Knowledge, perceptions and practices of medical students towards climate change and global warming: A cross sectional study

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ABSTRACT

Context: Climate change is the biggest global health threat and also the greatest health opportunity of the 21st century. Five warmest years among the last 140 years occurred between 2015 and 2019. Limited information is available regarding the knowledge and practices of medical students towards climate change, especially in India. Settings and Design: A cross-sectional survey was conducted in two medical colleges of Karimnagar city from January 2021 to July 2021 involving MBBS and Post-graduate students as study participants. Methods and Material: 903 undergraduate and post-graduate medical students who consented for the study were included. A pre-structured questionnaire was used. Statistical Analysis Used: Data is presented in frequencies and proportions with 95% confidence interval and Chi-square test is used as test of significance. Results: Poor knowledge regarding Sustainable Developmental Goal for climate action, Organisations dealing climate change and Government actions towards climate change were observed among study participants. Cardiovascular and respiratory diseases (84%) were answered as the major health impacts of climate change. Majority (97.4%) of the participants agreed that 'human actions are also the cause for global warming'. Environment-friendly practices were observed significantly high among participants with adequate knowledge. Major (72%) source of learning about climate change was via internet. Conclusions: Our study found that major proportion of participants doesn’t have environment-friendly practices. However, the participants with adequate knowledge about climate change were observed to have more eco-friendly practices compared to participants with inadequate knowledge.

Keywords: Climate change, global warming, sustainable development goal

Introduction

The key to man’s health lies largely in his environment and often man is responsible for the pollution of his environment through urbanization, industrialization and other human activities. Emission of greenhouse gases into the atmosphere have been increasing ever since the beginning of industrial revolution and it was estimated that average global surface temperature increases by 3°C by the year 2030 along with rise in the sea level of 0.1 – 0.3
metres by 2050 and an increase in the occurrence of extreme climatic events such as cyclones, heatwaves and draughts.\[9\]

The latest Lancet countdown on health and climate change reported a decadal increase in transmissibility of diseases (Malaria, Dengue Chikungunya, Cholera and Zika), increased heat-related deaths among elderly aged people and potential heat-related hours totally lost, especially in countries with low HDI like India.\[10\] As per the Paris Agreement, to limit the global rise in temperature to 1.5°C (maximum 2°C), Global Greenhouse Gas (GHG) emissions must fall by 7.6% each year starting in 2020.\[3\] Research suggests we could have as few as 8 years to prevent the world from warming beyond 1.5°C, a temperature threshold that, if breached, will have serious consequences for global health.\[4\] In spite of the temporary reduction in carbon footprint due to the COVID-19 pandemic-related movement restrictions, the target temperatures will be unable to be met.

Most recent studies have shown evidences of relation between climate change and suicide rates across the world and also an increase in number of allergic respiratory diseases.\[5,6\] Health care-sector is found to be responsible for up to 4.4% of greenhouse gas emissions globally.\[7\] The WHO in 2015, have asked all the health professionals of the world to be on the forefront in protecting the people from the harmful health impacts of the climate crisis. To achieve the United Nation's sustainable developmental goal-13 (SDG-13) i.e., “to take urgent action to combat climate change and its impacts”, the role of medical fraternity will be of paramount importance as primary care physicians, in actively guiding the people to adopt healthy, environmentally friendly practices and as health administrators, to unequivocally push for more sustainable health policies.\[8\] There is a need to sensitize medical students towards environment and health by conducting various activities like eco drive competitions, green campus initiatives etc., on important days like world environment day.

Inadequate research was found to be a hindering factor in carrying out the national strategies relating to health and climate change in 46% of the countries, says the WHO report (2021).\[9\] Alarmed by the overwhelming corroborations regarding the health impacts of climate change and also to assess the knowledge, perceptions and practices of medical students, the study is conducted in two medical colleges of Karimnagar district, Telangana state, India.

### Objectives

1. To evaluate the knowledge regarding climate change and global warming among MBBS and Post-Graduate Medical students.
2. To determine the perceptions and behavioural practices towards climate change and global warming among MBBS and Post-Graduate Medical students.

### Subjects and Methods

#### Study design, settings and subjects

A cross sectional study was conducted in two medical colleges of Karimnagar city from January 2021 to July 2021 involving MBBS and Post-graduate students as study participants.

#### Sample size and sampling technique

903 participants. Out of 1300 undergraduates, 260 interns and 500 postgraduates, 993 subjects came forward to participate in the study. 90 subjects were involved in pilot study and 903 participants were included in the current study. Hence the sample size is 903.

#### Study tool and data collection

A pre-structured questionnaire was designed to assess knowledge, perceptions and behavioural practices of the MBBS and Post-graduate students in both the medical colleges. The questionnaire was developed by reviewing questions from UNDP-JCCCP KAP survey (2016).\[10\] The questionnaire was pilot tested on a small group of medical students, interns and post graduates of both colleges and necessary modifications were made to the questionnaire with the help of subject experts from Community medicine and General medicine department. The data was collected by face-to-face interview method.

#### Statistical analysis

Data was entered into excel sheet and analysed using IBM SPSS Statistics for Windows Version 21.0. A score was given for each knowledge-based question about climate change and participants who scored 50% or more were considered to have adequate knowledge. The categorical variables were summarized using absolute frequency and proportions with 95% confidence interval (CI) and the quantitative variables were summarized by mean and standard deviation. The significance between the groups was assessed by Chi-square test for categorical variables. The level of statistical significance was considered as 5%.

