

ROAD TRAFFIC ACCIDENTS AND HEALTH COMPLICATIONS DURING THE KEDARNATH YATRA: A RETROSPECTIVE STUDY

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By

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Under the Supervision and Guidance of

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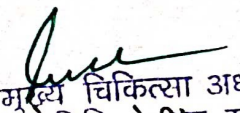
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हम उनके शिक्षण प्रयास के लिए उन्हें शुभकामनाएँ देते हैं।


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CERTIFICATE

This is to certify that Dr. Shwetangi Kumar Jakhmola in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur has successfully completed her internship at District Hospital, Rudraprayag during March 18 - June 17, 2024.

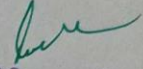
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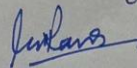
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UTTARAKHAND.

DECLARATION BY STUDENT

I hereby declare that this dissertation titled '**ROAD TRAFFIC ACCIDENTS AND HEALTH COMPLICATIONS DURING THE KEDARNATH YATRA: A RETROSPECTIVE STUDY**' is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Shwetangi J.
(Signature)

DR. SHWETANGI KUMAR JAKHMOLA
Name of Student

Date 2.07.2024

CERTIFICATE

This is to certify that dissertation titled **“ROAD TRAFFIC ACCIDENTS AND HEALTH COMPLICATIONS DURING THE KEDARNATH YATRA: A RETROSPECTIVE STUDY”** is a record of the research work undertaken by **Dr. Shwetangi Kumar Jakhmola** in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific and analytical.



Faculty guide:

IIHMR University, Jaipur

Date: 2/07/2024



School Dean.

IIHMR University, Jaipur

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ABSTRACT

TITLE: Road Traffic Accidents and Health Complications During the Kedarnath Yatra: A Retrospective Study

AUTHOR NAME: Dr. Shwetangi Kumar Jakhmola

ADVISOR NAME: Dr. Sandesh Kumar Sharma, Dr. Monika Rana

KEYWORDS: Kedarnath Yatra, Road Traffic Accidents, Health Complications, Pilgrimage Safety, Retrospective Study, Health Risks, Uttarakhand, Emergency Response

BACKGROUND: The Kedarnath Temple, located in the Rudraprayag district of Uttarakhand, India, is a major pilgrimage site attracting millions of devotees annually. The influx of pilgrims during the Yatra season leads to increased health risks and road traffic accidents (RTAs).

OBJECTIVE: This study aims to assess the health complications and road safety issues faced by pilgrims during the Kedarnath Yatra, providing evidence-based recommendations for improving pilgrim health and safety.

METHODOLOGY: A retrospective data analysis was conducted, examining health and accident reports from the District Hospital, Rudraprayag, spanning April 2023 to March 2024. The study focused on RTAs, cardiac shock, hemorrhagic shock, pulmonary edema, and hypoxia, comparing incidents during pilgrimage and non-pilgrimage seasons. Demographic factors such as age, sex, and comorbidities were analyzed to identify vulnerable groups.

RESULTS/FINDINGS: The study found a significant increase in health-related incidents during the Yatra season. Out of 331 RTA cases, 74.62% occurred during the pilgrimage months, showing a threefold increase compared to the non-pilgrimage period. The most affected age group for RTAs was 20-29 years, with males comprising 67.67% of the victims. Mortality due to cardiac and hemorrhagic shock, pulmonary edema, and hypoxia was higher during the Yatra, accounting for 72.45% of deaths. The highest number of deaths were recorded in May, predominantly affecting individuals aged 61-70 with pre-existing conditions.

Conclusions: The findings highlight the urgent need for enhanced medical facilities, emergency response teams, and acclimatization protocols to safeguard pilgrims. Implementing these measures can transform the Kedarnath Yatra into a safer, more spiritually fulfilling journey. This study provides crucial insights for developing strategies to mitigate health risks and improve overall safety for pilgrims.

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DR. SHWETANGI KUMAR JAKHMOLA

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
CS	Cardiac Shock
HS	Hemorrhagic Shock
HYP	Hypoxia
PE	Pulmonary Edema

CHAPTER 1. INTRODUCTION

As quoted by Carl Sagan, “The notion that SCIENCE and SPIRITUALITY are somehow mutually exclusive does a disservice to both.” We may hail from any part of the world but if there’s one common sentiment to all that transcends even basic human needs like hunger, shelter, health and any form of physical desires; it is SPIRITUALITY AND DEVOTION. But devotion without both fine fettle and mental well-being is as good as nothing.

During my 90 days comprehensive dissertation internship program at DISTRICT HOSPITAL, RUDRAPRAYAG, UTTARAKHAND I set out to call attention to this symbiotic relationship between Health and Spirituality.

Hinduism is the third-largest religion in the world with approximately 1.20 billion+ followers or 15%+ of the global population being the most widely professed faith in India, Nepal, Mauritius and in Bali, Indonesia. The followers of Hinduism are known as Hindus.^[1]

Each year witnesses a huge swarm of devotees and worshipers from all over the world visiting the Chota Char Dham tucked away in the foothills of the majestic and resplendent Himalayas to offer prayers and devout petition to God and in search of heavenly blessings and comfort in the untamed Garhwal region of the state of Uttarakhand, India.

The Chota Char Dham (small circuit of four abodes) consists of the holy shrines of Yamunotri, Gangotri, Kedarnath, and Badrinath (though now popularly known as Char Dham). It is labeled as ‘CHOTA’ Char Dham to differentiate it from the bigger circuit of Char Dham (the four abodes), also rendered the Chatur Dhama (Sanskrit: चतुर्धाम). It is a set of four Hindu pilgrimage sites in India, consisting of Badrinath (Uttarakhand), Dwarka (Gujarat), Puri (Odisha) and Rameswaram (Tamil Nadu).

In 2019 (pre-covid) the shrines had recorded a maximum footfall of 32.41 lakh devotees. In 2020 and 2021, the yatra was curtailed due to the Covid-19 pandemic and ‘yet’ saw a footfall of around 3 lakh and 5 lakh respectively.^[2] In 2022, the number of pilgrims visiting during the entire pilgrimage season was 46,27,292 (46.3 lakh approx.)^[3] The number of worshipers reached a record-breaking whopping number of

50 lakh+ in 2023.^[4] 2024 is expected to bear witness to even higher extraordinary numbers.

Char Dham	2019	2020	2021	2022	2023
Badrinath	1244100	155009	127307	1236555	1834729
Kedarnath	998956	135287	220481	1163661	1961025
Gangotri	529880	23736	32803	531720	905174
Yamunotri	465111	7717	32641	416927	735244
Total	3238047	321749	413232	3348863	5436162

(Note. Adapted from <https://www.sacredyatra.com/char-dham-yatra-witness-record-footfall.html>)

Of the four holy shrines of Char Dham Yatra, Kedarnath has seen a substantially higher footfall since post-covid era with 2.20 lakh visitors in 2021 and a substantial increase to 11.63 lakh devotees in 2022 following the ease of restrictions. According to UK Police Headquarters, more than 19.61 lakh devotees visited Kedarnath since the commencement of the pilgrimage in April 2023.^[5] As per reports, 12.38 lakh have already registered for Kedarnath Pilgrimage within the first week since the onset of registrations for the forthcoming Yatra, 2024 this year.

The pilgrimage to Char Dham is more than just a physical journey. It is a life-changing experience which encompasses the grandeur of nature and faith to promote enlightenment and spiritual renewal. Pilgrims travel far and wide enduring harsh terrain and adverse weather conditions, motivated by a committed devotion that surpasses worldly concerns.

But amid the love, ardor and devotion towards this holy voyage, there's a subdued and quietened yet grave fact to be aware of: the pilgrimage season also sees an increase in

health-related problems and various accidental cases of prangs and road accidents. The 2022 Kedarnath pilgrimage witnessed an alarming surge in fatalities, with 120 deaths reported in just 27 days. This stark increase contrasts sharply with the death tolls of previous years, which recorded 90, 102, and 112 deaths over a six-month period in 2019, 2018, and 2017, respectively. This sudden and significant rise in mortality has raised concerns and drawn attention from both medical and political spheres.^[6]

As a trainee at Rudraprayag District Hospital I was able to study, observe and shed some light on the health impacts of the holy expedition to one of the major shrines of the Chota Char Dham: THE KEDARNATH Temple that witnesses the largest number of devotees as compared to the other three holy sites each year.

With just one tertiary healthcare facility viz., Srinagar Medical College through the entire stretch of the Kedarnath and Badrinath pilgrimage route coupled with one secondary health facility in the form of District Hospital, Rudraprayag and few other CHCs, PHCs and temporarily created MRPs (Medical Relief Posts), the region's healthcare system is severely strained by the millions of devotees who gather in a comparatively short amount of time. The pilgrimage season poses a distinct set of health risks, ranging from various fatal health-related disorders to altitude-related illnesses to notable cases of road traffic casualties making it important to have a thorough understanding of them and take preventative action to minimize negative health effects.

In light of this annual holy expedition, this dissertation sets out on an expedition of its own: to decipher the complex dynamics of health implications during the pilgrimage to one of the major sites of the Char Dham: Kedarnath Temple. This research work makes use of conducting a retrospective study to identify those health related conditions, complaints and casualties which include mortality most prevalent during pilgrimage season and differentiated from the non-pilgrimage season. To provide answers to certain questions regarding the mentioned disparity, the systematic reflection and analysis of data are to be conducted and it is crucial to point out such factors as age, sex, and the presence of other diseases.

This research is not a formal research exercise where a particular subject is researched merely for the sake of writing a research paper. This necessary emphasizes the fact that the safe keeping of millions of pilgrims that journey through this path should be ensured. The objective of the study will be to assist in the formulation of intelligent strategies and policies that can lead to safer and more dependable pilgrimages.

The findings of this dissertation imply that spirituality enhances health and vice versa, which can help to comprehend the nature of the Char Dham yatra better. Let us strive to have enhanced and improved physical wellbeing of pilgrims so that the difficulties and diseases that are affiliated with the pilgrimage are not a base on which the true pilgrimage is built.

AIMS AND OBJECTIVES

AIM OF THE STUDY

To assess the specific types and incidence of health complications and road traffic accidents during the Kedarnath Yatra, compare them with non-pilgrimage months, identify vulnerable groups, and propose targeted recommendations to enhance pilgrim safety and health outcomes.

OBJECTIVES OF THE STUDY

1. To determine the incidence and types of health complications (e.g., cardiac shock, hemorrhagic shock, pulmonary edema, hypoxia) during the Kedarnath Yatra.
2. To investigate the occurrence and demographic distribution of road traffic accidents among pilgrims.
3. To identify age groups, genders, and individuals with pre-existing conditions who are most vulnerable to health complications and accidents.
4. Compare the incidence of health issues and accidents between pilgrimage and non-pilgrimage seasons.
5. Provide recommendations for improving medical facilities, emergency response systems, and preventive measures to enhance pilgrim safety.

