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PERCEPTIONS OF CLIMATE CHANGE AND AIR POLLUTION HEALTH RISKS: A CROSS-SECTIONAL SURVEY IN AN URBAN HEALTH TRAINING CENTRE CATCHMENT AREA, SIDDIPET, TELANGANA

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ABSTRACT

Background: Community perceptions shape personal protective behaviour and support for environmental policy. Local air pollution is visible and irritating, whereas climate change is gradual and abstract. This study assessed awareness, perceived health effects and factors associated with high perceived health risk among adults in an Urban Health Training Centre (UHTC) catchment in Siddipet, Telangana.

Methods: A community-based cross-sectional survey of 384 adults was conducted from June to September 2025 using systematic random household sampling and a pretested, structured Telugu interview schedule (back-translated into English). Proportions with Wilson 95% confidence intervals and chi-square tests ($p < 0.05$) were used; Cramér's V was derived from reported χ^2 values as an effect-size measure.

Results: Awareness of ambient air pollution was 74.2% (95% CI 69.6–78.3) and basic understanding of climate change 51.6% (46.6–56.5). Vehicular emissions (81.3%) and roadside dust or construction (64.1%) were the commonly identified sources; eye irritation (67.2%) and cough or throat irritation (62.5%) was the most commonly reported effects. High perceived health risk (58.9%; 53.9–63.7) was associated with education ($\chi^2 = 24.12$; $p < 0.001$; $V = 0.25$) and personal or family chronic respiratory illness ($\chi^2 = 6.31$; $p = 0.012$; $V = 0.13$); age and gender showed no significant association.

Conclusions: Awareness of local air pollution exceeded understanding of climate change in this urban catchment. Literacy-sensitive community education that links visible local hazards to climate and health, and environmental-history taking in primary care, may narrow these gaps. Self-reported symptoms, unadjusted analyses and the absence of ambient monitoring preclude causal inference.

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INTRODUCTION

Climate change and environmental deterioration pose substantial threats to human health, with disproportionate consequences in low- and middle-income settings. In India, urban growth, motorisation and fossil-fuel use contribute to ambient particulate pollution ($PM_{2.5}$ and PM_{10}) and greenhouse-gas emissions [1,2]. Ambient and household air pollution rank among the leading modifiable risk factors for the global disease burden [3,4], and India accounted for roughly one in four of the 8.1 million deaths attributed to air pollution worldwide in 2021 [5]. Within India, the health and economic burden of air pollution is substantial in every state [6,7]. In parallel, the 2024 Lancet Countdown report documents record-breaking climate-related health threats [2], and the IPCC Sixth Assessment Synthesis Report warns of mounting climate risks to human health [8]. Air pollution and climate change share drivers, notably fossil-fuel combustion, and can affect health through overlapping pathways [9,10]. Prolonged exposure to polluted air is associated with respiratory and cardiovascular morbidity

and higher all-cause mortality [4, 6]. Climate-related changes may, in addition, increase heat exposure and alter environmental conditions.

Community perception is central to prevention and risk communication. Dust, smoke, odour and eye or throat irritation make ambient pollution readily observable, whereas climate change is often experienced as distant, gradual and abstract; the concept of psychological distance helps to explain why such threats may be judged less personally relevant [11]. Education, personal experience and lived illness may influence perceived seriousness [12–14]. Urban Health Training Centres (UHTCs) of medical institutions serve defined urban populations and are well placed to assess local concerns and deliver contextualised environmental-health education (Figure 01). National action on air quality, such as the National Clean Air Programme [15], relies on informed and engaged communities; yet locally generated evidence on how residents of smaller Telangana urban areas perceive these threats is scarce.

Objectives. The primary objective was to estimate the proportion of adults in the UHTC catchment of Siddipet who were aware of ambient air pollution and who had a basic understanding of climate change. Secondary objectives were (i) to describe perceived sources of air pollution and self-reported health effects attributed to air quality, and (ii) to identify factors associated with high perceived health risk from air pollution.

