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Link between urban heat and cardiac health: A qualitative study in Bhubaneswar

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ABSTRACT

Background: Cardiovascular vulnerability has emerged as a critical health concern with the increasing frequency and intensity of heat waves across urban India. Elevated ambient temperatures exacerbate pre-existing heart conditions and often delay timely recognition and intervention. While quantitative studies have established statistical correlations, little is known about patient and provider experiences during heat-induced cardiac events.

Objective: To explore the lived experiences of patients with cardiac events during periods of high heat in Bhubaneswar, Odisha, alongside insights from cardiologists and dietitians.

Methods: A descriptive qualitative study was conducted through semi-structured interviews with participants from tertiary hospitals during officially declared heatwave periods. Thematic analysis was applied to identify and interpret patterns across participant narratives, supported by NVivo software for data management.

Results: Emergent themes included increased cardiac admissions during heatwaves, atypical symptom presentation, delays in care due to misattribution, and reliance on unverified home remedies. Misconceptions about hydration and cultural dietary habits further complicate patient outcomes. Structural challenges such as inadequate housing, outdoor work exposure, and lack of refrigeration limited the feasibility of implementing dietary and lifestyle advice. All participants emphasized the absence of clear, season-specific guidance on managing cardiac health during extreme heat.

Conclusion: Extreme heat magnifies cardiac health risks through both physiological and socio-environmental pathways. Integrating qualitative evidence into public health strategies such as pre-summer education campaigns, targeted triage protocols, and accessible dietary counseling is essential to strengthen climate-resilient cardiac care in urban India.

KEYWORDS

Urban heatwaves; Cardiac health; Climate-sensitive healthcare; Heat-related morbidity

ARTICLE HISTORY

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Introduction

Global climate systems are undergoing significant change, with a marked increase in average surface temperatures and the frequency of extreme heat events. These climatic shifts are having a measurable impact on human health, particularly in relation to cardiovascular morbidity and mortality. Exposure to high ambient temperatures places stress on the body's thermoregulatory mechanisms, leading to increased cardiac workload, dehydration, electrolyte imbalances, and systemic inflammation. For individuals with pre-existing heart conditions, this added physiological burden can precipitate acute events such as myocardial infarction or exacerbation of chronic heart failure [1].

In urban environments, this risk is amplified by the urban heat island (UHI) effect, wherein densely built-up areas retain and radiate heat, resulting in temperatures several degrees higher than those in adjacent rural regions [2]. The effect is exacerbated by limited green cover, extensive concretization, and anthropogenic heat sources, all of which are characteristic of rapidly expanding Indian cities. These urban microclimates, coupled with demographic factors such as an ageing population and high rates of non-communicable diseases, increase the vulnerability of urban populations to heat-induced health outcomes [3].

Bhubaneswar, the capital of Odisha, illustrates these challenges. The city has experienced a rapid pace of urbanization over the past two decades, accompanied by increasing surface temperatures and infrastructural expansion with limited attention to thermal resilience [4]. Climatic data from the India Meteorological Department (IMD) for March and April 2025 highlight repeated instances of severe heat, with temperatures exceeding 43°C in Bhubaneswar and peaking at 43.6°C in nearby Boudh (Table 1). These figures are significantly above seasonal averages and align with a broader pattern of intensifying heatwaves across eastern India. Red alerts issued by the IMD have become increasingly frequent, prompting concern among public health authorities [5] (Figure 1).

Table 1. Odisha temperature recorded by IMD, 2025.