CHAPTER 2. REVIEW OF LITERATURE

	AUTHORS (YEAR)	STUDY LOCATION	SAMPLE SIZE	SAMPLING TECHNIQUES	SALIENT FEATURES
1.	^[13] J Dickinson, D Heath, J Gosney, D Williams (1983)	The study focused on trekkers in the Himalayas, specifically those who experienced altitude-related deaths.	The study included seven individuals who succumbed to altitude-related complications during their trekking activities in the Himalayas.	Retrospective observational approach reviewing medical records, autopsy reports, and other relevant documents for the individuals in question.	The study emphasizes that fatal outcomes were primarily due to serious pulmonary, cardiovascular and cerebral diseases related to high altitude. The study highlights that despite prompt symptom recognition and treatment, including oxygen administration and evacuation to lower altitudes, one case still resulted in death. This study underscores the importance of proper acclimatization, recognizing early symptoms of altitude sickness, and adhering to safe trekking practices in high-altitude environments to mitigate the risk of serious altitude-related complications and fatalities.

2.	^[11] Herbert N. Hultgren MD (1992)	The study focuses on the effects of altitude, particularly referencing conditions at Keystone, Colorado, which is at an altitude of 9300 feet (2837 meters).	The survey involved 1909 adult visitors to Keystone, Colorado.	The study utilized a survey method to collect data from adult visitors to the mountainous area of Keystone, Colorado.	The research indicates that a growing number of middle-aged and elderly people are being exposed to high-altitude environments through activities such as skiing, trekking, and attending conferences. It highlights that high altitudes can aggravate cardiovascular conditions like coronary artery disease, systemic hypertension, and pulmonary hypertension. The study points out that typical complications from altitude exposure include increased incidence of angina or new cases of angina, higher blood pressure, and worsened symptoms in patients with pulmonary hypertension due to hypoxic pulmonary vasoconstriction.
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3.	^[18] Martin Burtscher (2007)	Austria	A case-control study was performed comparing the risk factor profiles of 247 males over the age of 34 who suffered SCD during mountain hiking or downhill skiing with those of 741 matched controls	Case-control study	Early CPR was administered to 33% of skiers and 14% of hikers upon loss of consciousness. Hikers who died suddenly during mountain hikes were more likely to have had prior heart issues such as myocardial infarction, known coronary artery disease, diabetes, and hypercholesterolemia, and were less active in mountaineering. Skiers who suffered sudden cardiac death were more likely to have had prior heart problems, hypertension, and were less engaged in strenuous exercise. These findings help identify high-risk individuals and suggest preventive measures.
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4.	^[12] Dante Penaloza and Javier Arias-Stella (2007)	Morococha, Peru, which is an Andean community located at 4540 meters above sea level (m).	The research involved examining eight cohorts of individuals native to high-altitude regions, spanning from newborns to individuals aged up to 60 years, residing at an elevation of 4540 meters.	electrocardiograph (ECG) and vectorcardiographic studies, as well as anatomical observations of heart specimens.	This review likely discusses the physiological and pathological aspects of heart and pulmonary circulation in individuals living at high altitudes, focusing on both healthy highlanders and those affected by chronic mountain sickness (CMS).
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5.	^[17] Eyal Leshem, Prativa Pandey, David R. Shlim, Kazuko Hiramatsu, Yechezkel Sidi et al (2007)	CIWEC clinic in Kathmandu	A total of 406 patients were evaluated, among them 327 retrospectively and 79 prospectively.	Retrospective and Prospective both.	Out of 406 patients assessed (327 retrospectively, 79 prospectively), altitude-related conditions were diagnosed: HACE in 21%, HAPE in 34%, combined HAPE and HACE in 27%, and AMS in 18%. Patients were older than trekker controls (44 ± 13.5 vs. 38.6 ± 13.9 years, $p < 0.0001$). Everest region trekkers had higher evacuation rates for altitude illness. Altitude illness-related deaths were estimated at 7.7 per 100,000 trekkers. Symptoms usually resolved within 2 days post-evacuation. Evacuations were more common among older trekkers and in the Everest region, with generally positive outcomes, though altitude-related deaths have increased over the decade.
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6.	^[9] Dr. Ramesh Chand (2014)	Govt. College Dharampur, Mandi (H.P.).	NM	NM	The study underscores Uttarakhand's increasing importance as a religious destination, attracting 28.4 million visitors annually compared to a population of 14 million. However, this surge has strained local infrastructure, leading to accommodation shortages and illegal construction along riverbanks. Uncontrolled tourism and development have caused environmental degradation, including deforestation and mining, while government inaction on environmental regulations has heightened vulnerability to disasters like floods. Economic growth driven by tourism has disregarded environmental concerns, further stressing Uttarakhand's ecosystem and infrastructure, notably contributing to the severity of the 2013 disaster.
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7.	^[7] Shardul Semwal and Brij M Upreti (2019)	Uttarakhand, India	The study analyzed tourist data from 2008 to 2018 for the Chardham Yatra pilgrimage sites (Kedarnath, Badrinath, Gangotri, and Yamunotri)	The data was sourced from official records or tourism departments, covering both national and foreign tourists visiting the Chardham sites during the specified years.	Analyzed the impact of the 2013 flash floods on tourism in Uttarakhand, specifically the Chardham Yatra. Examined trends in tourist inflow before and after the disaster, highlighting a significant initial decline followed by recovery. Emphasized the economic importance of pilgrimage tourism and discussed efforts to restore tourism infrastructure post-floods. Demonstrated a resurgence in tourist numbers post-2015, showcasing the resilience of pilgrims despite challenges.
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8.	^[15] Kamlesh Chandra Joshi and S. C. Bagri (2019)	Focused on the higher reaches of the Uttarakhand Himalayas, specifically examining the case of Kedarnath post the 2013 disaster.	NM	Qualitative research methods based on secondary data sources, including government reports, literature reviews, and interviews with local residents.	The study focuses on pilgrimage tourism in Uttarakhand's Himalayan region, stressing its economic importance. It examines the impacts of the 2013 disaster on pilgrimage tourism and emphasizes the need for disaster preparedness. It advocates for equitable and sustainable reconstruction efforts in Kedarnath, including afforestation and prioritizing agriculture for local development. To enhance sustainability, it suggests diversifying tourism, promoting community-based initiatives, and implementing eco-friendly infrastructure, aligning with sustainable tourism development goals.
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9.	^[8] Dr. Poonam Painuly, Kolluru Laxmi Goutami (2020)	Gurukula Kangri Vishwavidya laya, Haridwar, Uttarakhand, India.	NM	The study used a qualitative approach and relied on secondary data from various research articles and government reports. Hence, the sample size and specific sampling techniques were not directly mentioned, as the study primarily focused on analyzing existing data rather than collecting primary data through a specific sampling method.	The study focused on assessing the impact of the Covid-19 pandemic on the Char Dham pilgrimage in Uttarakhand. It aimed to identify the challenges faced by the holy shrines during the lockdown period, using secondary data analysis. The study highlighted the economic and livelihood impacts of the pandemic on the pilgrimage industry, particularly in terms of revenue losses, reduced tourist influx, and implications for local businesses and communities.
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10	^[10] Michal Apollo, Yana Wengel, Heike Schänzel, Ghazali Musa (2020)	Various Hindu temples in India, covering a range of locations from the Bay of Bengal to the Indian Himalayas	The study involved 14 semi-structured, in-depth interviews with stakeholders, including high priests, temple managers, and local expedition members from diverse socio-economic backgrounds.	The research utilized a flexible interview process, allowing participants to freely express their thoughts and experiences, thus gathering rich qualitative data. Participatory observation was also employed to immerse the researchers in the temple settings and local contexts.	The study focused on exploring the health hazards and tourism potential at Hindu pilgrimage sites in India. It identified significant safety, hygiene, accessibility, and environmental issues at these sites, which could impact both local populations and tourists. The research emphasizes the importance of addressing these challenges to improve visitor experiences, protect cultural heritage, and mitigate the potential spread of diseases, particularly during global pandemics.
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11	^[16] Niraj Kumar and Lalit Kumar (2020)	Mortuary of Base Hospital, Srinagar town in Pauri Garhwal district, Uttarakhand	294 autopsies were conducted out of which RTA was reported in 70 cases.	Retrospective autopsy-based study	A study conducted at Base Hospital's mortuary in Srinagar town, Uttarakhand, from January 2012 to December 2014 analyzed 70 medicolegal autopsies of road traffic accidents on hilly roads. Most accidents occurred between May and October, with males comprising 94.28% of fatalities. Public transport vehicles, like buses and taxis, were most commonly involved.
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12	^[14] Maciej Mikiewicz , MD Kamil Polok, MD, PhD Prof. Wojciech Szczeklik, MD, PhD Andrzej Górka, MA Sylwierz Kosiński, MD, PhD (2023)	The study took place in the Polish Tatra Mountains, specifically within the Tatra National Park (TNP).	The study reviewed 74 cases of sudden cardiac arrest in the mountain area.	Descriptive observational analysis.	The study investigated out-of-hospital cardiac arrests in the Polish Tatra Mountains. Key findings showed an 88% mortality rate and a 30% rate of return of spontaneous circulation (ROSC). Better survival was linked to AED use, a shockable rhythm, and quicker emergency responses. Survivors all had a shockable rhythm, and most had good neurological outcomes at discharge..
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CHAPTER 3. METHODOLOGY

KEY RESEARCH QUESTIONS

1. What is the incidence and nature of health complications during the Kedarnath Yatra?
2. What is the occurrence and demographic distribution of road traffic accidents during the Kedarnath Yatra?
3. Which age groups, genders, and individuals with pre-existing conditions are most vulnerable to health complications and accidents during the Kedarnath Yatra?
4. How does the incidence of health issues and accidents during the Kedarnath Yatra compare to the non-pilgrimage season?
5. What recommendations can be made to improve medical facilities, emergency response systems, and preventive measures to enhance pilgrim safety during the Kedarnath Yatra?

RESEARCH DESIGN

An **observational retrospective cohort study** will be used to conduct the research wherein data will be collected from hospital records and other relevant sources for a specific period i.e. last year's Pilgrimage season (2023) and compare the frequency of diseases and RTA cases during this period with a corresponding non-Pilgrimage period. The relationship between variables like age, sex, and comorbidities with disease occurrence and RTA cases during both the periods will be meticulously analyzed and documented.

STUDY SETTING

The study will be conducted at **District Hospital, Rudraprayag, Uttarakhand** which serves as a primary healthcare facility catering to the medical needs of pilgrims and residents in the region.

STUDY POPULATION:

- **Inclusion criteria:**

1. Patients seeking medical care at Rudraprayag District Hospital during the Kedaranath Pilgrimage season.
 2. Patients seeking medical care at Rudraprayag District Hospital during the non-pilgrimage months.
 3. Patients reporting to both OPD and Emergency during pilgrimage and non-pilgrimage season.
- **Exclusion criteria:**
 1. Patients with incomplete medical records.
 2. Patients reporting to Maternity OPD or maternity related emergencies.
 3. Patients reporting to Dental OPD.
 4. Patients reporting for routine activities like vaccinations, general examination, routine health check-ups, etc.

DURATION OF STUDY: March 18, 2024- June 17, 2024.