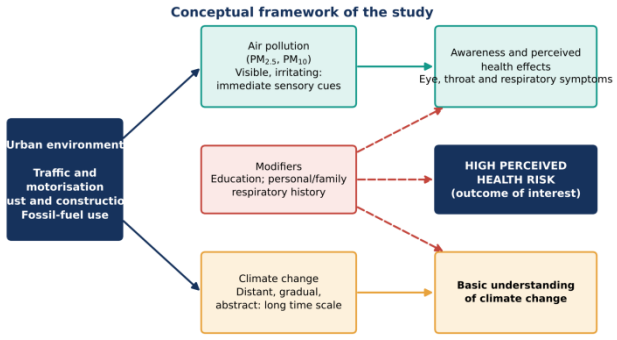

Figure 01.Conceptual framework of the study. Air pollution is perceived through immediate sensory cues, whereas climate change is perceived as abstract; education and respiratory history may modify perceived risk. Perceived health risk of air pollution is the outcome of interest and informs UHTC risk communication.

MATERIALS AND METHODS

Study design and setting

A community-based cross-sectional survey was conducted in the catchment area of the UHTC, Siddipet, managed by the Department of Community Medicine, Surabhi Institute of Medical Sciences (SIMS), Siddipet, Telangana. Data were collected from June to September 2025. The study is reported in accordance with the STROBE recommendations for cross-sectional studies [16] (Table 02).

Participants and sample size

Permanent residents aged 18 years or older who had lived in the catchment area for at least one year were eligible. The sample size was calculated using Cochran's formula for a single proportion [17]:

$$n = Z^2 p(1-p) / d^2 = (1.96)^2 \times 0.50 \times 0.50 / (0.05)^2 = 384.16 \approx 384$$

A proportion of 50% was assumed to give the maximum sample size, with 5% absolute precision and a 95% confidence level.

Sampling and data collection

Households within the designated UHTC wards were selected by systematic random sampling, and one adult per household (the head or an available adult member) was interviewed after informed consent. All 384 participants completed the survey. The participant flow is shown in Figure 02.

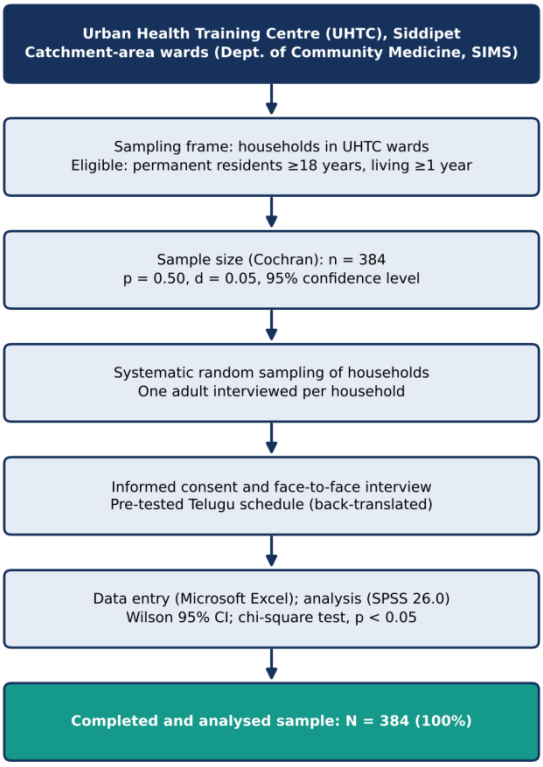

Figure 02: Flow of study design, sampling and analysis from the UHTC catchment area to the final analysed sample.

Data collection instrument and variables

Face-to-face interviews used a pretested, structured questionnaire translated into Telugu and back-translated into English to check consistency. The interview schedule had four sections (Table 01). Awareness of ambient air pollution, basic understanding of climate change and high perceived health risk were derived from the corresponding questionnaire domains and analysed as binary indicators. Perceived sources and self-reported symptoms attributed to air quality were recorded as multiple-response items. Explanatory variables were age group, gender, education and personal or family history of chronic respiratory illness; socio-economic status was recorded for description.