Date	Location in Odisha	Max Temperature	Heat Wave Status
14-Mar-25	Interior Odisha	40-42	Severe Heat Wave
15-Mar-25	Jharsuguda	41.8	Heat Wave
16-Mar-25	Boudh	43.6	Severe Heat Wave
17-Mar-25	Boudh	43.6	Severe Heat Wave

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18-Mar-25	North Interior Odisha	43.5	Severe Heat Wave
25-Mar-25	Interior Odisha	37-41	Forecasted Heat Wave
5-Apr-25	Interior Odisha	32-35	Normal
7-Apr-25	South Interior Odisha	32-36	Normal

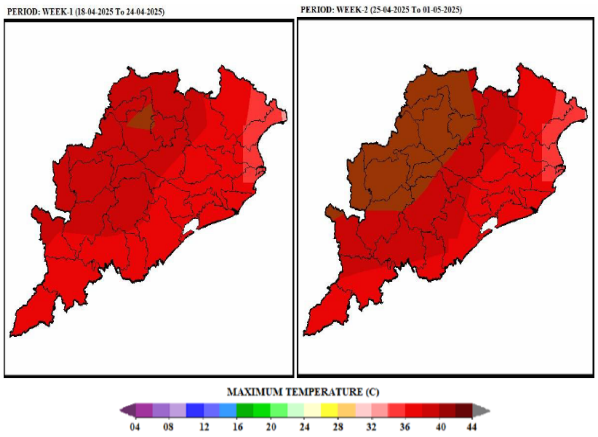

Figure 1. IMD forecast for maximum temperature (°C) [IMD: Current weather status & outlook for next two weeks (18th April, 2025 to 01st May, 2025)].

Historically, Odisha has been more prominently recognized for its cyclone-related vulnerabilities. However, recent patterns suggest that heatwaves are emerging as a critical seasonal threat, particularly in urban zones with inadequate heat-mitigation infrastructure. In Bhubaneswar, the risks are compounded by socio-economic disparities, a sizeable informal labor sector exposed to outdoor work, and varying levels of access to cooling systems and healthcare. These factors intersect to increase the likelihood of adverse health outcomes, particularly among individuals with cardiovascular conditions [6,7].

The scientific literature has consistently demonstrated an association between elevated temperatures and cardiovascular morbidity. Liu et al. (2022) found that a 1°C rise above the threshold temperature was associated with a 2.1% increase in cardiovascular mortality in cities across Southeast Asia [8]. Bunker et al. (2016) similarly reported a direct correlation between high ambient temperatures and hospital admissions for cardiac events across Europe [9]. Singh et al. (2024) provided evidence linking temperature extremes with increased cardiovascular risk in cities like Ahmedabad and Delhi. These studies reinforce the epidemiological basis for concern [10].

However, the bulk of existing research relies on quantitative methods primarily time-series analyses and retrospective hospital data. While these approaches are valuable in demonstrating trends and estimating excess morbidity or mortality, they do not capture the subjective experiences of those affected [11]. Questions around how individuals recognize heat-related symptoms, what triggers care-seeking behavior, and what environmental or socio-economic barriers impede timely medical intervention remain largely unexplored. As a result, public health interventions often lack the granularity needed to address the real-world complexities faced by patients [12].

Moreover, vulnerability is frequently framed in physiological terms, with less attention paid to behavioral responses, lived environments, or coping strategies that may mediate risk. For example, a patient with hypertension living in a poorly ventilated home without access to cooling is likely at greater risk than a similarly diagnosed individual with better housing and awareness. These contextual variables are not easily quantified but are crucial for understanding the full scope of heat-related cardiac risk [13].

This gap in the literature is particularly evident in cities like Bhubaneswar, where population growth, economic inequities, and infrastructural transitions are reshaping both environmental exposure and health behavior. The absence of qualitative, patient-centered studies limits the ability of health systems to craft responsive and inclusive strategies for heatwave preparedness. Capturing patient narratives particularly those of individuals hospitalized with cardiac events during peak heat periods offers an opportunity to inform targeted interventions.

This study aims to investigate how extreme urban heat influences the health experiences of individuals with cardiac conditions in Bhubaneswar. By focusing on the lived experiences of patients admitted with cardiac events during high-temperature periods, the research explores how they perceive heat-related risk, interpret early symptoms, and make decisions about seeking care. It also examines the environmental and socio-economic factors that shape these experiences, such as access to cooling, occupation-related exposure, and availability of healthcare services.