SAMPLE SIZE: The sample size will be determined based on the prevalence of health-related conditions, complaints and road traffic casualties including mortality during both the pilgrimage season and non-pilgrimage months.

SAMPLING TECHNIQUE: Consecutive sampling will be employed to include all eligible patients presenting to Rudraprayag District Hospital during the study period.

RESEARCH PROCEDURES/APPROACHES

The study is **Quantitative** in nature, focusing on analyzing numerical data (such as frequencies of diseases and RTA cases) and using statistical methods to draw conclusions.

OPERATIONAL DEFINITIONS:

1. **Health complications:** Specific health issues reported by patients during the study period.
2. **Confounding variables:** Demographic factors such as age, sex, and co-morbidities that may confound the relationship between pilgrimage season and disease occurrence.

STUDY INSTRUMENTS

Data Extraction Form: A structured data extraction form to systematically capture relevant information from hospital records.

Hospital Records/Hospital Information System (HIS)/Electronic Health Records (EHR): Utilizing the hospital's patients' records in the form of registers or electronic health records (EHR) software to access patient data.

Statistical Software: Statistical software to perform descriptive statistics (e.g., frequencies, percentages) and inferential analyses to examine associations between variables.

Data Cleaning Tools: Data cleaning tools (Excel) to ensure accuracy and consistency of extracted data.

DATA ANALYSIS PLAN

Numerical Data Analysis: numerical data obtained from hospital records, such as counts of disease occurrences and RTA cases during different periods will be analyzed.

Statistical Analysis: statistical methods (e.g., calculating frequencies, percentages, possibly conducting inferential tests) to analyze and interpret the data objectively will be employed.

Graphs and Tables: Graphs and tables will be incorporated to visually present the quantitative findings of the research.

ETHICAL CONSIDERATIONS A signed declaration has been obtained, ensuring that the identities of all study participants will remain confidential throughout the study period, as well as during and after the publication. This declaration is duly signed by the Additional CMO as the investigator.

CHAPTER 4. OBSERVATIONS AND RESULTS

Table 4. 1 FREQUENCY DISTRIBUTION OF TOTAL NO. OF RTA CASES BETWEEN NON-YATRA AND YATRA MONTHS

(APRIL 2023-MARCH 2024)

SR. NO.	MONTHS	NO. OF CASES	PERCENTAGE (%)
1.	NON-YATRA MONTHS	84	25.37
2.	YATRA MONTHS	247	74.62
	TOTAL	331	100.00

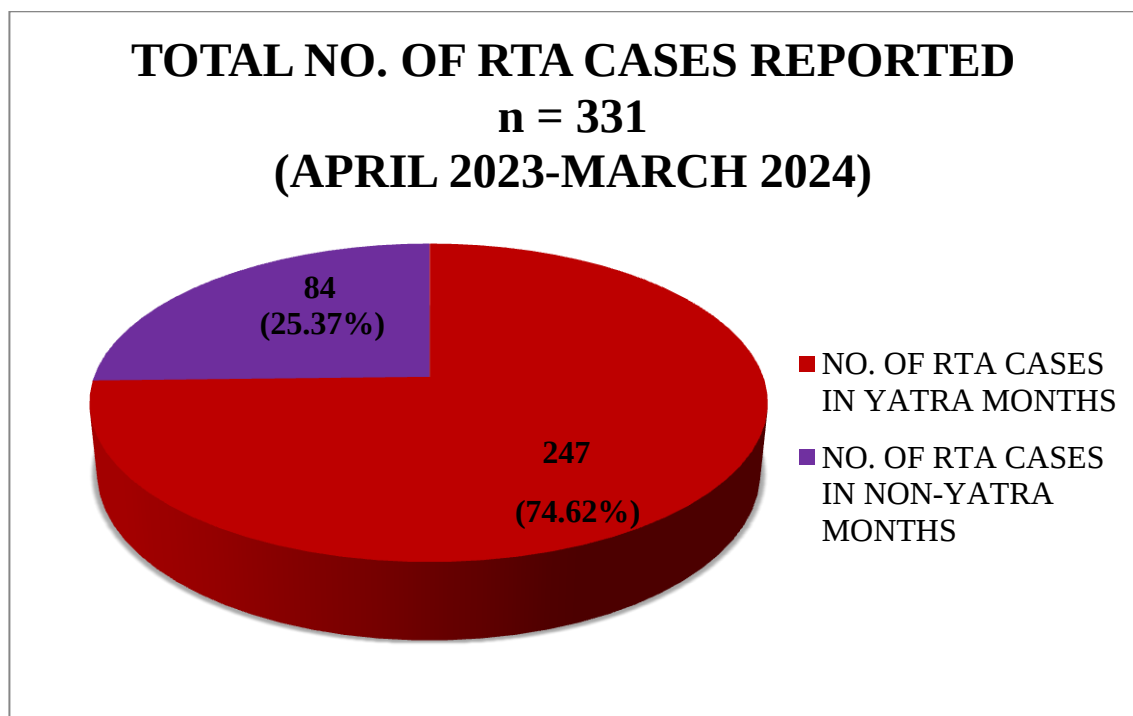


Figure 4. 1 PIE CHART REPRESENTING THE NO. OF RTA CASES REPORTED DURING YATRA AND NON-YATRA MONTHS

TABLE 4.1 AND FIGURE 4.1 show the total number of cases of Road Traffic Casualties reported from April 2023 to March 2024. Out of 331 cases reported during the whole year, 84 cases (25.37%) were reported in the non-yatra months while 247 cases (74.62%) were reported in the months when the yatra was functional.

Table 4. 2 MONTH-WISE DISTRIBUTION OF THE NO. OF RTA CASES REPORTED IN NON-YATRA MONTHS ($n_1=84$)

Sr. No.	Month	No. of RTA Cases	Percentage (%)
1.	APRIL 2023	19	22.62
2.	DECEMBER 2023	16	19.04
3.	JANUARY 2024	12	14.28
4.	FEBRUARY 2024	18	21.42
5.	MARCH 2024	19	22.62
	TOTAL	84	100.00

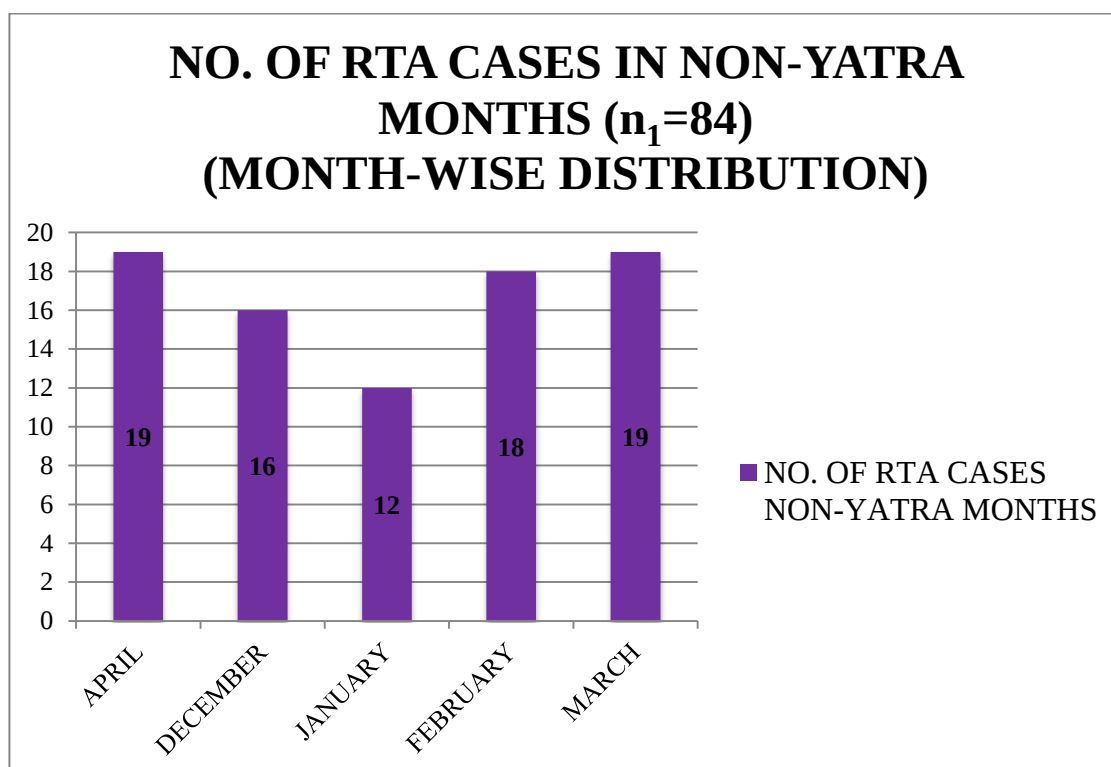


Figure 4. 2 BAR GRAPH REPRESENTING THE MONTH-WISE DISTRIBUTION OF THE NO. OF RTA CASES REPORTED IN NON-YATRA MONTHS ($n_1=84$)

TABLE 4.2 AND FIGURE 4.2 show the maximum number of cases were reported in the months of April 2023 and March 2024 (19; 22.62%) followed by February 2024 (18; 21.42%) while the least number of cases were reported in the month of January 2024 (12; 14.28%) i.e. **overall the highest number of RTA cases reported in any of the non-yatra months was 19.**

Table 4. 3 MONTH-WISE DISTRIBUTION OF THE NO. OF RTA CASES REPORTED IN YATRA MONTHS ($n_2=247$)

Sr. No.	Month	No. of RTA Cases	Percentage (%)
1.	MAY 2023	40	16.19
2.	JUNE 2023	30	12.14
3.	JULY 2023	26	10.52
4.	AUGUST 2023	36	14.57
5.	SEPTEMBER 2023	33	13.36
6.	OCTOBER 2023	47	19.03
7.	NOVEMBER 2023	35	14.17
	TOTAL	247	100.00