Table 01.Structure of the interview schedule

Section	Domain	Variables and items assessed
A	Socio-demographic variables	Age, gender, education, occupation, family income
B	Climate change awareness and perception	Local weather alterations, seasonal shifts, perceived causes
C	Air pollution awareness and	Sources, personal exposure, perceived

	perception	severity
D	Perceived health risks	Self-reported symptoms, chronic conditions, preventive measures

Questionnaire pretested, translated into Telugu and back-translated into English.

Statistical analysis

Data were entered in Microsoft Excel and analysed with SPSS version 26.0. Categorical variables are presented as frequencies and percentages; 95% confidence intervals for proportions were calculated by the Wilson score method, which performs well for single proportions [18]. The chi-square (χ^2) test assessed associations of selected factors (education/literacy, personal or family respiratory illness history, age group and gender) with high perceived health risk. A p-value below 0.05 was considered statistically significant. To aid interpretation, Cramér's V was derived from the reported χ^2 and N ($V = \sqrt{[\chi^2/N]}$ for 2-category outcomes) and read against conventional benchmarks [19]. Analyses were unadjusted and exploratory.

Ethical considerations

The study was approved by the Institutional Ethics Committee, Surabhi Institute of Medical Sciences, Siddipet (IEC/SIMS/2025/02). Verbal and written informed consent were obtained from all participants before data collection. Participation was voluntary and responses were kept confidential. Table 02 maps the STROBE reporting items to the sections of this manuscript.

Table 02: STROBE reporting items for cross-sectional studies and their location in this manuscript

Item	STROBE requirement	Location in this manuscript
1	Study design indicated in title and abstract	Title; Abstract (Methods)
2–3	Background, rationale and objectives	Introduction
4–5	Study design, setting and dates	Materials and Methods: Study design and setting
6	Eligibility criteria and sampling	Materials and Methods: Participants; Sampling (Figure 02)
7–8	Variables and measurement	Materials and Methods: Data collection instrument (Table 01)
9	Bias	Materials and Methods (back-translation); Discussion: Strengths and limitations (Table 08)
10	Study size	Materials and Methods: Participants and sample size
12	Statistical methods	Materials and Methods: Statistical analysis
13	Participant flow	Materials and Methods (Figure 02); Results
14–16	Descriptive, outcome and main results	Results (Tables 03–05; Figures 03–07)
18–21	Key results, limitations, interpretation, generalisability	Discussion; Strengths and limitations
22	Funding	Declarations

STROBE, Strengthening the Reporting of Observational Studies in Epidemiology [16].

RESULTS

Participant Characteristics

All 384 participants completed the survey. Mean age was 38.4 ± 11.2 years; 201 (52.3%) were male and 183 (47.7%) female. Overall, 262 (68.2%) were literate and 109 (28.4%) had completed high school or above; 212 (55.2%) belonged to the middle or lower-middle socioeconomic group (Table 03, Figure 03).

Table 03.Socio-demographic characteristics of participants (N = 384)

Characteristic	Category	n	%
Age (years)	18–30	128	33.3
	31–50	176	45.8
	> 50	80	20.8
Gender	Male	201	52.3
	Female	183	47.7
Education	Illiterate	122	31.8
	Primary / middle school	153	39.8
	High school and above	109	28.4
Socioeconomic status	Upper / upper middle	64	16.7
	Middle / lower middle	212	55.2
	Lower	108	28.1

Percentages may not total 100 because of rounding.

