

## Autopsy based profile of drowning cases at a tertiary care centre near a hilly river

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### Abstract

**Introduction:** Globally drowning is considered to be the third leading cause of unintentional injury death and is a major, but often neglected, public health problem. Little research has been published on the issue of drowning in hilly rivers. River valleys are related with a different kind of drowning hazards due to different kind of risk factors as compared with plane water rivers. This study was conducted in tertiary care centre of Srinagar, through which Alaknanda river passes through.

**Objective:** To study the pattern of different factors related to drowning death which may be helpful in better understanding of burden of problem in hilly region & implementing preventive measures.

**Materials and Methods:** The retrospective study was conducted in the department of Forensic Medicine and Toxicology of tertiary care centre, Government Medical college and Base hospital Srikot, Pauri Garhwal District, Uttarakhand, during three year duration of 1<sup>st</sup> January 2012 to 31<sup>st</sup> December 2014 on 42 autopsy cases. Relevant variables and detailed history were collected from police inquest reports, Postmortem Reports and other documents.

**Results:** Drowning death was highest in age groups of 31-35 years (16.66%) & 21-25 years (14.28%) and age group between 16-55 years contributed 90.44% cases. Men outnumbered women. Most death occurred between summer months of March to June (40.46%), followed by winter months. Rainy season shows less incidences. Most drowning incidences recorded in evening and night followed by early morning time. Maximum number of drowning deaths had occurred from residents of Srinagar town, Pauri, Chamoli, Tehri and Rudraprayag constitutes 35.7% cases. 11.93% cases were from outside the Uttarakhand state. Manner of death was unknown for a large number of cases (35.7%), 45.2% were accidental and 16.4% suicidal. Maximum cases were from lower middle class family.

**Conclusion:** Rate of death is high as compared to national rate. Death due to drowning are most common in summers, during Char Dham yatra season. Most common victims of drowning deaths were residents of Srinagar and nearby regions. Most of death were accidental in nature retrieved from Alaknanda river. The study results suggest that there is need for drowning prevention strategies that are tailored to specific need of this geographical region.

**Keywords:** Drowning, Hilly region, Srinagar.

### Introduction

Drowning is a major public health challenge which is most often neglected. The World Bank in association with WHO published the first global burden of disease (GBD) study, at the end of the 1990s. It showed that, drowning is one of the most common causes of death, globally.<sup>1</sup> Drowning is the third leading cause of unintentional death worldwide, constitutes 7% of all death which are related with injury.<sup>2</sup>

For the purpose of study, definition of drowning used, is that adopted at the first World Congress on Drowning (2002): "The process of experiencing respiratory impairment from submersion/immersion in liquid."

Much more national and international attention needed focused on drowning hazards, given the limited data available on its true scale and the heavy toll it takes on families, communities and economies.<sup>3</sup> Among the major unnatural causes of accidental deaths in India during 2012, drowning accounted for 7.4% cases. Daily average being 76 Deaths per day. Uttarakhand stands at 12<sup>th</sup> position with 8.5% national share of total number of drowning cases.<sup>4</sup> Little research has been published on the issue of drowning in hilly rivers, however several papers identify natural waterways (which includes rivers) as common drowning locations. This study was conducted in a tertiary care centre of Srinagar, Uttarakhand which lies on the national highway NH58 that connects Delhi with Badrinath and

Mana Pass in Uttarakhand near Indo-Tibet border. This highway passes through the Srinagar valley along the sides of Alaknanda River.<sup>5</sup> River valleys are related with a different kind of drowning hazards due to different risk conditions than plane water rivers for example highly placed sides, slip-off slopes, turbulent flow, Quickly changing depth, winding course, variable flow speed, presence of rocks, hidden obstacles and flash floods etc. whirlpools and water reversals are real threat to swimmers.<sup>2</sup>

Population-based data are appropriate in identifying and prioritizing the burden of drowning, but are not usually available. Drowning is underreported in hospital-based data. It is very difficult to find distinctions between unintentional and intentional drowning death. Intentional drowning deaths (e.g. suicide, homicide) are in most circumstances not reported or misclassified.<sup>6</sup> Educating people about risks, resuscitation training and near supervision are important steps which could be applied for better outcome. More research is needed to study the circumstances under which drowning seems to occur, the first aid procedures and fast health care response, not only within country but also cross nationally. Also, data on good practice which is obtained from other countries need to be transferred to other low and middle income. There is an urgent need to get drowning related loss higher on the agenda for policy makers and researchers, whatever the

intervention we need to apply.<sup>7</sup> Also, media can plays a vital role for educating the people for water safety.