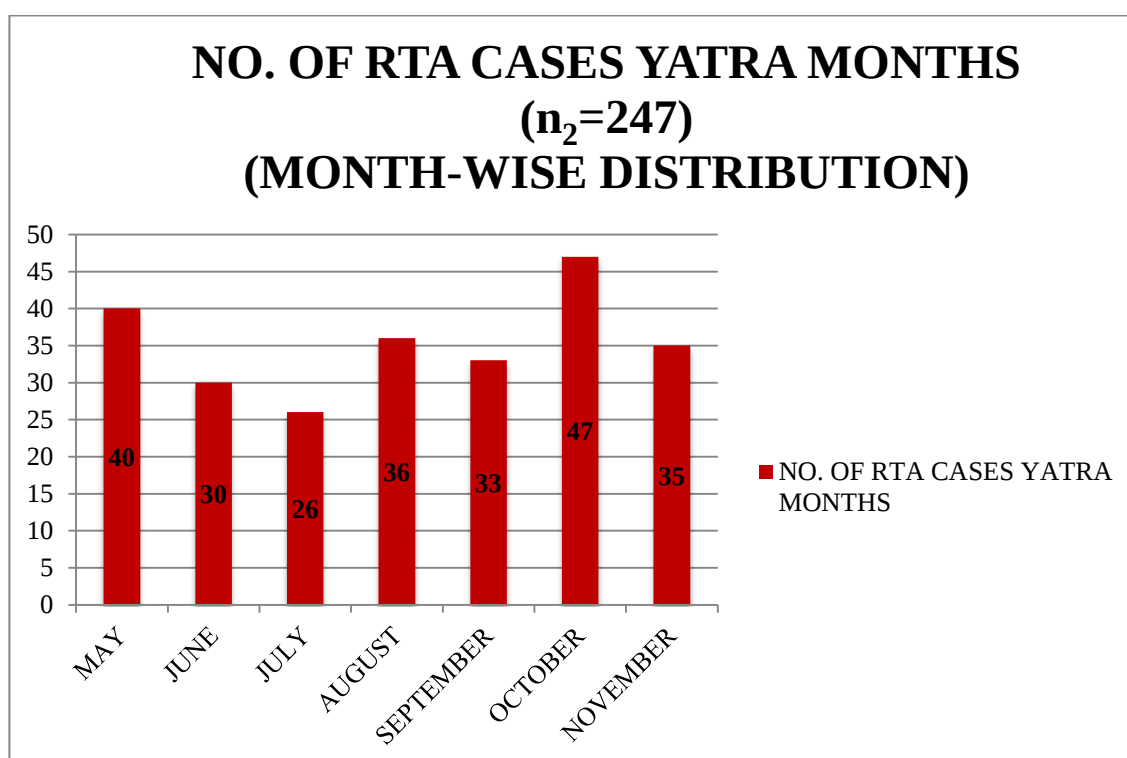


Figure 4. 3 BAR GRAPH REPRESENTING MONTH-WISE DISTRIBUTION OF THE NO. OF RTA CASES REPORTED IN YATRA MONTHS ($n_2=247$)

TABLE 4.3 AND FIGURE 4.3 show the maximum number of cases were reported in the month of October 2023 (47; 19.03%) followed by May 2023 (40; 16.19%) while the least number of cases were reported in the month of July 2023 (26; 10.52%) i.e. **overall the highest number of RTA cases reported in any of the yatra months was 47.**

Table 4. 4 DISTRIBUTION OF RTA CASES REPORTED IN YATRA MONTHS ACCORDING TO THE AGE GROUP (IN YEARS) (n₂=247)

Sr. No.	Age Group (in Years)	No. of Cases (n ₂ =247)	Percentage (%)
1.	0-9	11	4.45
2.	10-19	38	15.38
3.	20-29	81	32.47
4.	30-39	48	19.43
5.	40-49	36	14.57
6.	50-59	24	9.71
7.	>60	9	3.64
	TOTAL	247	100.00

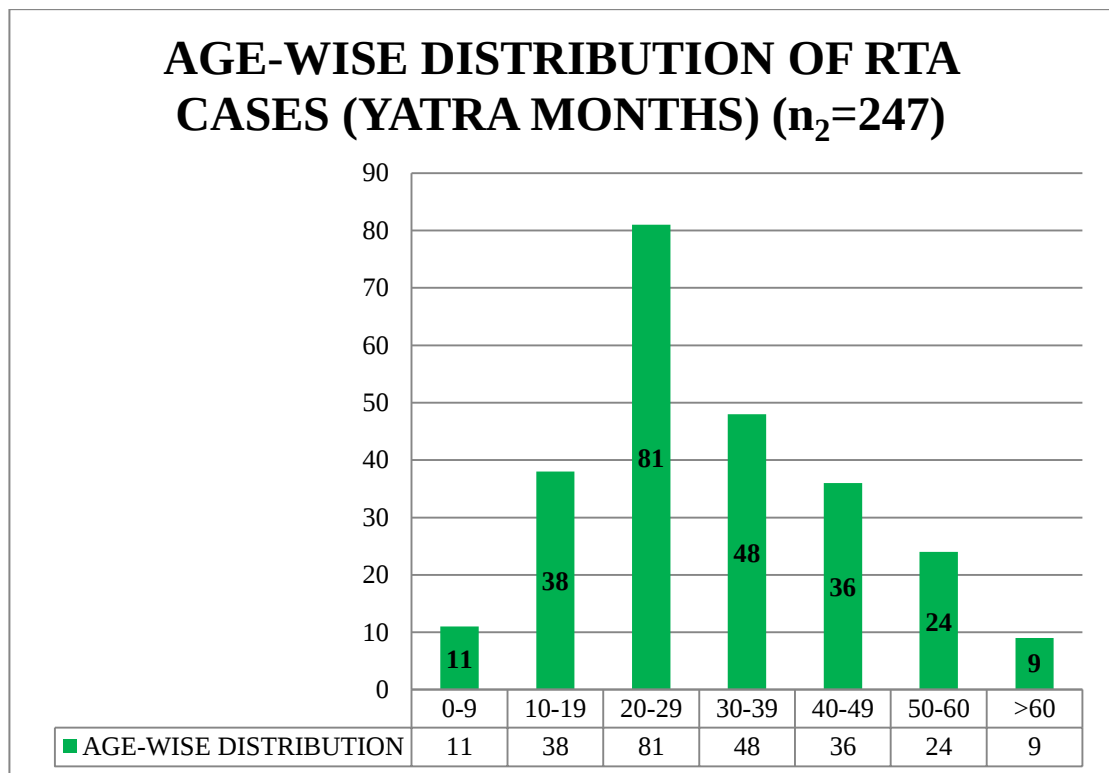


Figure 4. 4 BAR GRAPH REPRESENTING DISTRIBUTION OF THE CASES OF RTA REPORTED IN YATRA MONTHS ACCORDING TO THE AGE GROUP (IN YEARS) (n₂=247)

TABLE 4.4 AND FIGURE 4.4 show the **most vulnerable age group in case of RTA is 20-29 years** with the maximum no. of cases reported (81; 32.47%) followed by 30-39 years (48; 19.43%) while the least vulnerable age group is >60 years with minimum no. of cases reported (9; 3.64%).

Table 4. 5 DISTRIBUTION OF RTA CASES REPORTED IN YATRA MONTHS ACCORDING TO SEX (n₂=247)

SR. NO.	SEX	NO. OF CASES (n ₂ =247)	PERCENTAGE (%)
1.	MALE	167	67.67
2.	FEMALE	80	32.33
	TOTAL	247	100.00

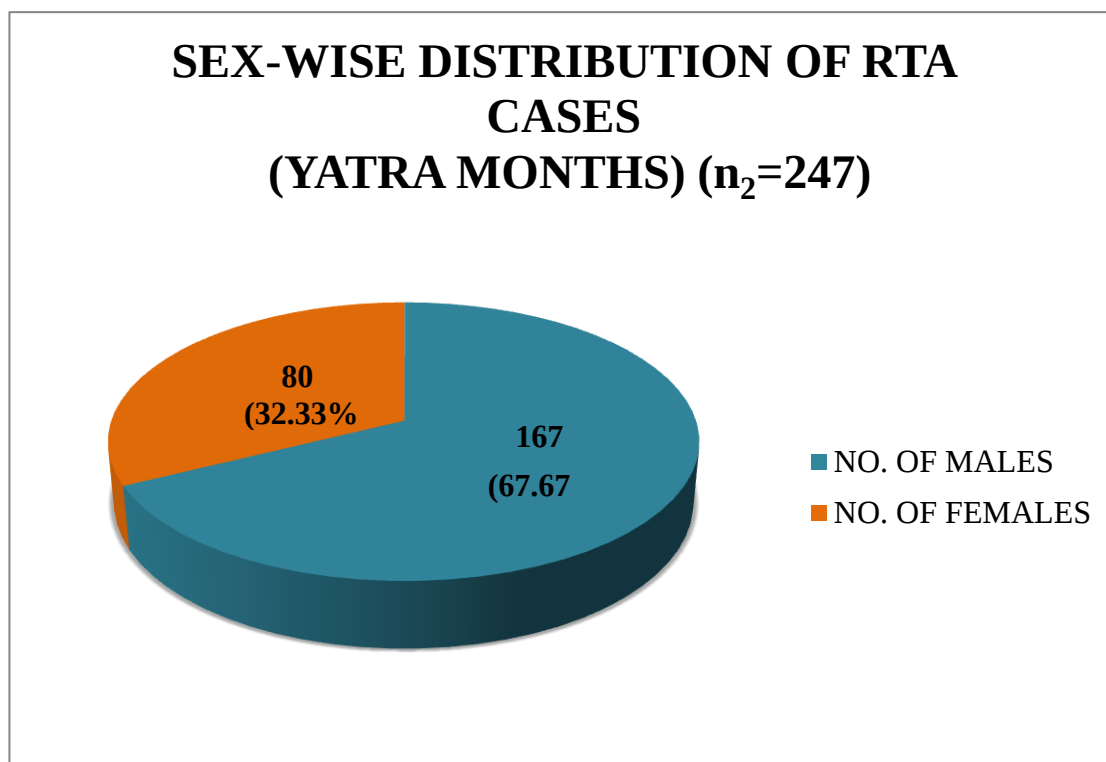


Figure 4. 5 PIE CHART REPRESENTING DISTRIBUTION OF THE CASES OF RTA REPORTED IN YATRA MONTHS ACCORDING TO SEX (n₂=247)

TABLE 4.5 AND FIGURE 4.5 show RTA was most frequently reported in males (167; 67.67%) as compared to females (80; 32.33%) during yatra months.