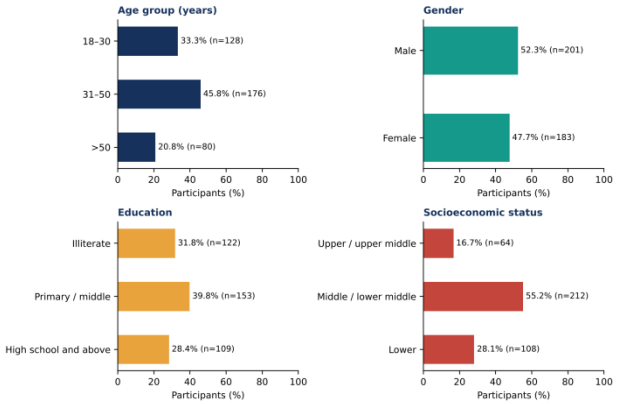

Figure 03. Profile of the 384 participants by age group, gender, education and socioeconomic status.

Awareness, perceived sources and perceived health effects

Awareness of ambient air pollution was reported by 285 participants (74.2%; 95% CI 69.6–78.3). Vehicular emissions were identified as a source by 81.3% and roadside dust or construction activity by 64.1%. Basic understanding of climate change was reported by 198 participants (51.6%; 46.6–56.5), and high perceived health risk by 226 (58.9%; 53.9–63.7) (Table 04, Figure 04). Awareness of air pollution was therefore 1.44 times as common as basic understanding of climate change, an absolute gap of 22.7 percentage points (87 of 384 participants; Figure 06).

The most frequently reported symptoms attributed to ambient air quality were eye irritation or burning (258; 67.2%) and cough or throat irritation (240; 62.5%). Shortness of breath or asthma aggravation was reported by

146 (38.0%), headache or fatigue by 115 (29.9%) and skin conditions or allergies by 82 (21.4%). Multiple responses were permitted (Table 04, Figures 04–.5). These are self-reported perceptions, not clinically verified outcomes.

Table 04.Awareness, perception, perceived sources of air pollution and self-reported health effects (N = 384)

Indicator	n†	%	95% CI
A. Awareness and perception			
Aware of ambient air pollution	285	74.2	69.6–78.3
Basic understanding of climate change	198	51.6	46.6–56.5
High perceived health risk from air pollution	226	58.9	53.9–63.7
B. Perceived sources of air pollution			
Vehicular emissions	312	81.3	77.0–84.8
Roadside dust / construction activity	246	64.1	59.1–68.7
C. Self-reported health effects attributed to ambient air quality (multiple responses permitted)			
Eye irritation / burning	258	67.2	62.3–71.7
Cough / throat irritation	240	62.5	57.6–67.2
Shortness of breath / asthma aggravation	146	38.0	33.3–43.0
Headache / fatigue	115	29.9	25.6–34.7
Skin conditions / allergies	82	21.4	17.5–25.7

CI, Wilson 95% confidence interval. † Counts for items originally recorded as percentages were derived from the percentage and N = 384.

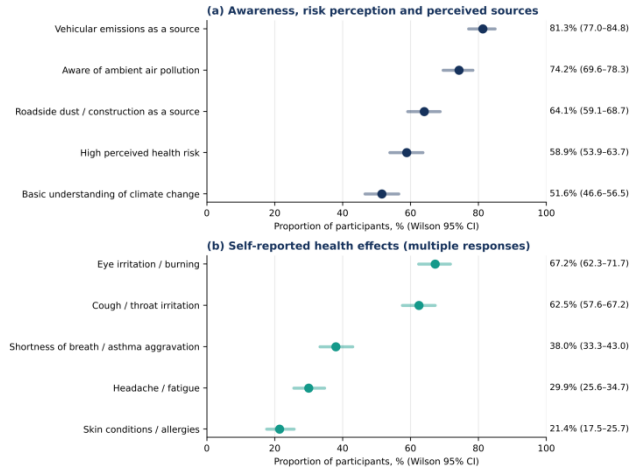

Figure 04: Prevalence estimates with Wilson 95% confidence intervals: (a) awareness, risk perception and perceived sources of air pollution; (b) self-reported health effects attributed to ambient air quality (N = 384).