Methodology

This study employed a descriptive qualitative design to investigate the experiences of cardiac patients during periods of extreme heat in Bhubaneswar, Odisha. Qualitative methods are particularly suited for exploring how individuals interpret, respond to, and navigate health-related challenges in contextually complex environments. Unlike quantitative studies that focus on prevalence and correlations, a qualitative approach allows for the collection of rich, narrative data to understand behavior, meaning-making, and subjective perceptions that are crucial for informing public health responses in climate-sensitive health scenarios. Given the exploratory nature of this inquiry and the absence of prior patient-centered research on this topic in India, this design was deemed most appropriate.

The research was conducted in Bhubaneswar, an urbanizing city located in eastern India, which has seen significant increases in ambient temperatures and urban heat island intensity in recent years. According to the India Meteorological Department (IMD), Bhubaneswar recorded maximum temperatures exceeding 43°C on multiple days in March and April 2025, including during a verified heatwave event. As per IMD criteria, a heatwave in the plains is defined as a situation where the maximum temperature reaches ≥40°C for at least three consecutive days. Bhubaneswar's healthcare infrastructure includes several tertiary care hospitals with dedicated cardiology departments, making it suitable for identifying and recruiting patients admitted with acute cardiac conditions. The city also exhibits stark disparities in housing

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quality, access to cooling mechanisms, and healthcare utilization, which makes it an ideal setting for examining the social and environmental determinants of heat-related cardiac events.

Participant selection

Participants were selected using purposive sampling based on pre-defined eligibility criteria. Adults aged 18 years and above who had been admitted to tertiary hospitals in Bhubaneswar with clinically diagnosed cardiac events such as myocardial infarction, unstable angina, or acute arrhythmias during officially declared heatwave periods were eligible for inclusion. Participants needed to have preserved cognitive function to provide reliable and reflective accounts of their experiences. Individuals diagnosed primarily with chronic illnesses unrelated to cardiac health or those unable to participate in interviews due to clinical instability were excluded.

The final sample size was guided by the principle of data saturation. Interviews continued until no new codes or themes emerged in at least three consecutive transcripts.

Data collection

Semi-structured, in-depth interviews were conducted in person either at the hospital, during outpatient follow-up, or at the participant's residence, depending on convenience and privacy. Interviews followed a flexible guide that included open-ended questions on heat perception, symptom onset, behavioral responses, decision-making regarding care, and challenges faced during the health episode.

All interviews were conducted in Odia or English based on the participant's preference and lasted between 30 and 45 minutes. Interviews were audio-recorded with written or verbal consent, and detailed field notes were maintained to capture non-verbal cues and contextual observations. The interview locations were chosen in consultation with the participants to ensure comfort, privacy, and minimal disturbance. The interview guide was pre-tested with two patients and revised for clarity and cultural relevance.

Ethical considerations

Ethical clearance was obtained from the Institutional Ethics Committee. Written informed consent was obtained from all participants after they were briefed on the study's purpose, their right to withdraw at any point, and the assurance of confidentiality. Participants were informed that their decision to participate or not would have no impact on their ongoing medical care.

To protect privacy, all identifiable information was removed during transcription and replaced with coded identifiers. Audio files and transcripts were stored in encrypted, password-protected digital folders accessible only to the core research team. Any signs of distress during interviews were managed sensitively, and participants had the option to skip questions or discontinue the interview.

Data analysis

Interview data were analyzed using thematic analysis following the approach of Braun and Clarke (2006) (Figure 2). Transcripts were first reviewed for accuracy and completeness. Manual open coding was performed to identify initial patterns, followed by axial coding to organize similar codes into broader categories. These categories were further refined into higher-order themes that captured key aspects of each participant experiences [14].

NVivo software was used for efficient data management, retrieval, and tracking of codes across transcripts. Peer debriefing was conducted with an independent qualitative researcher to ensure the credibility of the coding process. In addition, member validation was performed with a subset of participants, who reviewed summarized findings to confirm the accuracy of interpretations. These validation steps enhanced the novelty and analytical rigor of the study.