Table 4. 6 FREQUENCY DISTRIBUTION OF THE TOTAL NO. OF DEATHS REPORTED DUE TO CS, HS, PE AND HYP BETWEEN NON-YATRA AND YATRA MONTHS (n₃=167)

(APRIL 2023 - MARCH 2024)

SR. NO.	MONTH	NO. OF DEATHS (n ₃ =167)	PERCENTAGE (%)
1.	NON-YATRA	46	27.54
2.	YATRA	121	72.45
	TOTAL	167	100.00

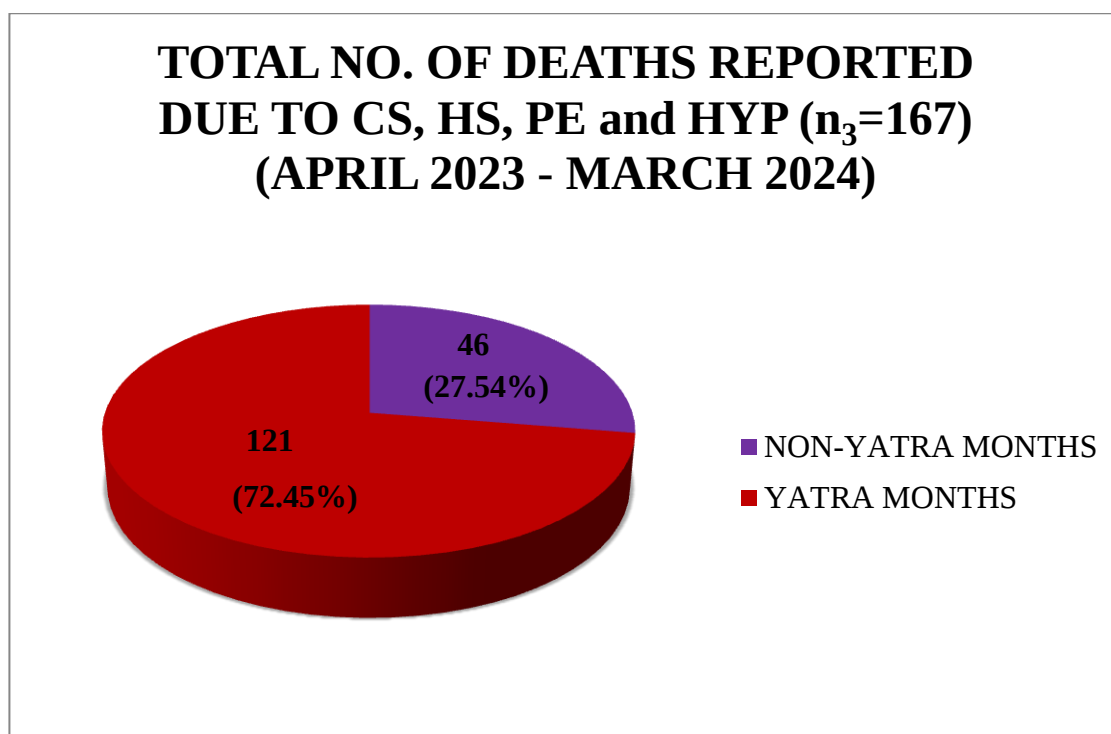


Figure 4. 6 PIE CHART REPRESENTING THE TOTAL NO. OF DEATHS REPORTED DUE TO CS, HS, PE and HYP DURING NON-YATRA AND YATRA MONTHS (n₃=167)

(APRIL 2023 - MARCH 2024)

TABLE 4.6 AND FIGURE 4.6 show the total number of deaths reported due to cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia reported from April 2023 to March 2024. Out of 167 deaths reported during the whole year, 46 (27.54%) were reported in the non-yatra months while 121 deaths (72.45%) were reported in the months when the yatra was functional.

Table 4. 7 MONTH-WISE DISTRIBUTION OF THE NO. OF DEATHS REPORTED DUE TO CS, HS, PE and HYP IN NON-YATRA MONTHS (n₄=46)

Sr. No.	Month	No. of Deaths (n ₄ =46)	Percentage (%)
1.	APRIL 2023	10	21.74
2.	DECEMBER 2023	9	19.56
3.	JANUARY 2024	9	19.56
4.	FEBRUARY 2024	6	13.04
5.	MARCH 2024	12	26.09
	TOTAL	46	100.00

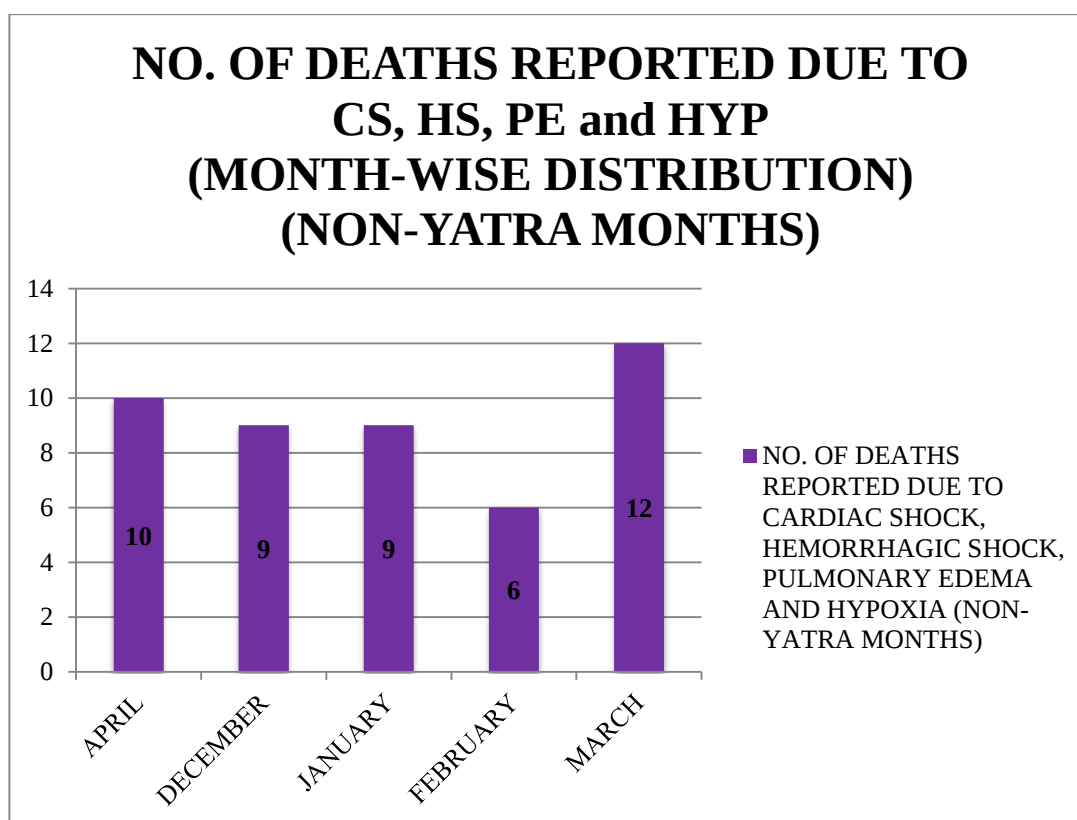


Figure 4. 7 BAR GRAPH REPRESENTING THE MONTH-WISE DISTRIBUTION OF THE NO. OF DEATHS REPORTED DUE TO CS, HS, PE, HYP IN NON-YATRA MONTHS (n₄=46)

TABLE 4.7 AND FIGURE 4.7 show the maximum number of deaths were reported in the month of March 2024 (12; 26.09%) followed by April 2023 (10; 21.74%) while the least number of deaths were reported in the month of February 2024 (6; 13.04%) i.e. **overall the highest number of deaths reported in any of the non-yatra months was 12.**

Table 4. 8 MONTH-WISE DISTRIBUTION OF THE NO. OF DEATHS REPORTED DUE TO CS, HS, PE and HYP IN NON-YATRA MONTHS (n₅=121)

Sr. No.	Month	No, of Deaths (n ₅ =121)	Percentage (%)
1.	MAY 2023	40	33.05
2.	JUNE 2023	31	25.62
3.	JULY 2023	10	8.26
4.	AUGUST 2023	10	8.26
5.	SEPTEMBER 2023	7	5.78
6.	OCTOBER 2023	18	14.87
7.	NOVEMBER 2023	5	4.13
	TOTAL	121	100.00

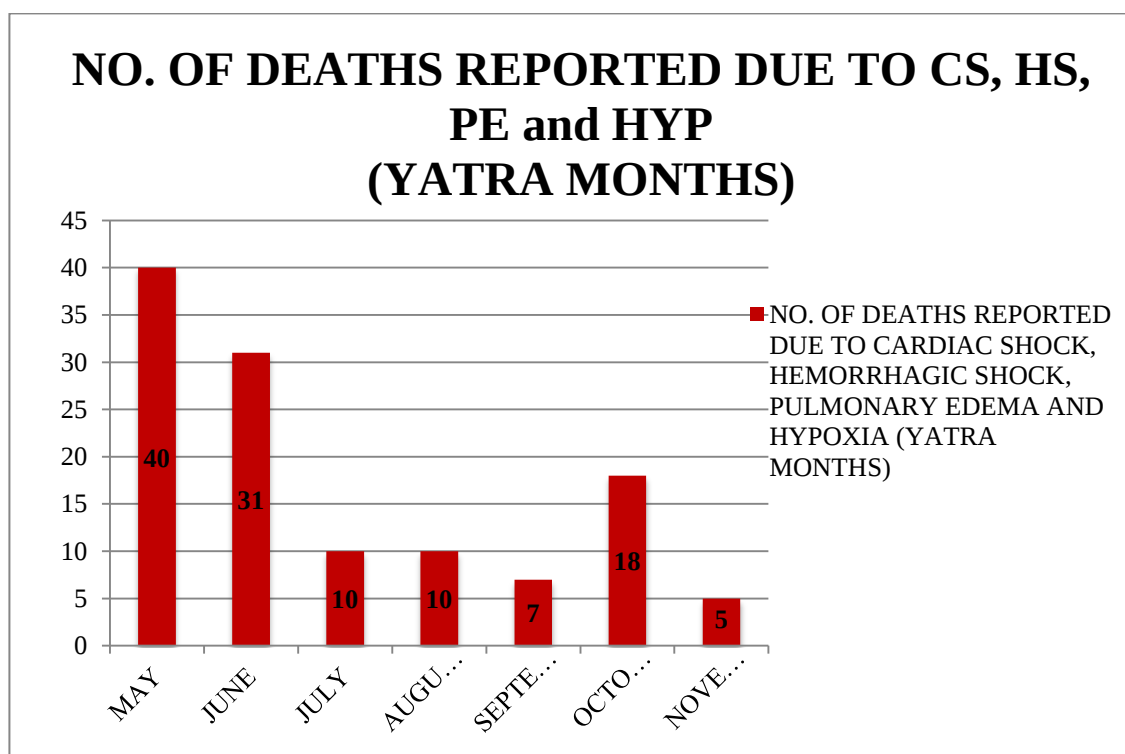


Figure 4. 8 BAR GRAPH REPRESENTING THE MONTH-WISE DISTRIBUTION OF THE NO. OF DEATHS REPORTED DUE TO CS, HS, PE and HYP IN YATRA MONTHS (n₅=121)

TABLE 4.8 AND FIGURE 4.8 show the maximum number of deaths were reported in the month of May 2023 (40; 33.05%) followed by June 2023 (31; 25.62%) while the least number of deaths were reported in the month of November 2023 (5; 4.13%) i.e. **overall the highest number of deaths reported in any of the yatra months was 40.**

Table 4. 9 DISTRIBUTION OF DEATHS REPORTED IN YATRA MONTHS DUE TO CS, HS, PE and HYP ACCORDING TO THE AGE GROUP (IN YEARS) (n₅=121)

SR. NO.	AGE GROUP	NO. OF DEATHS (n ₅ =121)	PERCENTAGE (%)
1.	0-20	1	0.82
2.	21-30	11	9.09
3.	31-40	15	12.39
4.	41-50	10	8.26
5.	51-60	31	25.61
6.	61-70	33	27.27
7.	>70	20	16.52
	TOTAL	121	100.00