## Materials and Methods

This was a retrospective study conducted at tertiary care centre, Government Medical college and Base hospital in Srikot, Pauri Garhwal District, Uttarakhand. We carried out study on epidemiological profile of the drowning deaths on 42 cases out of 110, 83 & 101 total autopsies done during the period of 3 years from January 2012 to December 2014. Aim of the study was to find out various relevant epidemiological parameters. The inclusion criteria was, those dead corpuses which were recovered from water sources and having history of drowning, brought for post mortem examination. Those case were excluded which occurred due to cloudburst, landslide in the river, flash flood and vehicle fall from height in river due to road traffic accidents. For collection of data, a pre-tested proforma specially designed for this purpose was used. As per law, consent of the relatives was not required to carry out the study, but Prior permission and no objection certificate was obtained from institutional ethics committee (VCSGMS & RI Srinagar, Pauri Garhwal), Hospital Superintendent of Base Hospital and Superintendent of police, Pauri Garhwal. Detailed history with relevant variables were collected from police inquest report (Panchanama), Postmortem Reports and other documents regarding the age, sex, religion, region from where deceased belong, expected time of death, supposed cause of death and eye witness of happening etc. Mortality rate was calculated using population as the denominator (deaths per 100 000 persons).

## Results

### Age and Sex wise Distribution

Among the total cases, 76.16% victims were male and 23.8% were female. Ratio to male: female was 3.2:1. According to data obtained most common age group was in age range of 31-35 years (16.66%) followed by 21-25 years (14.28%) and age group between 16-55 years contributed 90.44% of cases. Predominance of male was seen in all age groups in drowning death except in the age group 76-80 years. (Table 1)

**Table 1: Age & gender wise distribution**

Age Groups	Male	Female
0-5	1	0
6-10	1	0
11-15	0	0
16-20	4	1
21-25	4	2
26-30	4	1
31-35	5	2
36-40	3	2
41-45	3	0
46-50	2	0

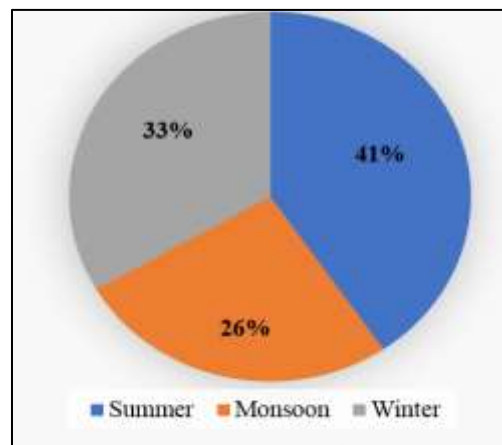
51-55	4	1
56-60	1	0
61-65	0	0
66-70	0	0
71-75	0	0
76-80	0	1
Total	32	10

### Seasonal Variation

Out of three year data maximum death occurred between summer months of March to June (40.46%, n=17), followed by between winter months of October to February (33.32%, n=14). Rainy season has less drowning cases (26.18%, n=11). No drowning cases recorded in July and December months. (Table 2; Fig. 1)