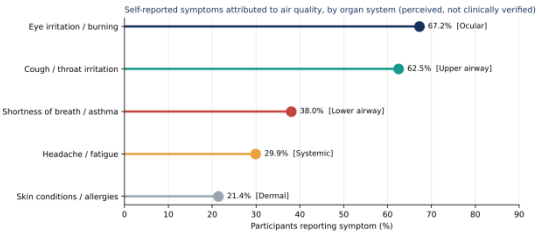

Figure 05: Self-reported symptoms attributed to air quality, grouped by organ system. Ocular and upper-airway irritation predominated; symptoms are perceived and were not clinically verified.

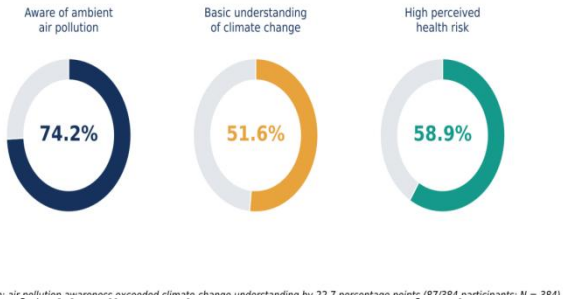

Figure 06: Headline indicators: awareness of ambient air pollution, basic understanding of climate change and high perceived health risk among 384 adults, with the awareness gap.

Factors associated with perceived risk

High perceived health risk was significantly associated with education ($\chi^2 = 24.12$, $p < 0.001$; Cramér's V = 0.25) and with a personal or family history of chronic respiratory illness ($\chi^2 = 6.31$, $p = 0.012$; V = 0.13). Age group and gender were not significantly associated ($p > 0.05$) (Table 05, Figure 07). By conventional benchmarks the education association was of small-to-medium strength and the respiratory-history association small.

Table 05: Association of selected factors with high perceived health risk

Factor	Test	χ^2	p-value	Cramér's V*	Interpretation
Literacy / education	Chi-square	24.12	< 0.001	0.25	Significant; small-to-medium
Personal / family history of chronic respiratory illness	Chi-square	6.31	0.012	0.13	Significant; small
Age group	Chi-square	—	> 0.05	—	Not significant
Gender	Chi-square	—	> 0.05	—	Not significant

Chi-square test; $p < 0.05$ considered statistically significant. χ^2 values were not reported for non-significant factors. *Derived post hoc as $\sqrt{(\chi^2/N)}$, N = 384.

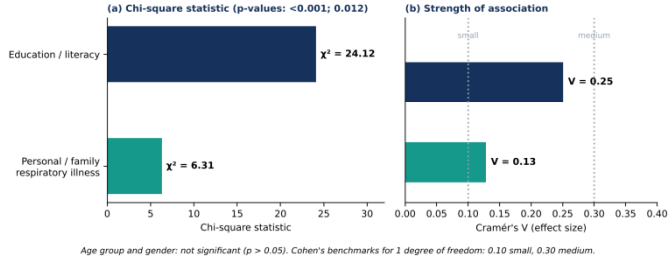

Figure 07: Association of selected factors with high perceived health risk: (a) chi-square statistics with p-values; (b) corresponding effect sizes (Cramér's V) against conventional benchmarks.

DISCUSSION

Principal findings

In this survey of 384 adults, awareness of local air pollution was more common than basic understanding of climate change. Participants commonly identified vehicular emissions and roadside dust or construction activity as pollution sources, and eye and respiratory irritation were the symptoms most frequently attributed to air quality. High perceived health risk was more likely among better-educated respondents and those with personal or family respiratory illness. These findings describe awareness and perceptions; the survey did not measure ambient pollution or clinically assess symptoms.

Why local pollution is better recognised than climate change

The divergence may reflect the immediate visibility of dust and emissions compared with the longer time scale of climate change; hazards that are distant in time, space and personal relevance tend to be discounted [11,14]. Similar findings are reported from India, where perceptions were tied to anomalies in immediate weather rather than to the overall concept of climate change [20]. A survey of roadside shopkeepers in Bangalore found major gaps in knowledge of the wider health hazards of ambient air pollution despite broad awareness [21], and perceptions of climate effects across physical, mental and environmental health domains have been documented in South India [22]. The high reporting of eye and respiratory symptoms is consistent with national evidence of a substantial burden of respiratory disease attributable to particulate pollution [4,6,7].