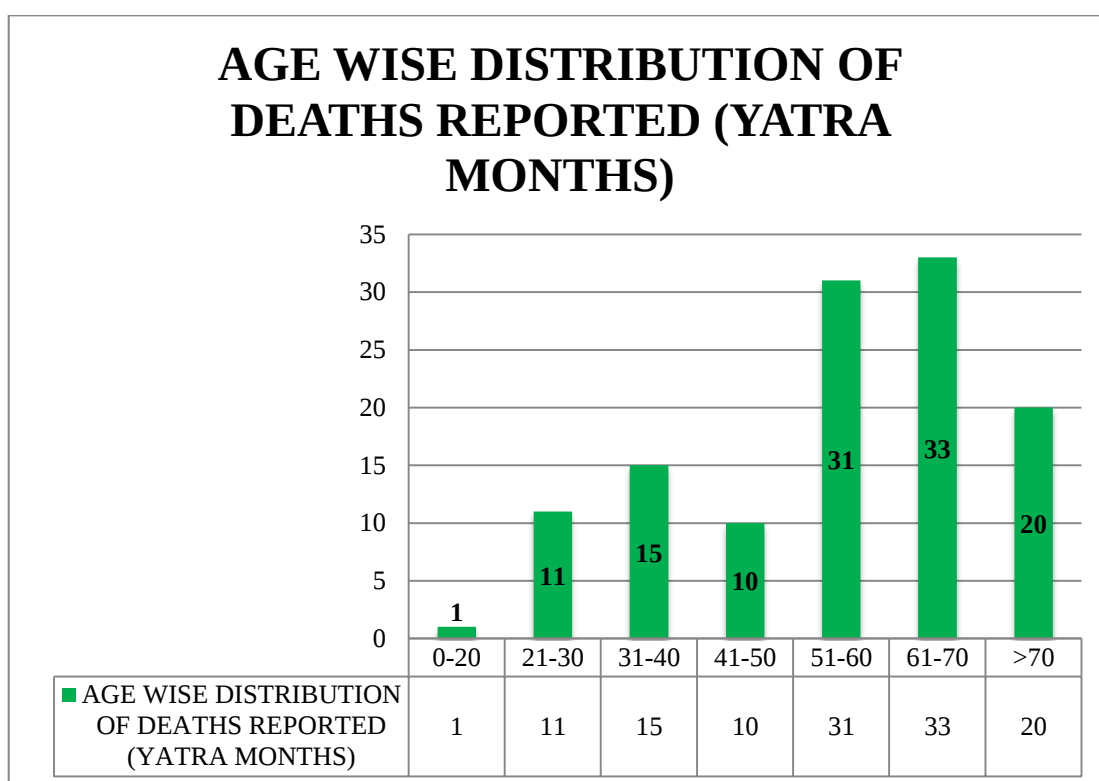


Figure 4. 9 BAR GRAPH REPRESENTING DISTRIBUTION OF DEATHS REPORTED IN YATRA MONTHS DUE TO CS, HS, PE and HYP ACCORDING TO THE AGE GROUP (IN YEARS) (n₅=121)

TABLE 4.9 AND FIGURE 4.9 show the **most vulnerable age group in case of mortality is 61-70 years** with the maximum no. of deaths reported (33; 27.27%) followed by 51-60 years (31; 25.61%) while the least vulnerable age group is 0-20 years with minimum no. of deaths reported (1; 0.82%).

Table 4. 10 DISTRIBUTION OF DEATHS REPORTED IN YATRA MONTHS DUE TO CS, HS, PE and HYP ACCORDING TO SEX (n₅=121)

SR. NO.	SEX	NO. OF DEATHS (n ₅ =121)	PERCENTAGE
1.	MALE	95	78.51
2.	FEMALE	26	21.48
	TOTAL	121	100.00

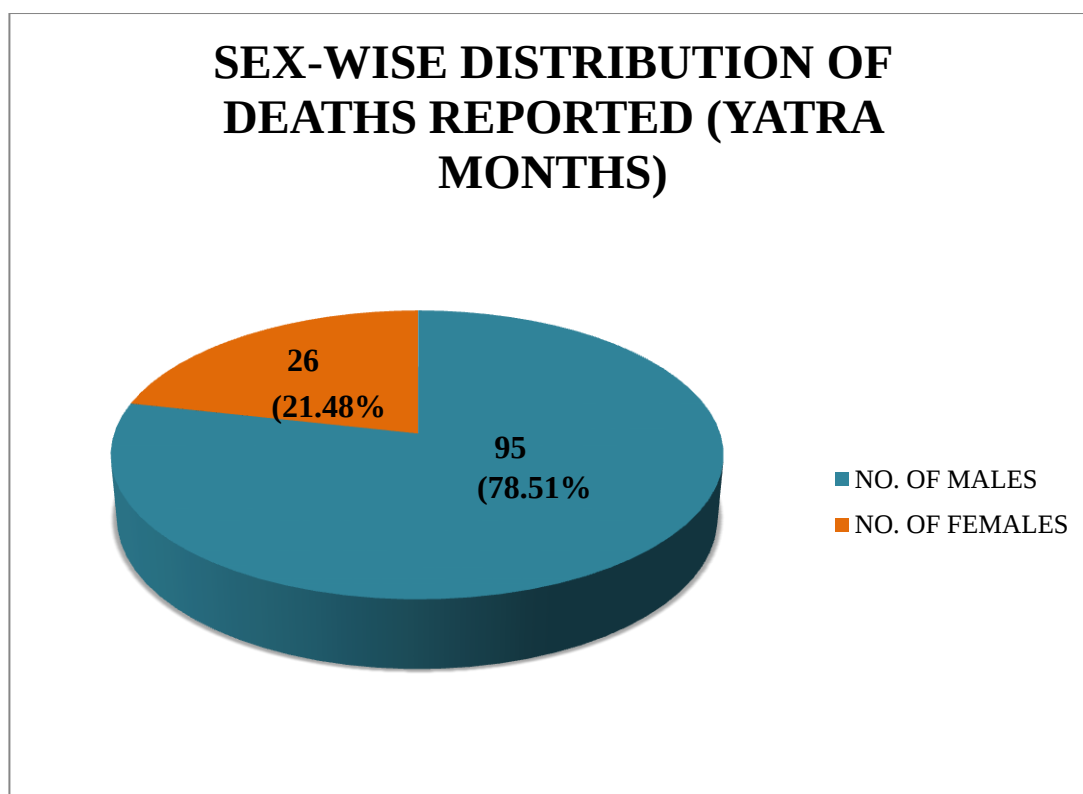


Figure 4. 10 PIE CHART REPRESENTING DISTRIBUTION OF DEATHS REPORTED IN YATRA MONTHS DUE TO CS, HS, PE and HYP ACCORDING TO SEX (n₅=121)

TABLE 4.10 AND FIGURE 4.10 show deaths due to CS, HS, PE and HYP were most frequently reported in males (95; 78.51%) as compared to females (26; 21.48%) during yatra months.

Table 4. 11 DISTRIBUTION OF DEATHS REPORTED IN YATRA MONTHS DUE TO CS, HS, PE and HYP ACCORDING TO PRESENCE OR ABSENCE OF CO – MORBIDITIES (n₅=121)

SR. NO.	CO - MORBIDITIES	NO. OF DEATHS (n ₅ =121)	PERCENTAGE (%)
1.	YES	76	62.81
2.	NO	45	37.19
	TOTAL	121	100.00

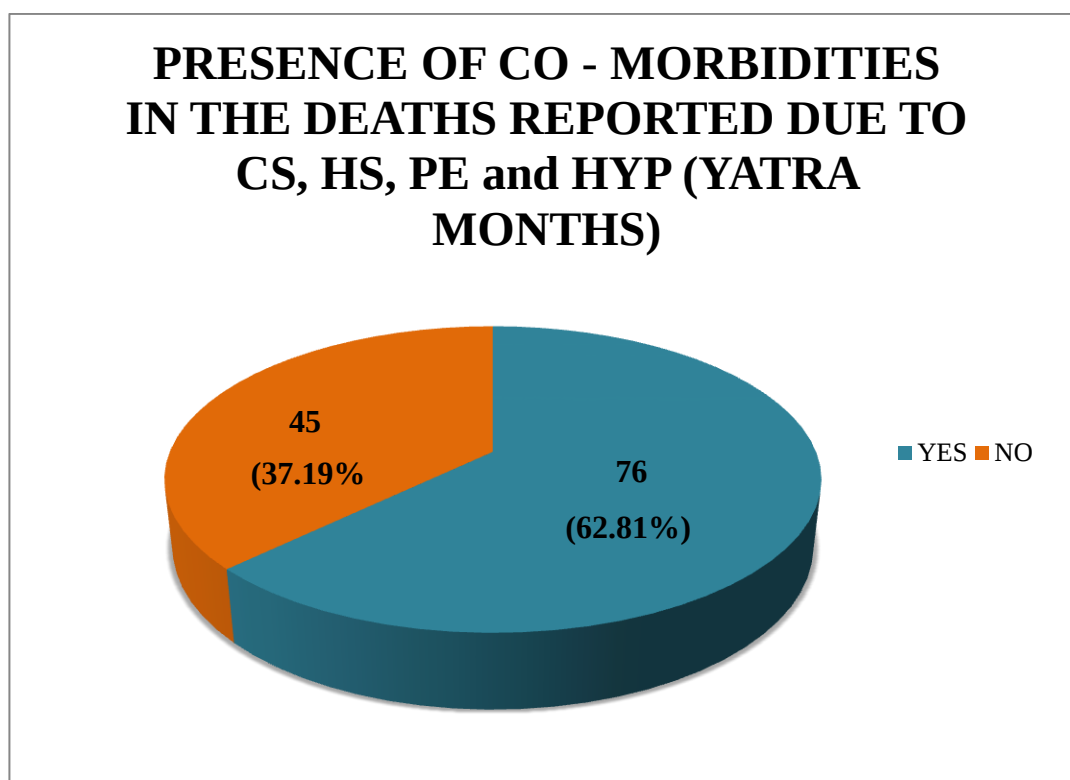


Figure 4. 11 PIE CHART REPRESENTING THE DISTRIBUTION OF DEATHS REPORTED IN YATRA MONTHS DUE TO CS, HS, PE and HYP ACCORDING TO PRESENCE OR ABSENCE OF CO – MORBIDITIES (n₅=121)

TABLE 4.11 AND FIGURE 4.11 show deaths due to CS, HS, PE and HYP were most frequently reported in pilgrims with co-morbidities (76; 62.81%) as compared to those without any co – morbidities (45; 37.19%).

CHAPTER 5. DISCUSSION

Char Dham Yatra is a pilgrimage circuit in the Indian state of Uttarakhand. It involves visiting four sacred Hindu shrines located in the Himalayas. The four shrines included in the yatra are **Badrinath, Kedarnath, Gangotri, and Yamunotri**.



Each of these shrines holds significant religious and mythological importance in Hinduism.

The Pilgrimage Season usually starts in April or May and continues until November. The opening date of the Char Dham pilgrimage is traditionally decided based on specific religious and astrological considerations. The final dates are decided by the authorities of the temple committees and the Head priests (Rawal) of the said temples. The opening ceremonies are conducted, and from holy texts and horoscopes, they determine the most favorable days.