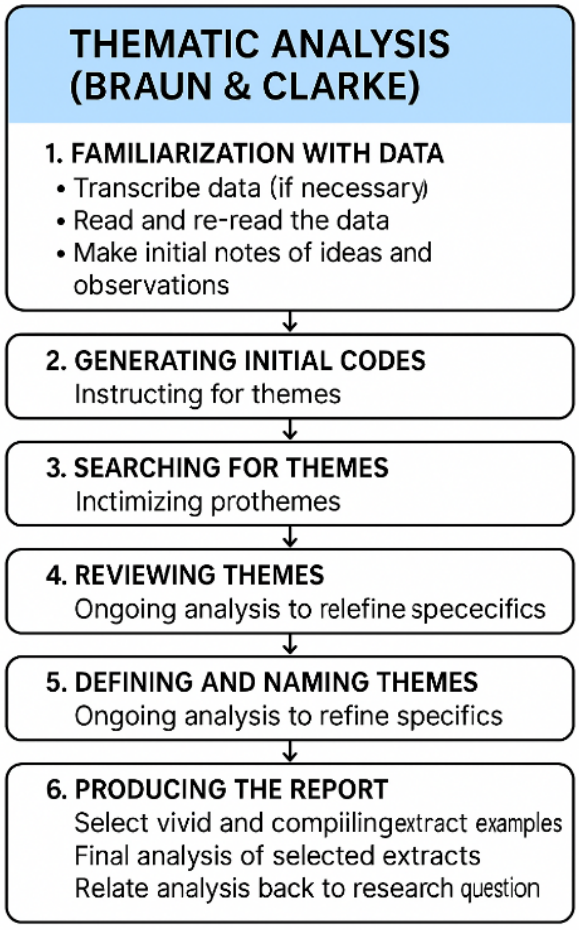

Figure 2. Schematic flowchart of Braun and Clarke Analysis model.

Results

We describe the key findings and themes based on the qualitative interviews on intense heat and its adverse effects on the cardiac health on the individuals in Bhubaneshwar. This involved collecting qualitative data through interviews and questionnaires before conducting content analysis to identify and interpret themes. Table 2 summarizes the questions asked, the themes identified, the responses from participants, and the key findings and themes derived from the content analysis.

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Table 2. Thematic analysis of participant responses on the impact of heatwaves on cardiac health and nutritional challenges.

Theme	Question	Participant Response	Response Analysis
Trends in Cardiac Admissions During Heatwaves	Have you noticed any difference in how often people experience heart problems during hot weather?	**Participant A:** We observe a clear spike in cardiac admissions during summer, particularly among the elderly and those with pre-existing heart conditions. **Participant B:** There is a seasonal pattern in complaints like fatigue and dizziness that might link to dehydration and poor intake. **Participant C:** I felt weaker during the summer days, and my chest pain started after two days of intense heat.	All participants acknowledged a seasonal trend linking heat to cardiac health. Clinical observations, dietary patterns, and personal experiences aligned with the theme.
Clinical Presentation of Heat-Affected Cardiac Patients	Do the symptoms or signs of heart issues seem different or more intense during very hot days?	**Participant A:** Patients often present with palpitations, breathlessness, and even collapse, sometimes worsened by dehydration. **Participant B:** They report nausea, reduced appetite, and salt cravings which can relate to fluid imbalance. **Participant C:** I had severe sweating, breathlessness, and my heart felt like it was racing uncontrollably.	The symptoms described by all groups points toward intensified or atypical presentations of cardiac distress during heat, confirming a distinct clinical pattern.
Challenges in Emergency Response During Heat Events	What are some of the challenges you faced or observed in getting or giving emergency care during hot weather?	**Participant A:** Overcrowding and delays in treatment are common during peak heat days due to a surge in cases. **Participant B:** There is often not enough time for dietary assessments when wards are flooded. **Participant C:** I waited a long time at the emergency room, and it was very hot there too. I was feeling worse before they attended me.	All responses highlight systemic stress on healthcare delivery during heatwaves, including delays and inadequate support services like dietary consultation.
Comorbidities and Heat Sensitivity	Do existing conditions like diabetes or blood pressure make things worse during the heat?	**Participant A:** Definitely. These patients are more likely to decompensate quickly when exposed to high temperatures. **Participant B:** It's hard to manage their nutrition because many have restrictions but still need hydration and cooling agent foods. **Participant C:** I have both diabetes and blood pressure problems, and in the heat, I feel dizzy even if I have taken my medicines.	There is result that diseases like blood pressure and diabetes significantly increase heat-related risk and complicate clinical and dietary management.