Comparison with other Indian studies

Climate change awareness in our catchment (51.6%) was lower than that reported from another UHTC in Western Maharashtra, where 74% of respondents had good knowledge and 88.05% had a good perception of health effects (cross-sectional, n = 385) [23]. A mixed-methods study in rural Assam (n = 200) reported 65% awareness [24], and an urban community in Chennai showed 63% awareness [25]. These comparisons are summarised in Table 06 and Figure 08, although differences in definitions of awareness versus knowledge, instruments and sampling limit direct comparison.

Table 06: Comparison of climate change awareness with recent Indian studies

Study	Setting and design	Outcome measure	Key finding
Present study	UHTC, Siddipet; cross-sectional, n = 384	Basic understanding of climate change	51.6%; education associated with high perceived risk
Gowda and Arora [23]	UHTC, Western Maharashtra; cross-sectional, n = 385	Good knowledge; good perception of health effects	74% good knowledge; 88.05% good perception
Dey et al. [24]	Rural Assam; mixed-methods, n = 200	Awareness	65%; education an independent predictor (adjusted OR 2.8)
Gopinath and Arulmozhi [25]	Urban community, Chennai; cross-sectional	Awareness	63%; no association with education

OR, odds ratio. Outcome definitions differ between studies; comparison is indicative only.

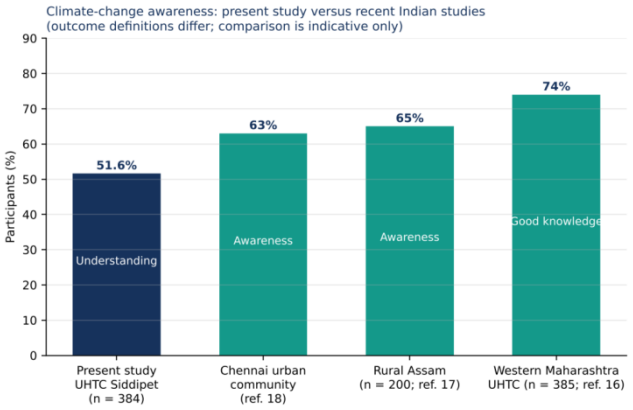

Figure 08: Climate change awareness in the present study compared with recent Indian studies. Outcome definitions differ (awareness versus knowledge versus basic understanding); comparison is indicative only.

A ten-country survey found that people living in more polluted localities reported greater concern and more protective behaviour despite lower air-quality knowledge, with India among the highest concern scores [26]. This parallels our finding of high air pollution awareness but weaker climate understanding. Similar questions have been examined among the general population and university students in Egypt, indicating that this is a widespread communication challenge [27,28].

Education and respiratory history

Education emerged as a significant correlate of perceived risk, in line with a 119-country analysis in which educational attainment was the strongest predictor of climate change awareness [13]. In rural Assam, education was likewise an independent predictor of awareness (adjusted OR 2.8) [24]. A study of an urban community in Chennai, however, found no association between education and awareness, so the effect of schooling may vary with setting and measurement [25]. The association with personal or family respiratory history may reflect lived experience of illness, consistent with the psychometric view that familiar and visible hazards are judged as higher risk [12] and with evidence that personal experience and affect shape risk perception [29]. However, the cross-sectional design cannot establish causation or direction, and the age and gender findings should be interpreted cautiously. The derived effect sizes (V = 0.25 and 0.13) indicate that statistical significance should not be equated with large practical differences.