The yatra, the religious pilgrimage is not only religious but a major cultural and tourism ‘festival’ for the state of Uttarakhand and India. In economic aspect, it plays a significant role within the several communities meaning employment to the residents of the several regions and boosting the tourism sector in the area.^[18]

Among all the temples of India, the Kedarnath is one of the places where numerous pilgrims visit every year; it is located in the Garhwal Himalayas. The town is constructed at 3580 m near Chorabari glacier which is one of the sources of the river Mandakini. It ranks amongst the twelve admired Jyotirlingas of lord shiva all over India.^[19]

The yatra to Kedarnath Temple involves trekking through challenging terrains, including high altitudes and mountainous regions. The Char Dham yatra witnessed a high number of deaths among the devotees in 2023 mostly due to cardiac arrest and other health ailments. The yatra, which attracts millions of pilgrims every year, has also been marred by road accidents and landslides. ^[18]

The deaths during the Kedarnath pilgrimage visit (“Kedarnath yatra”) in 2022 had shown an unusual rise, amounting to 120 deaths in just 27 days. This mortality was not at par with the previous years' records which had 90, 102 and 112 deaths in the 6-month travel window for the years 2019, 2018, and 2017, respectively. This acute unexpected rise in deaths is concerning and has invited medical and political attention. ^[6]

As a part of academic requirements I got an opportunity to learn and work as a trainee in the Quality Department of District Hospital, Rudraprayag, Uttarakhand wherein I was able to study, observe and shed some light on the health impacts of the holy expedition to one of the major shrines of the Chota Char Dham: THE KEDARNATH Temple that witnesses the largest number of devotees as compared to the other three holy sites each year. The hospital serves as the secondary healthcare facility and primary referral unit to millions of pilgrims steering through the holy trek each year.

An observational retrospective cohort study on the topic, ‘Understanding Health Risks and Road Safety during the Kedarnath Pilgrimage: A Comparative Analysis and Evidence-Based Recommendations for Pilgrim Health and Safety’ was conducted in the Quality Department of District Hospital, Rudraprayag over a period of 3 months from March 2024 2023 to June 2024 wherein retrospective data from April 2023 to March 2024 was recorded. The sample size was not fixed and included complete enumeration of all the cases reporting to the hospital during both the pilgrimage season and non-pilgrimage months to find the cases relevant to the study at hand.

The aim of the study was to identify the prevalent health complaints, road traffic casualties and mortality patterns during the Kedarnath pilgrimage, assessing differences in incidence between pilgrimage and non-pilgrimage months along with exploring the influence of demographic factors such as age, sex, and co-morbidities on their occurrence to develop evidence-based recommendations for improving pilgrim health and safety.

ROAD TRAFFIC CASUALTIES PATTERN

MONTH-WISE DISTRIBUTION

In the present study, it was observed that a total of 331 cases of road accidents were reported between April 2023 and March 2024. Out of these 331 cases, 84 (25.37%) were outlined during the months when the Kedaranath Yatra was non-operational while the remaining 247 (74.62%) cases were reported in the months when the yatra was operational. Thus, the number of RTA cases became almost thrice during the Yatra months (May 2023-November 2023).

In analyzing the monthly distribution of road traffic accidents during the Yatra season, it was found that the highest number of incidents occurred in October (47; 19.03%), followed closely by May (40; 16.19%), while July recorded the lowest number of casualties (26; 10.52%).

Similarly, **Niraj Kumar and Lalit Kumar**, in their research, conducted a retrospective autopsy-based study involving 70 medicolegal autopsies on road traffic accident cases in the mortuary of Base Hospital, Srinagar town, Pauri Garhwal district, Uttarakhand. They reported a similar trend, noting that most accidents occurred between May and November. ^[16]

Table 5. 1 COMPARATIVE ANALYSIS OF MONTH-WISE DISTRIBUTION OF RTAs REPORTED IN PRESENT STUDY WITH STUDY CONDUCTED BY NIRAJ KUMAR AND LALIT KUMAR

MONTH	Niraj Kumar and Lalit Kumar.^[15] (2020) (n=70)	Present Study (n=331)
May	18	40
June	4	30
July	0	26
August	6	36
September	22	33
October	7	47
November	2	35
TOTAL	59	247

In the study conducted by Niraj Kumar and Lalit Kumar 84.29% of the total RTA cases reported during the course of the study were chronicled between the months of May and

November similar to the present study wherein 74.62% of the total RTA cases were reported during the months of Yatra Season (May-November).

AGE-WISE DISTRIBUTION

In our study the maximum number of road accidents were reported in the age group 20-29 (81; 32.47%) followed by 30-39 years (48; 19.43%). The age group that was reported to be the least affected by road traffic casualties was >60 years (9; 3.64%).

Similar findings were reported by **Niraj Kumar and Lalit Kumar** in their study wherein the highest number of incidents of RTA were observed among the age group 20-25 years (13; 18.57%) while the least susceptible age group was noted to be 06-10 and 66-70 years (1; 1.42%).

NIRAJ KUMAR AND LALIT KUMAR. ^[16] (2020) (n=70)

Table 5. 2 DISTRIBUTION OF RTA CASES ACCORDING TO AGE-GROUP IN STUDY CONDUCTED BY NIRAJ KUMAR AND LALIT KUMAR

AGE GROUP (IN YEARS)	NO. OF CASES (n=70)
0-5	0
6-10	1
11-15	2
16-20	8
21-25	13
26-30	11
31-35	12
36-40	3
41-45	6
46-50	3
51-55	3
56-60	4
61-65	3
66-70	1
TOTAL	70

PRESENT STUDY

Table 5. 3 DISTRIBUTION OF RTA CASES ACCORDING TO AGE-GROUP IN PRESENT STUDY

AGE GROUP (IN YEARS)	NO. OF CASES (n ₂ =247)
0-9	11
10-19	38
20-29	81
30-39	48
40-49	36
50-59	24
>60	9
TOTAL	247

SEX-WISE DISTRIBUTION

In the present study it was noted that males highly outnumbered the females in case of road traffic accidents. The number of males who suffered road traffic casualties were 167 (67.67%) while females were relatively much lesser with total number of casualties recorded at 80 (32.33%).

Niraj Kumar and Lalit Kumar ^[16] made similar observations during the course of their study wherein significantly much higher number of RTA victims were males (66; 94.28%) as opposed to a much smaller number of females (4; 5.71%).

Table 5. 4 DISTRIBUTION OF CASES OF RTA ACCORDING TO SEX IN STUDY CONDUCTED BY NIRAJ KUMAR AND LALIT KUMAR

SEX	Niraj Kumar and Lalit Kumar. ^[15] (2020) (n=70)	PRESENT STUDY (n ₂ =247)
MALE	66	167
FEMALE	4	80
TOTAL	70	247

MORTALITY PATTERN DUE TO CARDIAC SHOCK, HEMORRHAGIC SHOCK, PULMONARY EDEMA AND HYPOXIA

MONTH-WISE DISTRIBUTION

In the present study, it was observed that a total of 167 cases of deaths due to cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia were reported between April 2023 and March 2024. Out of these 167 deaths, 46 (27.54%) were outlined during the months when the Kedaranath Yatra was non-operational while the remaining 121 deaths (72.45%) were reported in the months when the yatra was operational. Thus, the number of deaths due to cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia became almost thrice during the Yatra months (May 2023-November 2023).

On observing the month-wise distribution of the deaths due to cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia during Yatra season it was observed that the highest number of deaths were reported in the month of May (40; 33.05%) with June (31; 25.62%) coming a close second while the least number of deaths were reported in the month of November (5; 4.13%).

A direct comparison with similar studies on this aspect of our research is unavailable since there is limited prior research directly aligning with our methodology and specific outcomes. However, **J Dickinson, D Heath, J Gosney and D Williams conducted a research study in 1983** focused on trekkers in the Himalayas, specifically those who experienced altitude-related deaths. They observed that fatal outcomes were primarily due to serious pulmonary, cardiovascular and cerebral diseases related to high altitude.

^[13] Despite the absence of a direct comparative study, the findings of this research align with the primary causes of mortality during Kedarnath Temple trek noted in our present study i.e. cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia.

PRESENT STUDY

Table 5. 5 MONTH-WISE DISTRIBUTION OF THE NUMBER OF DEATHS REPORTED IN PRESENT STUDY

MONTH	NO. OF DEATHS (n ₅ =121)	PERCENTAGE (%)
MAY 2023	40	33.05
JUNE 2023	31	25.62
JULY 2023	10	8.26
AUGUST 2023	10	8.26
SEPTEMBER 2023	7	5.78
OCTOBER 2023	18	14.87
NOVEMBER 2023	5	4.13
TOTAL	121	100.00

AGE-WISE DISTRIBUTION

In our study the maximum number of deaths due to cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia were reported in the age group 61-70 years (33; 27.27%) followed by 51-60 years (31; 25.61%). The age group that was reported with the least number of deaths was 0-20 years (1; 0.82%).

Similar findings were noted by **Eyal Leshem, Prativa Pandey, David R. Shlim, Kazuko Hiramatsu, Yechezkel Sidi**, and their colleagues in a study evaluating 406 patients for severe altitude illness in Nepal, with 21% diagnosed with HACE, 34% with HAPE, 27% with both, and 18% with AMS. The mean patient age was older compared to trekker controls (44 ± 13.5 vs. 38.6 ± 13.9 years, $p < 0.0001$). The study concluded that altitude illness leading to evacuation is more common among trekkers in the Everest region and older individuals.^[17]

PRESENT STUDY

Table 5. 6 DISTRIBUTION OF THE NUMBER OF DEATHS REPORTED ACCORDING TO AGE-GROUP IN PRESENT STUDY

AGE GROUP	NO. OF DEATHS (n ₅ =121)	PERCENTAGE (%)
0-20	1	0.82
21-30	11	9.09
31-40	15	12.39
41-50	10	8.26
51-60	31	25.61
61-70	33	27.27
>70	20	16.52
TOTAL	121	100.00

SEX-WISE DISTRIBUTION

In the present study it was noted that females were outnumbered by males in case of mortality patterns observed due to cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia during Yatra season. The number of males who died were 95 (78.51%) while females were relatively much lesser with total number of deaths recorded at 26 (21.48%).

In their study, Eyal Leshem, Prativa Pandey, David R. Shlim, Kazuko Hiramatsu, Yechezkel Sidi, *et al.* ^[17] noted similar trends while examining the demographic characteristics and ascent profiles of patients with severe altitude illness across different trekking areas. They found a notably higher proportion of male patients regardless of the trekking location.

Table 5. 7 DISTRIBUTION OF NO. OF PATIENTS WITH SEVERE ALTITUDE SICKNESS ACCORDING TO SEX IN STUDY CONDUCTED BY EYAL LESHEM , PRATIVA PANDEY , DAVID R. SHLIM , KAZUKO HIRAMATSU , YECHEZKEL SIDI *et al*

	Annapurna	Everest	Langtang	Mountaineers
Male gender (%)	56	69	62	85

PRESENT STUDY

Table 5. 8 DISTRIBUTION OF THE NUMBER OF DEATHS REPORTED ACCORDING TO SEX IN PRESENT STUDY

SEX	NO. OF DEATHS (n ₅ =121)	PERCENTAGE
MALE	95	78.51
FEMALE	26	21.48
TOTAL	121	100.00

DISTRIBUTION BASED ON PRESENCE OR ABSENCE OF CO-MORBIDITIES

In the present study it was discerned that among the individuals who suffered death due to cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia during Yatra season majority were suffering from previously diagnosed co-morbidities viz., hypertension, diabetes, asthma, k/c/o CAD to name a few. Out of 121 deaths registered during the Yatra season, 76 (62.81%) were reported in those suffering from various co-morbidities while a relatively lesser number of deaths i.e. 45 (37.19%) were reported in individuals with no previously diagnosed ailments.

