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Original Research Article

Healthcare professionals' acquaintance with climate change in India: impact on health, adaptation and mitigation strategies

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ABSTRACT

Background: Climate change is one of the most pressing global public health threats of the 21st century, affecting human health through increased respiratory and vector-borne diseases, food and water insecurity, extreme weather events and mental health challenges. Vulnerable populations, including children, the elderly, and those in low-resource settings, are disproportionately affected. India is particularly vulnerable due to existing health and social inequities, underscoring the need for a climate-literate health workforce. This study aimed to assess awareness among healthcare professionals regarding the health impacts of climate change and to examine their understanding of mitigation and adaptation strategies.
Methods: An exploratory cross-sectional survey was conducted using convenience sampling among doctors, nurses, and paramedical professionals working across India. Data were collected online via a structured questionnaire covering climate dynamics, health impacts and vulnerability. Ethical approval and informed consent were obtained. A total of 1009 participants responded between October 2024 to April 2025.
Results: Most participants were nurses (89.4%), females (68.3%) and aged 26- 30 years. Nearly all respondents (98.2%) reported experiencing climate change in their localities. The mean knowledge score was moderate (10.0 ± 2.65 out of 24), with doctors scoring highest. Significant gaps were identified in understanding mitigation and adaptation concepts.
Conclusions: Despite great concern about climate change, healthcare professionals demonstrated limited conceptual clarity and engagement, highlighting an attitude-action gap and the need for strengthened climate-health education and training.

Keywords: Adaptation, Climate change, Climate-related health challenges, Health impacts, Healthcare professionals, Knowledge gap, Mitigation, Public health

INTRODUCTION

Climate change has emerged as one of the most pressing global health threats of the 21st century, with consequences that are both immediate and long-term. Its effects on human health are multifaceted, ranging from increased prevalence of vector-borne diseases and respiratory conditions to food and water insecurity, extreme weather events, and mental health challenges.[1-3] These impacts are disproportionately experienced by vulnerable populations, including children, the elderly, and individuals in low-resource settings.[1,3] Despite growing scientific evidence and recognition from global organizations such as the World Health Organization and the Intergovernmental Panel on Climate Change, the integration of climate change knowledge into healthcare education and practice remains limited.[1-3] In India, the

existing health and social disparities within the population make this country most vulnerable to climate change impacts.[8] Indian Government has also taken initiatives focusing on climate change and health as evinced by the recent addition of a health mission to the National Action Plan on Climate Change (NAPCC).[8] Therefore, healthcare professionals play a vital role in researching, managing and responding to climate change impacts on health.

Healthcare professionals are uniquely positioned to address climate-related health challenges, not only through clinical care but also by acting as educators, advocates, and policy influencers.[1] However, research indicates that while many healthcare providers acknowledge the reality of climate change and its risks to health, their knowledge and preparedness to respond effectively are often inadequate. Studies show a significant gap in formal training, with most health professionals expressing a strong desire to learn more about climate-health interactions.[1-3] This lack of preparedness is exacerbated by the absence of standardized climate change content in health professional curricula, as well as a general scarcity of institutional support for climate-related healthcare initiatives.[2] Globally there is an acknowledged need to train healthcare professional to engage in study, and manage health impacts of climate changes.[8]

International efforts to improve climate literacy among healthcare providers have shown promising outcomes. Collaborative models that bring together educators, researchers, and public health leaders have successfully piloted interprofessional training programs that raise awareness and build competencies in climate-related health issues.[2] These programs emphasize the importance of cross-disciplinary learning, integrating public health, clinical care, disaster response, and policy advocacy. They also highlight the need for healthcare professionals to adopt a global perspective, recognizing their roles in both mitigation and adaptation efforts to reduce the health burden of climate change.[1,2]

In this context, assessing healthcare professionals' awareness of climate change is essential for developing responsive educational strategies, informing policy, and strengthening health systems' resilience. Understanding their perceptions, knowledge levels, and the barriers they face will help identify gaps and opportunities for targeted interventions. As climate change continues to affect global health, equipping healthcare workers with the necessary skills and knowledge is not just relevant it is imperative.[1-3]

Hence, this study aims to evaluate the awareness among healthcare professionals regarding the impacts of climate change on health and analyse the mitigation and adaptation strategies that healthcare professionals currently employ.