Implications for UHTC and primary-care practice

As primary-care infrastructure, UHTCs of medical colleges are well placed to integrate environmental health literacy into routine outreach, antenatal clinics and non-communicable disease screening camps (Figure 09). Communication should distinguish perceived from measured exposure. Because pollution was salient to participants while its climate link was weaker, messages that connect visible local hazards, such as vehicle smoke and construction dust, to both immediate respiratory effects

and longer-term climate change may be more persuasive than abstract climate messaging alone. Literacy-appropriate formats (pictorial and vernacular material, group sessions) are warranted given the education gradient. Municipal collaboration on dust management and green infrastructure may complement health education and align with national clean-air efforts [15], although these interventions were not evaluated here. Training of future clinicians should also include climate-health content [30]. Table 07 translates each principal finding into a proposed UHTC action, and Figure 10 sketches a phased roadmap.

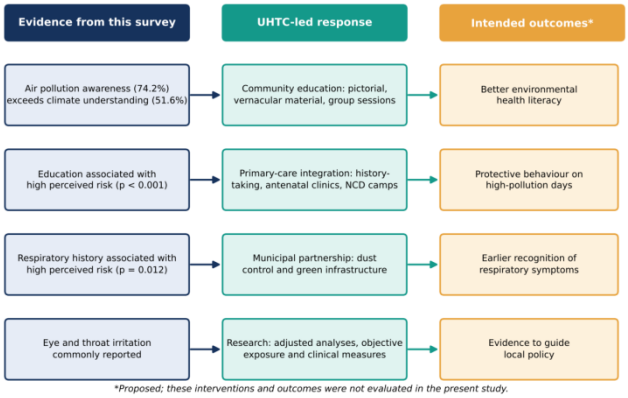

Figure 09: Proposed UHTC-led response framework linking the survey findings to community education, primary-care integration, municipal partnership and research. Intended outcomes are proposed and were not evaluated in this study.

Table 07: Translation of principal findings into proposed UHTC actions

Finding	Implication	Proposed UHTC action
Air pollution awareness (74.2%) exceeds climate change understanding (51.6%)	Local pollution is salient; its climate link is weak	Link visible local hazards (dust, vehicle smoke) to climate and health in outreach messages
High perceived risk associated with education	Lower-literacy groups may under-perceive risk	Pictorial and vernacular material; group sessions
High perceived risk associated with respiratory illness history	Lived illness shapes risk perception	Environmental history-taking in respiratory clinics and NCD screening camps
Eye (67.2%) and throat (62.5%) irritation commonly reported	Symptoms are salient but not clinically verified	Counselling that distinguishes perceived from measured exposure; objective monitoring in future studies
Vehicular emissions (81.3%) and dust (64.1%) named as sources	Community recognises actionable sources	Municipal partnership for dust control and green infrastructure

NCD, non-communicable disease. Proposed actions were not evaluated in this study.

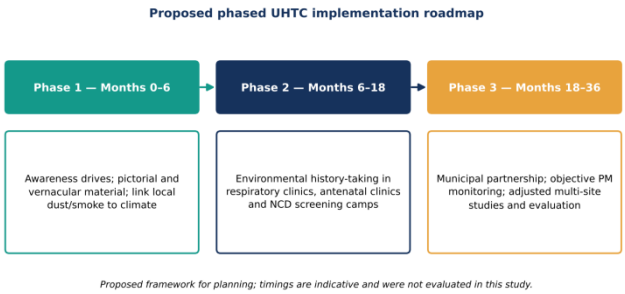

Figure 10: Proposed phased UHTC implementation roadmap. Timings are indicative, for planning only, and were not evaluated in this study.

Strengths and limitations

Strengths include a community-based design, a stated sample-size calculation, systematic household sampling, translation and back-translation of the interview schedule, and completion by all 384 participants. Limitations are summarised in Table 08. In particular, perceived risk and symptoms were self-reported, one adult per household was interviewed, and only unadjusted chi-square tests were used, so confounding cannot be excluded. Questions on the definition and scoring of awareness, understanding and perceived risk should be reported in full in future work to improve comparability with other studies.

