cases, followed by absence of protective equipment in 61 (24.4%) and adverse weather contribution in 52 (20.8%). Alcohol involvement was reported in 44 (17.6%) cases, while lack of supervision was identified in 29 (11.6%) cases.

Table 3. Risk Factors Associated with Drowning Events (n=250)

Variable	Category	n (%)
Lack of Supervision	Yes	29 (11.6)
	No	221 (88.4)
Alcohol Involvement	Yes	44 (17.6)
	No	206 (82.4)
No Protective Equipment	Yes	61 (24.4)
	No	189 (75.6)
Adverse Weather Contribution	Yes	52 (20.8)
	No	198 (79.2)
Swimming Inability Suspected	Yes	95 (38.0)
	No	155 (62.0)

Among males, occupational drowning was more frequent at 31 (18.0%) compared with females, where only 3 (3.8%) occupational drownings were observed, showing a significant association with gender (p=0.014). Fishermen and laborers had a markedly higher proportion of occupational drowning at 24 (41.4%) compared with only 10 (5.2%) among other occupations, with a highly significant association (p<0.001).

Table 4. Association of Gender and Occupation with Drowning Type

Variable	Accidental n (%)	Occupational n (%)	p-value
Male (n=172)	118 (68.6)	31 (18.0)	0.014
Female (n=78)	63 (80.8)	3 (3.8)	
Fisherman/Laborer (n=58)	26 (44.8)	24 (41.4)	<0.001
Others (n=192)	155 (80.7)	10 (5.2)	

Monsoon-associated cases accounted for 104 (41.6%) incidents, while 21 (8.4%) occurred during cyclonic or storm events. The mean time to recovery of victims was 7.3 ± 4.1 hours, and delayed retrieval beyond 6 hours was observed in 94 (37.6%) cases. Suspected disaster-associated drowning accounted for 13 (5.2%) cases.

Table 5. Seasonal Distribution and Outcome-Related Patterns

Variable	n (%) / Mean ± SD
Cases during Monsoon	104 (41.6)
Cases during Cyclonic/Storm Events	21 (8.4)
Mean Time to Recovery (hours)	7.3 ± 4.1
Cases with Delayed Retrieval (>6 hrs)	94 (37.6)
Suspected Disaster-Associated Drowning	13 (5.2)

DISCUSSION

This study evaluated drowning patterns in the coastal region of Odisha and demonstrated distinct demographic, environmental, and occupational trends associated with drowning events. Drowning victims were predominantly young males, accidental drowning represented the majority of cases, coastal and riverine locations accounted for a large proportion of incidents, and monsoon months showed the highest burden of drowning events. These findings highlight the multifactorial nature of drowning risk and support the need for context-specific prevention strategies in coastal populations.A major finding of this study was that drowning predominantly affected younger individuals, particularly those aged 20–39 years, who accounted for 38.4% of cases. This suggests that economically productive age groups bear a substantial burden of drowning mortality. Previous research has similarly reported increased drowning risk among young adults, often attributed to occupational exposure, risk-taking behavior, and greater environmental interaction with water bodies. In addition, children and adolescents together constituted a notable proportion of cases, reinforcing that younger age groups remain an important vulnerable population [11].

Male predominance was marked, with males comprising 68.8% of victims. This finding is consistent with previous research showing higher drowning risk among males, often linked to occupational exposures, greater participation in water-related activities, behavioral risk factors, and increased exposure to hazardous environments. The observed gender disparity likely reflects similar mechanisms in this population [12].Residence patterns showed that rural populations constituted nearly two-thirds of cases, suggesting a greater burden among populations with frequent proximity to open water bodies and potentially limited access to safety infrastructure. Previous research has also suggested elevated drowning risk in rural communities where environmental hazards and preventive resources may differ from urban settings [13].

Accidental drowning accounted for 72.4% of cases and represented the dominant pattern of occurrence. This supports the view that most drowning events in this setting may be preventable through targeted safety interventions. Occupational drowning, while less frequent overall, remained important and was particularly associated with fisherman and laborer occupations. Previous research has similarly identified occupational water exposure as a major risk factor in coastal populations [14].The finding that sea/coastal waters represented the most common location of drowning (36.4%), followed by rivers and canals, highlights the importance of environmental exposure in shaping drowning risk. Coastal waters present unique hazards including tides, currents, weather instability, and rescue challenges. Previous research has likewise demonstrated that location-specific hazards are central to drowning epidemiology and prevention planning [15].Seasonal variation was a notable finding, with the highest proportion of cases occurring during monsoon months (41.6%). This suggests a substantial temporal influence on drowning risk, likely related to flooding, increased water hazards, stronger currents, and environmental instability. Previous research has similarly identified monsoon or rainy seasons as high-risk periods for drowning in vulnerable regions.The observed association between male gender and occupational drowning further supports the intersection of demographic and occupational risk [16]. This suggests that prevention strategies may need to consider overlapping vulnerability profiles rather than isolated risk factors alone.Disaster-associated drowning represented a smaller but important proportion of cases, reflecting Odisha's known vulnerability to cyclones and extreme weather events. Although these cases were fewer, their presence supports the importance of integrating drowning prevention within disaster preparedness planning. Previous research has similarly emphasized the relevance of disaster risk reduction strategies in drowning prevention.These findings have several public health implications. Community-level prevention strategies may include swimming and rescue education, environmental hazard reduction, child supervision interventions, protective equipment promotion, occupational safety measures for fishermen, and strengthened preparedness during monsoon and cyclone periods. The strong predominance of accidental and potentially preventable events suggests substantial opportunity for intervention.

CONCLUSION

It is concluded that drowning in the coastal region of Odisha predominantly affects young males and is largely associated with accidental events, coastal water exposure, occupational risk, and seasonal

vulnerability during monsoon periods. Swimming inability, lack of protective equipment, and adverse weather emerged as important contributing factors, while fishermen and laborers represented a particularly high-risk subgroup. These findings highlight identifiable and potentially preventable drowning patterns and support the need for targeted public health interventions, water safety measures, occupational protection strategies, and disaster preparedness planning to reduce drowning-related mortality.

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