METHODS

A quantitative research approach was used to examine the study objectives. This was explored by conducting surveys, awareness questions addressing the research problem, and to ensure understanding of the complex interactions between climate dynamics, the mitigation and adaptation strategies. Quantitative statistical techniques, employ descriptive statistics and inferential statistics to summarize demographic information and key variables.

Sample size

The sample size calculated was 1500 and study duration was for 6 months.

Sampling

Convenient sampling method was used to ensure representation across different demographic, socio-economic, and geographic characteristics. Inclusion criteria include those samples who were healthcare professionals (doctors, nurses, and paramedical workers) working anywhere in India. And those who agreed to participate in the study by giving consent.

Study instrument

A Google form was prepared based on the objectives of the study. Participants' awareness was assessed using true/false and multiple-choice questions, where each correct answer received a score of 1 and each incorrect answer received a score of 0. The average score will be used to determine the level of awareness. We also ensured that the instrument covers key aspects related to climate dynamics, well-being, and vulnerability and diverse perspectives among the different healthcare professionals.

Data collection

A survey, using a suitable channel-Google form, ensuring anonymity and confidentiality of participants' responses was circulated among the healthcare professionals in different regions of the country. Self-structured questionnaires were created based on the study's objectives. Data was collected between October 2024 to April 2025.

Data analysis

A total of 1009 responses from the participants were recorded in the goggle form, which were further analyzed by the researcher based on the research objectives.

Ethical consideration

Ethical approval was obtained from the research ethics board of the institute. Written permission from the research division cell of the institute was taken. Consent

from the participant was also obtained via google form. Data was only accessed by the researchers.

RESULTS

Total number of participants who got themselves registered via email address, were 1022. Among them 1009 healthcare professionals participated in the study, which provided valuable insight into their awareness and attitudes toward climate change and its health impacts. Study participants included the majority nurses (n=900; 89.4%), then doctors (n=58; 5.8%) and para- medical/ allied health sciences staff (n=48; 4.8%). Majority of the participants were of 26- 30 years (31.2%) followed by 31-35 years (24.9%), and 36- 40years (14.3%) respectively.

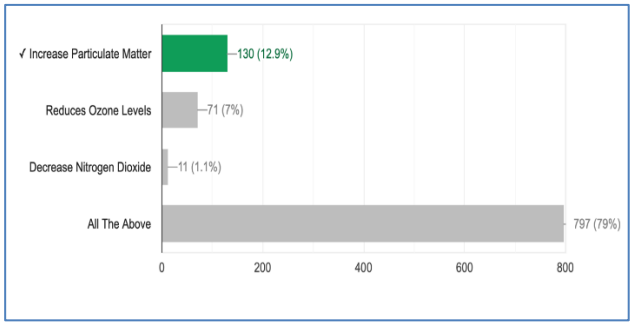

Figure 1: How does climate change affect air quality.

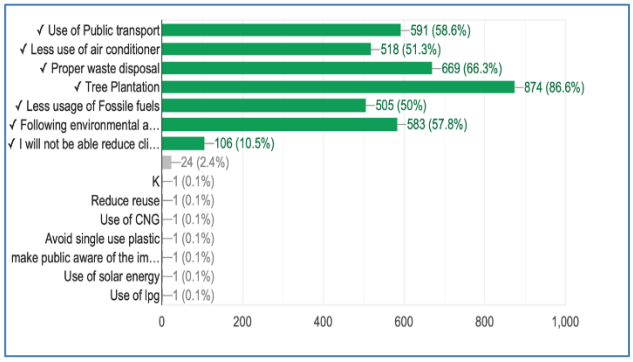

Figure 2: Action that will help to reduce climate change.