Table 08: Limitations, their possible consequences and suggested remedies

Limitation	Possible consequence	Suggested remedy in future work
Cross-sectional design	Associations only; causality between perceived exposure and clinical outcomes cannot be inferred	Longitudinal or interventional follow-up
Self-reported perceptions	Recall and perception bias; no clinical validation or ambient air quality monitoring	Clinical assessment with objective PM monitoring
One adult per household; single urban catchment	Selection bias cannot be excluded; may not generalise to rural settings	Multi-site urban and rural sampling; random selection of respondent within household
Unadjusted chi-square tests only	Confounding cannot be excluded	Adjusted multivariable analyses

PM, particulate matter.

CONCLUSIONS

Among surveyed adults in the UHTC Siddipet catchment, awareness of local air pollution exceeded basic understanding of climate change. Participants reported symptoms they attributed to air quality, but these were not clinically verified. Education and personal or family respiratory history were associated with high perceived health risk, with small-to-medium effect sizes (Figure 11).

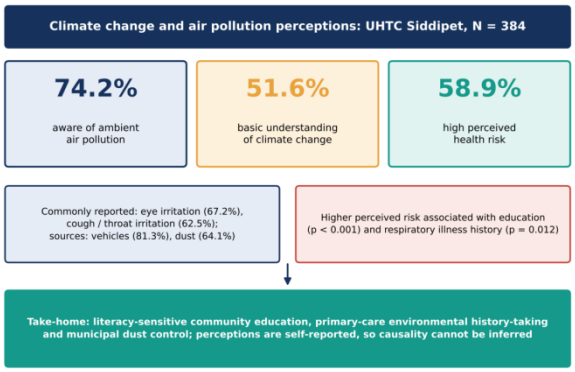

Figure 11: Graphical summary of the principal findings and take-home message.

RECOMMENDATIONS

Community environmental health education: regular UHTC awareness drives on personal protection (for example masks on high-pollution days) and protection of children and the elderly.

Green infrastructure: municipal bodies to partner with health centres to promote green belts and control urban dust emissions.

Primary care integration: medical officers and interns at UHTCs to include environmental risk assessment in routine history-taking for respiratory illness, with climate-health content in health-science training [30].

Future research: use transparent scoring definitions, adjusted analyses and objective exposure or clinical measures where feasible.

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FUNDING

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CONFLICT OF INTEREST

None declared.

ETHICAL APPROVAL

Institutional Ethics Committee, Surabhi Institute of Medical Sciences, Siddipet (IEC/SIMS/2025/02).

Informed consent: Verbal and written informed consent were obtained before data collection.

DATA AVAILABILITY

The datasets are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS (CREDIT)

Nikita Gwalani (NG) and DhanshaGwalaniMulchandani (DGM) are co-first authors and contributed equally to this work. AtulGopalAgrawal (AGA) and Manish Kumar (MK) are co-second authors and contributed equally to this work; AGA is the corresponding author. AnkitaAgrawal (AA) is the third author.RuthikaBasa (RB) is the fourth author.Priyanka Shaw (PS) is fifth author. All authors read and approved the final manuscript, agree to be accountable for all aspects of the work, and meet the ICMJE criteria for authorship. Individual contributions are summarised in Table 09.

Table 09: Author contributions (CRediT taxonomy)

Author	Role	Contribution
Nikita Gwalani (NG)†	Co-first author	Conceptualization, methodology, validation, writing – review and editing, critical revision for important intellectual content
Dhansha Gwalani Mulchandani (DGM)†	Co-first author	Conceptualization, methodology, validation, writing – review and editing, critical revision for important intellectual content
AtulGopalAgrawal (AGA)‡,*	Co-second author; corresponding author	Study design, data collection, formal analysis, corresponding-author responsibilities
Manish Kumar (MK)‡	Co-second author	Interpretation of findings; critical revision of the manuscript for important intellectual content
Ankita Agrawal (AA)	Third author	Critical review, manuscript drafting and revision
Ruthika Basa (RB)	Fourth author	Manuscript revision
Priyanka Shaw (PS)	Fifth author	Manuscript revision

† Equal contribution (co-first authors). ‡ Equal contribution (co-second authors). * Corresponding author.

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