**Table 2: Month wise distribution**

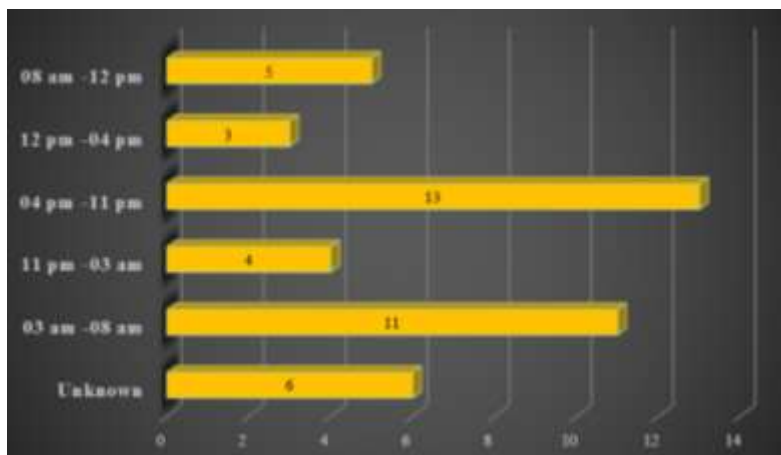
Months	2012	2013	2014	Total
January	0	0	3	3
February	1	1	2	4
March	0	0	1	1
April	3	1	0	4
May	1	4	2	7
June	3	3	2	8
July	0	0	0	0
August	1	0	0	1
September	1	2	3	6
October	1	2	2	5
November	0	3	0	3
December	0	0	0	0



**Fig. 1: Seasonal variation**

### Estimated Time of incidence

Maximum number of drowning occurred in evening and night till 11 pm (30.94%, n=13), followed by early morning time (26.18%, n=11). Very less number of cases occurred in afternoon (7.14%, n=3) and midnight (9.52%, n=4). Time of 6 cases (14.28%) could not be determined. (Fig. 2)



**Fig. 4: Estimated time of death**

### Distribution According to Residence

Most of the cases of drowning deaths were residents of Srinagar town and nearby village areas (16.66%) followed by residents of Pauri, Chamoli, Tehri and Rudraprayag together constitutes 35.7% cases. 11.93% cases were from outside the Uttarakhand state. If 35.71% of unknown cases spared, residents of Uttarakhand constitute 52.36% of cases. All female cases were either from Uttarakhand (11.9%, n=5) or unknown (11.9%, n=5). (Table 3)

**Table 3: Resident**

S. No.	Resident	No. of cases	Percentage
1.	Srinagar	7	16.66%
2.	Pauri	5	11.90%
3.	Chamoli	5	11.90%
4.	Tehri	3	7.14%
5.	Rudraprayag	2	4.76%
6.	Uttar Pradesh	2	4.76%
7.	Haridwar	1	2.39%
8.	Bihar	1	2.39%
9.	Hamirpur	1	2.39%
10.	Unknown	15	35.71%

### Manner of Death

Since manner of death was inspected from documents for many of which investigation procedure were still in progress, manner was unknown for a large part of cases (35.7%). For those of known mechanism 45.2% were accidental and 16.4% were suicidal cases. Only one case was confirmed as homicidal drowning. Out of total 10 female cases, 3 females committed suicide (7.14%), 2 females drowned due to accidental fall or slipping from sides of Alaknanda river (4.76%) and in rest 5 females cause of drowning was unknown. (Table 4)

**Table 4: Manner of death**

S. No.	Manner of Death	Total number of cases	Percentage
1	Accidental	19	45.20%
2	Suicidal	7	16.70%
3	Homicidal	1	2.40%
4	Unknown	15	35.70%
5	Total Cases	42	100

Other than above mentioned facts, Socioeconomic status of 35.7%, (n=15) cases was unknown, 54.74% (n=23) were of lower middle class and 4 cases (9.52%) of middle class.

Out of total drowned cases 40 (95.2%) were recovered either from the river bank or were floating in the river. 1 person drowned to death in a well and another was found floating in Dam canal of Hydro Electric Project, Srinagar.

### Discussion

As most other parts of India, the reporting system for deaths and health related events is weak in this region. Thus, it is very difficult to ascertain the burden of diseases and injuries in the hilly region based on routinely collected data. In addition, most recent population-based research on the burden of drowning in the region and Uttarakhand state is quite dated. Therefore, this study based on different parameters and variables, update on the burden and epidemiology of drowning in Hilly region. Global death rate due to drowning in 2012 was 5.2; (7.0 for male & 3.4 for female) according to WHO Global Health Estimates 2012.<sup>8</sup> In India NCRB 2012 data shows drowning rate was 2.3.<sup>9</sup> But updated data on [www.worldlifeexpectancy.com](http://www.worldlifeexpectancy.com) shows drowning rate for India to be 4.91.<sup>10</sup> For Uttarakhand state in 2012 rate was 1.72.<sup>9,11</sup> According to our study for Srinagar, as per the 2011 census, Srinagar, Srikot, Kirti Nagar and Rudraprayag for which Base Hospital mortuary is serving has a population of 272191. When calculated for drowning death rate it turn out to be 4.4 in year 2012. But when calculated for average of three years i.e. 14 cases, it is 5.14, which was higher than the