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Perceived Gaps in Public Awareness and Preparedness	Do you think people are aware of how heat can affect heart health, and are they prepared?	**Participant A:** Most patients are unaware or ignore warnings until symptoms become serious. **Participant B:** I find that many still believe in drinking more sugary or salty beverages rather than balanced hydration. **Participant C:** I had no idea that heat could cause heart problems. I thought it was just dehydration.	All three participants acknowledged a significant gap in public knowledge about the link between heat and heart health.
Nutritional Vulnerability During Extreme Heat	How does extreme heat affect what you eat or how much you eat and drink?	**Participant B:** Many patients skip meals, avoid hot food, and reduce intake, which affects electrolyte balance. **Participant A:** Patients come in weaker, possibly because of reduced calorie and fluid intake. **Participant C:** I did not feel like eating anything, just drank water and laid down. Later, I started feeling very weak.	Diet-related vulnerability during heat is a serious issue, with reduced appetite, improper hydration, and nutritional deficits contributing to cardiac risk.
Cultural Food Practices and Summer Risk	Do food habits during summer affect heart health, positively or negatively?	**Participant B:** Some summer foods like raw mango drinks help, but others, like deep-fried snacks, increase sodium and fat intake. **Participant A:** Spicy, oily foods during hot weather can trigger indigestion and stress the heart. **Participant C:** We usually eat pickles and fried snacks at home, and I did not think it was a problem until my chest pain started.	Food habits during heatwaves can either protect or exacerbate health risks. Traditional practices need contextual modification.
Hydration Practices and Misconceptions	What types of drinks do you prefer during the summer, and why?	**Participant B:** Many patients drink salty buttermilk or sugary juices, thinking they are beneficial, but it can backfire. **Participant A:** Electrolyte imbalance from poor hydration choices often complicates treatment. **Participant C:** I drank cold soda and lemon juice with salt. I thought it would cool me down, but I still felt uneasy.	Misconceptions about hydration are widespread, and improper fluid choices can directly worsen cardiac conditions during heatwaves.
Diet Counseling Access and Communication Barriers	Did you or your patient receive dietary advice during or after treatment? Was it easy to understand and follow?	**Participant B:** Sometimes there is no time for detailed counseling due to the rush in wards. **Participant A:** We refer patients, but follow-up is inconsistent. **Participant C:** I got a diet chart, but I did not really understand what to eat or avoid in summers.	There is a clear gap between dietary advice and implementation. System constraints and low health literacy are barriers.