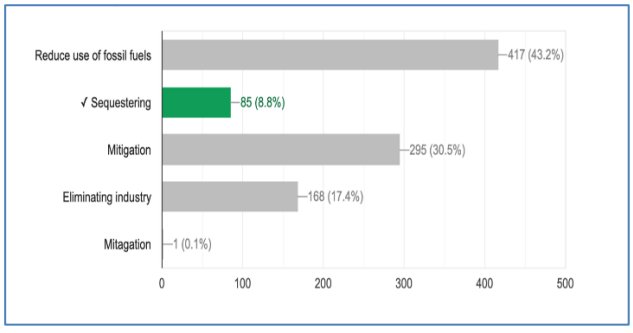

Figure 3: Method that is recommended to reduce the release of greenhouse gases without decreasing the production of gases.

Most of them were females (68.3%) and males were 31.7%, among which 74.9% belonged to the urban community and 25.1% rural community. 61.3% represented their jobs in clinical services and 31.2% in education/academics. 35.1% of the Healthcare professionals described climate change as global warming, whereas 22.7% suggested as weather change, and 22.1% as temperature alteration. Healthcare professionals who participated were mostly from the Eastern Region of India, i.e. n=377 (37.4%) representing Bihar, Jharkhand, West Bengal, Chhattisgarh and Odisha; followed by Northern Region, i.e. n =309 (30.6%) representing Uttar Pradesh, Delhi, Punjab, Haryana, Chandigarh and Uttarakhand. 22.8% (n= 230) represented Southern Region which includes Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Telangana and Puducherry. Remaining participants were from Western and North-East region of the country. 98.2% (n= 983) participants had experienced climate change in their cities/town or villages. While assessing the healthcare professional's acquaintance with climate change, the average knowledge score across all respondents was 10.0 out of 24, with a standard deviation of 2.65, indicating moderate knowledge with some variation in understanding levels. The data depicts that majority of healthcare professionals were aware that climate change affects the holistic health (94.9%), vector-borne diseases are climate-specific (89.2%), change in habitat and ecosystem increases rate of migration which serve as origin of psychological problems (86.8%) and rapid climate change causes anxiety and depression disorders (73.4%). There is also a widespread recognition of 74.8% of healthcare professionals, that socially marginalised groups are often disproportionally impacted by measures to address climate change and 65% that malnutrition is a potential health impact of climate- related food insecurity. On the contrary, there were some misconceptions among healthcare professionals which was evident, i.e. 77.8% of the participant agreed that global warming is caused by greenhouse gas, 93.2% agreed that chlorofluorocarbon causes ozone depletion and 70.3% of healthcare professionals affirmed that heat waves have been associated with mental and behavioural disorders and 82.7% agreed that lower respiratory infections and COPD is very common in middle and low income countries.

By profession, doctors scored highest with a mean of 11.48, followed by paramedical/allied health staff at 10.5 and nurses at 10.02. This trend suggests a need for environmental health education, either by incorporating climate change awareness into the teaching and learning curriculum in universities, schools, higher degree courses, or in-service education programmes.

Age-wise, knowledge appears to increase slightly with age, peaking among those above 60 years who averaged 11.44, perhaps reflecting accumulated professional experience. Gender-wise, male respondents had a slightly higher average score (10.20) compared to females (10.09), although the difference is minor. The dataset also

reveals interesting patterns in healthcare workers' attitudes and understanding of climate change mitigation and adaptation strategies.

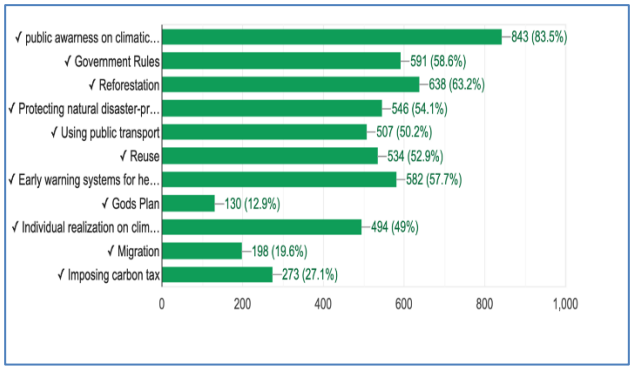

Figure 4: Measures that are crucial for mitigating the effects of climate change.