national rate. The probable reason behind higher rate is multifactorial as river valleys are related with a different kind of drowning hazards due to different kind of factors as compared with plane water rivers for example Badrinath national highway (NH 58) runs along Alaknanda river on high sides of river, variable amount of vegetations on highly placed sides hide the depth of river at multiple places, slip-off slopes, turbulent flow, Quickly changing depth, winding course, variable flow speed, presence of rocks, hidden obstacles and flash floods etc.

The most productive age group between 16-55 years are most susceptible to drowning hazard contributing 90.44% of cases in Srinagar; whereas in the Global report on drowning, published in 2014, it was found that, Globally, the highest drowning rates was seen in children of age group 1-4 years, followed by children of age group 5-9 years.<sup>3</sup>

In all age groups in drowning death, predominance of male was seen, except in the age group 76-80 years. Of the total cases studied, 76.16% victims were male and 23.8% were female. The male: female ratio was 3.2:1. Same findings were obtained by Hawland.<sup>12</sup> Reason behind male predominance of cases, probably, is multifactorial, especially men have more opportunities to drown in that they have greater probability of high exposure activities where submersion is possible.

Yatra to four Himalayan shrines began in April, which lead to maximum activity and traffic on highway along Alaknanda, that's why maximum death occurred between summer months of march to June (40.46%, n=17), which is consistent with the media reports every year.<sup>13,14</sup> Which is followed by cases between winter months (33.32%). Rainy season has less drowning cases (26.18%) as people remain confined to their homes. No drowning cases recorded in July and December months.

Maximum number of drowning occurred in evening and night till 11 pm (30.94%), followed by early morning time (926.18%) which is against the data collected in Royal Life Saving National Drowning Report.<sup>15</sup> Very less number of cases occurred in afternoon (7.14%) and midnight (9.52%). Time of 6 cases (14.28%) could not be determined.

Most of drowning deaths had occurred from residents of Srinagar town and nearby village areas (16.66%) followed by residents of Pauri, Chamoli, Tehri and Rudraprayag together constitutes 35.7% cases. 11.93% cases were from outside the Uttarakhand state. If 35.71% of unknown cases spared, residents of Uttarakhand constitute 52.36% of cases. All female cases were either from Uttarakhand (11.9%) or unknown (11.9%).

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females drowned due to accidental fall or slipping from sides of Alaknanda river (4.76%) and in rest 5 females cause of drowning was unknown.

Other than above mentioned facts, Socioeconomic status of 35.7%, (n=15) cases was unknown, 54.74% (n=23) were of lower middle class and 4 cases (9.52%) of middle class.

Out of total drowned cases 40 (95.2%) were recovered either from the river bank or floating in the river. One person drowned in a well, and one was taken out from the Dam canal of Hydro Electric Project in Srinagar.

## Conclusion

From the study we learnt that, rate of death is high as compared to national rate. Male predominance was seen in death due to drowning with highest incidence was in third and fourth decades. Drowning death was most common in summer season, during Char Dham yatra. Most common victims of drowning deaths were residents of Srinagar and nearby regions. Maximum number of death were accidental in nature. Lower middle class found to be most effected communities by socioeconomic condition data. Dead bodies were most commonly recovered from Alaknanda river followed by well.

The study results suggest that there may be a need for drowning prevention strategies that are tailored to specific need of this geographical region. The government should draft specific policy, plans, provide budget and implement strategy for drowning prevention.

**Conflict of Interest:** None.

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**How to cite this article:** Kumar N, Mangare V, Kandpal N, Bajpei A. Autopsy based profile of drowning cases at a tertiary care centre near a hilly river. *Indian J Forensic Community Med* 2019;6(1):28-32.