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Preventive Dietary Strategies for Heat Management	What do you think people with heart problems should eat or avoid during extreme heat?	**Participant B:** Light, water-rich foods like fruits and boiled vegetables, and avoiding spicy or oily food. **Participant A:** Patients need to stay hydrated and avoid high-sodium foods that stress the heart. **Participant C:** I was told to eat less salt and drink more water, but I was not sure which foods were okay.	Preventive dietary guidance is acknowledged as important by all, but patient-level implementation remains weak.
Personal Experiences of Cardiac Symptoms During Heat	What did you feel or experience before coming to the hospital, and did you think it was related to the heat?	**Participant C:** I felt very tired, had heavy sweating, and then pain in my chest. I thought it was just the heat. **Participant A:** Many patients present with vague symptoms that worsen over a day or two of high heat exposure. **Participant B:** Patients often mention feeling drained or skipping meals before their condition worsens.	Symptom progression and misinterpretation of early signs are common among patients. Early action is often delayed due to misattribution.
Barriers to Timely Care-Seeking During Heatwaves	Was there anything that made you or your patients delay coming to the hospital during the heat?	**Participant C:** I thought the symptoms would go away, and I did not want to go out in the heat. **Participant A:** Many delay due to travel issues or underestimate the seriousness. **Participant B:** Some skip follow-ups because they feel weak or avoid long commutes during peak heat.	Delays in seeking care are consistently attributed to environmental discomfort, underestimation, and fear of travel in heat.
Influence of Living and Working Conditions on Health	Do your home or work conditions affect how you feel during very hot days?	**Participant C:** I work outside and live in a small room with a tin roof. It's unbearable in summer. **Participant A:** Many live in heat-trapping structures and work in high-exposure environments, which increases risk. **Participant B:** Dietary suggestions often fail when patients do not have refrigeration or time to prepare cooling agent meals.	Environmental exposure to both occupational and residential structure deeply influences health and limits the feasibility of medical advice.
Coping Strategies and Home Remedies	What do you or your patients usually do at home when they feel unwell during hot days?	**Participant C:** I stay in the shade, drink cold water, and take herbal drinks. **Participant A:** Delayed hospital visits are common due to belief in home remedies . **Participant B:** Some patients fast or consume excessive cooling agents like raw tamarind, which disrupts balance.	Self-treatment is common but often ineffective or inappropriate. Delay due to reliance on home remedies is a repeated pattern.

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Perceived Role of Doctors and Dietitians in Preventing Heat-Triggered Events	What kind of guidance do you expect or give to help patients prevent heat-related heart issues?	**Participant C:** I expected someone to tell me exactly what to do and what to avoid in the heat. **Participant A:** We do brief counseling, but there's limited time. Many patients need detailed guidance. **Participant B:** I try to advise on fluid intake and food choices, but follow-up is lacking.	There is a strong demand for structured, repeated health education. Preventive counseling remains inconsistent and fragmented.

Discussion

Interpretation of findings

This study offers a triangulated understanding of the impact of extreme heat on cardiac health in Bhubaneswar, with insights drawn from Participant A, Participant B, and Participant C. The findings align with established physiological mechanisms, where high ambient temperatures contribute to cardiovascular stress through fluid loss, increased cardiac workload, and systemic strain [15].

Participant A confirmed a seasonal increase in acute cardiac admissions, particularly among elderly patients with comorbidities. Participant B observed increased fatigue, reduced appetite, and electrolyte imbalance during these months. Participant C linked the onset of symptoms such as chest discomfort and dizziness to prolonged heat exposure. These experiences support existing epidemiological data showing seasonal spikes in cardiac mortality in India (Singh et al., 2024) and validate heat as a contributing trigger for cardiac events [16].

Hydration behavior emerged as a recurring concern. Participant B noted that patients commonly rely on sugary or overly salted beverages during summer, believing them to be protective. Participant A confirmed that such practices often lead to dehydration and arrhythmias. Participant C acknowledged habitual use of cold sodas and salted lemon drinks, unaware of their potential harm. These responses highlight misconceptions that complicate cardiac care during heatwaves, aligning with patterns observed in similar low- and middle-income settings (Sampson et al., 2013) [17].

Urban vulnerability and cardiac stress

Participant C reported living in a small, unventilated room with a tin roof and working outdoors during peak hours conditions known to exacerbate thermal stress. Participant A observed that patients from informal housing sectors admit more frequently and in worse condition during summers. Participant B emphasized the challenges of implementing dietary advice when patients lack refrigeration or time to prepare nutritious meals.