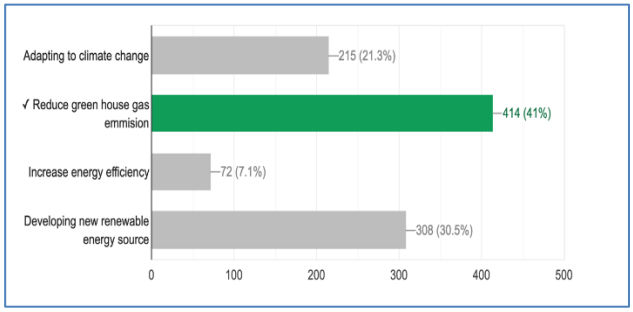

Figure 5: Primary goal of climate change mitigation efforts.

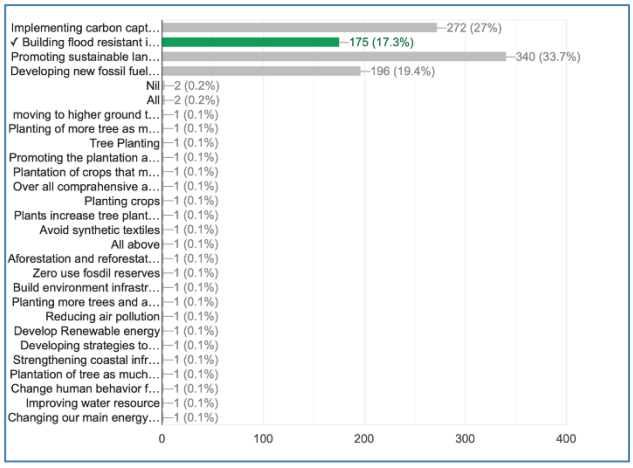

Figure 6: Adaptation strategy for climate change.

A majority of the results for acquaintance with adaptations and mitigation are detrimental, indicating that healthcare workers are not aware of these measures, i.e. only 12.9% of the participant were knowing that climate change affects air quality by increasing particulate matter; merely 8.8% of the healthcare professionals were mindful that sequestering is a suggested strategy to lower greenhouse gas emissions without lowering gas production; precisely 17.3% of subjects were acquainted that one way to respond to climate change is to create infrastructure that is resistant to flooding. Responses which were mostly selected by the participants, that were crucial for mitigating the effects of climate change were "public awareness on climate change" i.e.83.5%, followed by reforestation (63.2%), and government rules (58.6%). Early warning systems for health-related impacts were chosen by 57.7% of the respondents, and 54.1% selected protecting natural disaster-prone areas, followed by 52.9% for reuse practices, indicating awareness of climate-related disaster risks. There was a moderate response rate for using public transport was 50.2% and individual realization on climate issues by 49%. The least priority options were found to be imposing carbon tax (27.1%) which implies that there is a lack of familiarity about economic mitigation tools, and migration (19.6%) and God's plan (12.9%).

The results regarding personal measures participants would adopt to mitigate climate change, the most commonly selected action was tree plantation (86.6%), indicating a strong public perception of afforestation as a vital climate solution. This was followed by proper waste disposal (66.3%), then use of public transport (58.6%), these both actions exhibit awareness of pollution control and sustainable commuting among healthcare professionals. Other significant responses were following environmental and government law (57.8%); less use of air conditioners (51.3%), which shows recognition of both regulatory compliance and energy conservation. Less usage of fossil fuels was selected by 50% of the healthcare professionals as one of the actions to reduce climate change.

Interestingly, 10.5% of the participants felt that they would not be able to reduce the climate change by their action, which either reflects a sense of helplessness, or lack of awareness or perceived systemic barriers to individual impact.