Martin Butscher, ^[18] in his study on assessing the Risk of Cardiovascular Events During Mountain Activities, found similar trends. He observed that hikers who experienced sudden death during mountain hiking were significantly more likely to have had a history of myocardial infarction (17% vs. 0.9%), known coronary artery disease without prior myocardial infarction (17% vs. 4%), diabetes (6% vs. 1%), hypercholesterolemia (54% vs. 20%), and were less involved in regular mountaineering activities compared to hikers in the control group (all $P < 0.001$). Additionally, skiers who suffered sudden cardiac death were more likely to have had a prior myocardial infarction (41% vs. 1.5%), hypertension (50% vs. 17%), known coronary artery disease without prior myocardial infarction (9% vs. 3%), and were less engaged in regular strenuous exercise compared to controls (all $P < 0.05$).

PRESENT STUDY

Table 5. 9 DISTRIBUTION OF DEATHS REPORTED ACCORDING TO PRESENCE OR ABSENCE OF CO-MORBIDITIES IN PRESENT STUDY

CO - MORBIDITIES	NO. OF DEATHS (n ₅ =121)	PERCENTAGE (%)
YES	76	62.81
NO	45	37.19
TOTAL	121	100.00

CHAPTER 6. CONCLUSION

Located in the state of Uttarakhand in India, Kedarnath Temple is one of the twelve Jyotirlingas that are revered by devotees throughout the year. This religious site is positioned at an altitude of over 6770 meters in the Rudraprayag district of Uttarakhand, India making it not only a place of pilgrimage but also the testament of people's tenacity in the face of sheer difficult geography.

The Kedarnath Temple attracts devotees from around the globe. Estimated to be one of the twelve Jyotirlingas of Lord Shiva, it holds a high esteem among the pilgrim centers. It is said to have been built by Pandavas in Dwapar Yuga and later in eighth century it was reconstructed by Adi Guru Shankaracharya. Thus, it may be said that the construction of this historic temple was associated with strong faith and great religious passion.

However, in the recent past few years, the region around Kedarnath has come in to lime light mainly because of the tragic floods that hit the state in 2013. An amazing saga of the reconstruction process of the shrine after the calamity has proven the unrelenting character and pride that is attributed to this sacred place.

It is however very risky as several pilgrims are often likely to develop one severe ailment or the other, or even die while en-route at Kedarnath. Physical endurance is also tested due to the fact that most of the routes leading to the temple are bumpy and steep. Severe inconveniences comprise low oxygen levels that make one have altitude sickness, a condition that can be lethal once it escalates.

The nature of the extreme weather that ranges from April up to November includes heavy snow, prying and continuous rains, and low and freezing temperatures. Nonetheless pilgrims are willing to undertake this trip as they are religious people and believe that they attend this holier place for blessings which are worth the efforts of climbing the steep terrains. Unfortunately, challenges exhibited by the pilgrimage normally lead to cases of calamities and deaths, so as to underscore the great sacrifices people had to endure in order to derive blessings from such distant and risky parts of the world.

To improve the pilgrims' transformative journey, the well-being and safety issues of pilgrims in search of spirituality at Kedarnath Temple should be considered. Hence the

health of the pilgrims should be carefully looked after to ensure the pilgrimage is not just about suffering but also a rich encounter with the divine. Taking all these measures, the pilgrims can commence on this arduous journey with certainty that their basic requirements are met as they embark on the spiritual pursuit of Kedarnath which remains as such a potent symbol of devotion and perseverance.

District Hospital, Rudraprayag, Uttarakhand primarily caters all the health care needs of the trekkers and devotees as the first point of referral unit. This study has involved all the RTA cases and patients attending the District Hospital with Cardiac shock, Hemorrhagic shock, Pulmonary edema and hypoxia from April-2023 to March-2024. Our study includes 5 months when the Yatra was non-functional and 7 months when the Yatra was operational from April 2023 and March 2024. This has been done to discern if the number of road accidents and cases of cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia increased during the Yatra season as was previously hypothesized before the research was commenced and established. Deaths due to the aforementioned clinical causes have also been documented in this study. Correlation with demographic factors like Age, Sex and presence or absence of co-morbidities has been studied to be able to detect and highlight the most vulnerable and susceptible group of pilgrims taking the journey to the holy shrine so that the importance of robust support systems, including adequate medical facilities, emergency response teams, and thorough acclimatization protocols can be further highlighted so that the well-being and safety of pilgrims be prioritized to enhance their transformative journey.

This is an extensive study with results in accordance with similar previous studies carried out by other researchers in different states and even countries.

The study shows that out of a total of 331 cases of road accidents that reported to the hospital, 74.62% (247) were noted during the Yatra months while a mere 25.37% (84) were observed during the months when the Yatra was non-operational i.e. the number of RTAs tripled during the months of Kedarnath Yatra.

It was further noted that the number of road traffic casualties during the Yatra Season were recorded in the following order: October (19.03%)> May> August> November> September> June> July (10.52%). The most vulnerable age-group was observed to be 20-29 years (32.47%) with others in the following order: 30-39> 10-19> 40-49> 50-60> 0-9> 60+ (3.64%). Sex scanning of the Yatra data for road accidents concluded that females were highly outmanned by the number of male victims. With female victims

proportion being just 32.33% (80), males were almost a double at 67.67% (167) of the total RTA cases reported during the Yatra months.

While studying the mortality patterns between April 2023 and March 2024 it was observed that out of 167 deaths reported the proportion of deaths due to cardiac shock, hemorrhagic shock, pulmonary edema and hypoxia was significantly higher in the Yatra months 72.45% i.e. 121 as compared to the non-Yatra season with a much lesser 27.54% i.e. 46. Thus, the proportion of deaths due to the above mentioned causes almost became three-fold in the Yatra months.

Month-wise breakdown of the deaths recorded during the Yatra season revealed the following observations. The highest number of deaths were recorded in the month of May (33.05%) followed by June> October> July> August> September> November (4.13%). The most vulnerable age-group was observed to be 61-70 years (27.27%) with 51-60 (25.61%) coming a close second while the other age-groups were in the following order: 70+> 31-40> 21-30> 41-50> 0-20 (0.82%). While studying for sex-wise distribution of the number of deaths reported during the Yatra season it was noted that mortality among males was significantly higher (78.51%) was significantly higher as compared to the number of females who were much fewer in proportion with a mere 21.48%. Observing the relative proportion of the presence or absence of co-morbidities revealed that of the 121 deaths reported during the Yatra season, 62.81% were reported in those with co-morbid conditions while a relatively lower 37.19% were observed in those with no previously present co-morbidities.

The study elucidates significant patterns in the incidence of road traffic accidents (RTAs) and mortality among pilgrims traveling to Kedarnath Temple. From the data collected between April 2023 and March 2024, the most vulnerable groups for RTAs were individuals aged 20-29 years (32.47%), predominantly males (67.67%). The highest occurrences of RTAs were observed in October (19.03%) and May (16.19%) i.e. almost 35%-40% of the pilgrimage takes place during these two months, underscoring the critical need for enhanced road safety measures during the peak period(s).

In terms of mortality patterns, the study highlights that pilgrims aged 61-70 years (27.27%) are at the highest risk, followed closely by those aged 51-60 years (25.61%). Males constitute a significantly larger proportion of the mortality statistics (78.51%). Furthermore, a substantial majority of deaths were recorded among individuals with

pre-existing co-morbid conditions (62.81%), emphasizing the need for targeted medical attention and preparedness for these groups. Death trends in terms of month-wise distribution showed almost similar patterns as RTA trends with highest number of deaths reported in the month of May (33.05%) followed by June (25.62%) and October (14.87%) highlighting the need for robust safety protocols during the peak period(s).

The implications of such studies are significant. In order to improve safety and welfare for pilgrims visiting Kedarnath Temple and cope with an annual influx of huge numbers of visitors, the following suggestions are made:

1. Controlling the Huge Influx of Pilgrims:

- **Permit System:** Establish a permit system to control the number of pilgrims visiting each day. Ensure that Pilgrims apply in advance for the permits with an online system of distributing them.
- **Time-Slot Allocation:** Time slots should be allocated to enable effective crowd management and prevent overcrowding at any one time.
- **Advanced Registration:** Advanced registration system should be established.
- **Peak Season Management:** Impose restrictions on peak seasons while encouraging visits during off seasons by giving travel discounts and accommodation deals.

2. Creating More Screening Points:

- **Additional Screening Locations:** Further screening points need to be created along the Yatra route so as to cover all health and safety requirements. The screening points should be strategically placed so that no pilgrim bypasses them.
- **Strict Enforcement:** Ensure that every pilgrim has gone through all screening points before proceeding. For instance, at each checkpoint, a pass or stamp could be issued which should later on be handed over again in other subsequent sites.

3. Collaboration with Private Ambulance Services and NGOs:

- **Emergency Equipment and Response Teams:** The hospital can partner with private ambulance services and NGOs to provide emergency equipment and trained response teams. It is also important that these particular services are of low cost as private ambulances are known to be expensive.

- 24/7 Availability: Ensure 24/7 accessibility to these services especially during peak pilgrimage season.

4. Enhanced Peak Season Management:

- Road Safety Measures: Extra traffic personnel and safety barriers should be installed along the route. Also ensure that sensitive landslide zones are effectively marked to alert and guide pilgrims safely through these areas.
- Health Monitoring: Set up additional health camps along the route. These camps should offer services like oxygen supplies, first aid, and basic medical treatment.

5. Mandatory Pre-Acclimatization Training:

- Training Programs: Pre-acclimatization training should be made compulsory for all pilgrims, focusing on the aged and people with pre-existing illnesses to teach them about the dangers of high altitudes as well as gradual body adaptation to such conditions.
- Special Safety Kits: Special safety kits should be provided with oxygen canisters and first aid kits.

6. Awareness Campaigns and Research:

- Public Awareness: Use various media platforms to create awareness amongst the pilgrims about health and safety measurements.
- Continuous Research: Continuous research should be conducted to ensure continuous improvement in safety measures through refining strategies based on what is learned from such data.

Government can greatly improve the security and welfare of visitors at Kedarnath Temple by adopting these recommendations.

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ANNEXURE

DECLARATION FORM

I, Dr. Shwetangi Kumar Jakhmola hereby declare that I shall not disclose the identity of any of the research participants during or after the study period or during publication.


(डा० शिवमल सिंह गुसाई)
अपर मुख्य चिकित्साधिकारी
Signature of Investigator
रुद्रप्रयोग