These findings confirm that infrastructure, rather than health literacy alone, limits patients' ability to respond to heat effectively. The perception of symptoms also contributed to delayed care. Participant C admitted assuming the discomfort was due to general heat fatigue. Participant A linked such misinterpretations to clinical deterioration upon arrival. Misattributed symptoms and poor environmental conditions together form a critical barrier to timely intervention.

Public health implications

Participant A stated that most patients were unaware of the cardiac risks posed by extreme heat. Participant B noted that preventive education especially regarding diet and hydration was rarely delivered systematically. Participant C confirmed never receiving such information before hospitalization, underscoring the communication gap.

All participants called for more accessible, season-specific public messaging. Participant B stressed that basic instructions like what to drink and what to avoid must be widely disseminated. Participant C desired clear, simple advice on how to manage their condition during extreme heat. These findings emphasize the need for pre-heatwave community education programs that include dietary, behavioral, and emergency response components.

Participant C reported relying on neighbour's remedies, such as herbal drinks, which delayed hospital visits. This highlights the role of peer networks in shaping care-seeking behaviour and supports prior findings on community-level decision-making in climate-sensitive health scenarios (Leow et al., 2022) [18].

Policy and health system response

Participant A highlighted systemic stress on emergency departments during heatwaves, including longer waiting times and missed opportunities for preventive counseling. Participant B acknowledged that limited staff and time often impede dietary consultation. Participant C described long delays in care and unclear discharge instructions, especially regarding diet and hydration.

These findings reveal gaps in seasonal health system preparedness. Urban heat adaptation must include heat-specific triage protocols, clear patient education at discharge, and structured involvement of dietitians. As seen in Ahmedabad's Heat Action Plan, early alerts and interdepartmental coordination improve resilience. Bhubaneswar's urban health system could benefit from a similar model, adapted to local infrastructure and workforce capacity.

Additionally, Participant B suggested that community-level initiatives, such as public hydration stations and mobile diet counseling, could alleviate systemic burden. Participant A supported integrating preventive advice into routine cardiac care, particularly during outpatient visits in late spring.

Strengths and limitations

This study's strength lies in its three-pronged narrative framework, offering insight into how heat affects cardiac health

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from medical, nutritional, and patient perspectives. Participant triangulation allowed for validation of themes and deeper contextual understanding.

However, the study's scope was limited to a single city, which may restrict generalizability. As interviews were retrospective, recall bias cannot be excluded. To minimize this, interviewers used open-ended questions and followed up on vague responses for clarity. Future research could expand to multi-city comparisons or include rural settings for broader applicability.

Conclusion

This qualitative study aimed to examine how extreme urban heat influences the lived experiences of patients with cardiac conditions in Bhubaneswar. By capturing perspectives from Participant A, Participant B and Participant C, the study provides a multidimensional understanding of the intersection between climate stress and cardiovascular health. The findings confirm that elevated ambient temperatures significantly contribute to the onset and worsening of cardiac symptoms, particularly in vulnerable individuals with comorbidities or limited access to cooling infrastructure.

All participants acknowledged a clear seasonal pattern of increased cardiac admissions and a typical symptom presentation during heatwaves. Patient narratives revealed misattributed symptoms, delays in care-seeking, and reliance on traditional treatment mechanisms. Participants mentioned gaps in dietary counseling and public education on safe hydration practices. These responses reflect a consistent disconnect between public perception, clinical urgency, and preventive health behavior.

Structural vulnerabilities such as poor housing, outdoor occupational exposure, and lack of refrigeration limit the feasibility of conventional health advice. Health communication strategies must therefore be rooted in the socio-environmental realities of affected populations.

Public health agencies, municipal bodies, and healthcare institutions must collaboratively invest in anticipatory care models. These should include community-level awareness programs, season-specific triage protocols, and the integration of dietitians into routine cardiac management during high-temperature months. As urban heat events become more frequent under global climate change, incorporating patient-centered insights into policy and planning will be critical to reducing heat-related cardiac morbidity and mortality in India's urban centers.

Disclosure statement

No potential conflict of interest was reported by the author.

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