DISCUSSION

This study depicts valuable insight about the awareness, knowledge, attitudes and perceived responsibilities of the healthcare professionals in India regarding climate change and its impact on health. In this study, 1009 healthcare professionals participated in which, predominantly were nurses. This highlights the relevance and need to explore climate health literacy among frontline workers in healthcare, who often engage most directly with vulnerable populations. As per the results of the study, doctors achieved the highest mean score (11.48), followed by paramedical staff (10.5) and nurses (10.2), which suggests a probable correlation between education level and climate health literacy. Concepts of climate change have been minimally included in health profession curriculum globally and similarly, the principle of planetary health in clinical practice is applied narrowly.[9] There is a need to train health professionals to

engage in studies and manage the health impacts of climate change.[8] Various initiatives and propositions about the possible roles of the healthcare professionals are taken which aimed at increasing the pre- and postgraduate and continuing education of the healthcare professionals about climate and environmental change, its effects and their already occurring and future consequences on human health.[9] Another similar study conducted, suggests that there is a strong need to incorporate greater attention to climate change and heat health as a part of medical education and the healthcare system in India. Workshops, seminars and conferences can be organised to sensitize healthcare providers on an ongoing basis.[12] Hence, it will help to bridge the gap between the environment and health. The results from this study also show similar findings to the one previously conducted study in which we cannot deny the role of media in getting the information about climate change, which stood to be vital in discussing the scientific issues and discussions.[13]

Several gaps were identified in understanding the key climate change concepts. Only 41% of healthcare professionals correctly identified the primary goal of climate mitigation (i.e., reducing greenhouse gas emissions), with many confusing it with adaptation strategies or renewable energy development. A study done in Ohio recognized the impact of climate change on health and believed that pharmacists have also roles in mitigating its effects and wanted to learn more about it.[15] In addition to it, 54%, incorrectly believed that human-powered transport does not contribute to emission reduction, revealing a lack of awareness regarding lifestyle-based prevention, and fragmented knowledge about adaptation levels suggests a deficiency in foundational training. These same misconceptions have been elucidated in another study, noting that even professionals engaged in policy development exhibited confusion about mitigation versus adaptation and lacked clarity on regional variations in climate actions.[5] The results regarding personal measures regarding actions to reduce climate change were by proper waste disposal (66.3%), then use of public transport (58.6%) which was very similar to the findings of the another study conducted in Italy among the healthcare professionals.[14] In this study, the nurses were found to have the least awareness about the health impacts of climate change, indicating a need for enhanced education among nursing professionals. A global study also emphasized that oncology nurses require better understanding and resources related to climate change and disasters, as they are in a leadership role in education, research and practical interventions concerning climate and health.[16] Another similar study reflects that physicians, nurses and physician assistants have a responsibility to conserve resources and prevent pollution within their professional practice and they also agreed that the relationship between pollution, climate change and health should be covered in the classroom and should be reinforced in the clinical setting.[17]

CONCLUSION

This national survey provides one of the quantitative evaluations of climate change awareness among healthcare professionals in India, improving knowledge of climate-health readiness. The moderate mean knowledge score (10.0/24) indicates a significant gap between lived experience and conceptual understanding of environmental health linkages, despite the fact that nearly all respondents (98.2%) reported direct experiences of climate change impacts. Formal training has a significant impact on climate health literacy, as evidenced by the observed variance in knowledge across professional cadres, with doctors rating highest, followed by the paramedical workers and nurses. Significant conceptual gaps are found, especially when it comes to understanding adaptation techniques from mitigation measures. Additionally, there is a clear attitude-action gap, emphasizing that professional participation does not follow from great concern. This study adds new evidence to why healthcare systems are still unprepared for climate-related health concerns by addressing these gaps and the impact of institutional and educational barriers. The findings underline the critical need for systematic integration of climate change content into the health professional education system, especially in nursing curricula, along with sustained professional development and supportive policy frameworks. Enhancing advocacy, creating a climate-resilient health system and advancing India's progress towards sustainable development and climate-resilient public health all depend on raising the level of climate literacy among healthcare professionals, especially nurses, who make up the majority of the workforce.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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