#### Ethical considerations

The study participants were briefed about the purpose and nature of the study, and informed consent was obtained before data collection. Study was approved by Institutional ethics committee.

#### Results

Majority of the participants were females (64.9%) and 44.7% of the participants were from 1st and 2nd MBBS. [Table 1]

Poor Knowledge regarding Sustainable Developmental Goal for climate action, Organisations dealing climate change and Government actions towards climate change were observed among study participants. [Table 2]

Cardiovascular and respiratory diseases (84%) were answered as the major health impacts of climate change and few (9%)
subjects were not aware about health impacts of climate change. [Figure 1]

Majority of the 3rd and 4th year MBBS students (79.1%) and male students (76%) have adequate knowledge but the difference between the groups is not statistically significant. [Table 3]

Deforestation is answered as the biggest contributor to climate change whereas agricultural activities are perceived as the least contributor to climate change by the participants [Figure 2]

Majority (97.4%) of the participants agreed that human actions are also the cause for global warming and 94.5% of the subjects feel that children should be taught more about climate change. The difference between perceptions of study groups about climate change is not statistically significant. [Table 4]

Majority (94%) of the participants turn off lights/devices when not in use followed by using energy saving appliances (60%) and buying environmentally friendly products (57%) [Figure 3]

Environmentally friendly practices like using energy saving appliances, using public transport, car pool travel, Defrosting refrigerator often, recycling waste and buying environmentally friendly products were observed high among people with adequate knowledge in comparison to participants with inadequate knowledge and the difference is statistically significant. [Table 5]

Major (72%) source of learning is internet followed by Television (68%) and Newspaper [Figure 4].

This study was conducted in two medical colleges involving under-graduate and post-graduate medical students as

### Table 1: Gender, education & age-wise distribution of the participants (n=903)

|                | Frequency | Percentage |
|----------------|-----------|------------|
| Gender         |           |            |
| Females        | 586       | 64.9       |
| Males          | 317       | 35.1       |
| Education      |           |            |
| 1st Year MBBS  | 228       | 25.2       |
| 2nd Year MBBS  | 176       | 19.5       |
| 3rd Year MBBS  | 190       | 21.0       |
| 4th Year MBBS  | 107       | 11.8       |
| Intern         | 105       | 11.6       |
| Post-Graduates | 97        | 10.7       |
| Mean Age (years) ± SD |       |            |
| 1st Year MBBS  | 18.3±0.53 |            |
| 2nd Year MBBS  | 20.6±0.34 |            |
| 3rd Year MBBS  | 21.2±0.23 |            |
| 4th Year MBBS  | 22.3±0.36 |            |
| Interns        | 23.5±0.22 |            |
| Post-Graduates | 29.3±0.69 |            |

### Table 2: Knowledge of participants regarding climate change (n=903)

| Questions                                           | 1st & 2nd Year MBBS (n=404) | 3rd & 4th Year MBBS (n=297) | Interns (n=105) | Post-graduates (n=97) | Total (%) [95% CI (n=903)] |
|-----------------------------------------------------|------------------------------|------------------------------|-----------------|------------------------|-----------------------------|
| Do you know the causes of climate change?            | 343 (85)                     | 253 (86)                     | 89 (85)         | 81 (84)                | 768 (85) [82.5, 87.3]       |
| Do you know the environmental effects of climate change? | 364 (90)                     | 267 (90)                     | 95 (90)         | 87 (90)                | 813 (90) [87.8, 91.9]       |
| Do you know the Sustainable Developmental Goal for Climate action? | 53 (13)                      | 71 (24)                      | 11 (10)         | 9 (9)                  | 126 (14) [11.7, 16.3]       |
| Is Reversing of global warming possible?             | 283 (70)                     | 208 (70)                     | 85 (81)         | 78 (80)                | 677 (75) [72, 77.7]         |
| Do you know any Organisations dealing with climate change in India? | 93 (23)                      | 80 (27)                      | 24 (23)         | 20 (21)                | 208 (23) [20.3, 25.9]       |
| Is government taking actions to reduce global warming? | 133 (33)                     | 101 (34)                     | 35 (33)         | 25 (26)                | 289 (32) [28.9, 35]         |
| Do you know the ways to reduce climate change?       | 311 (77)                     | 238 (80)                     | 84 (80)         | 71 (73)                | 695 (77) [74, 79.6]         |
| Do you know the ways to protect yourself from climate change? | 315 (78)                     | 229 (77)                     | 87 (83)         | 71 (73)                | 704 (78) [75.1, 80.6]       |

### Table 3: Association between adequacy of knowledge regarding climate change with class and gender of the participants (n=903)

| Knowledge | Adequate (%) | Inadequate (%) | Chi-square, P |
|-----------|--------------|----------------|---------------|
| Class     |              |                |               |
| 1st & 2nd Year MBBS (n=404) | 303 (75) | 101 (25) | 0.104         |
| 3rd & 4th Year MBBS (n=297) | 235 (79.1) | 62 (20.9) | 0.010         |
| Interns (n=105) | 77 (73.3) | 28 (26.7) | 0.937         |
| Post-Graduates (n=97) | 65 (67) | 32 (33) | 0.132         |
| Total (n=903) | 680 (75.3) [72.3, 78] | 223 (24.7) [21.9, 27.6] |               |
| Gender    |              |                |               |
| Male (n=317) | 241 (76) | 76 (24) | 0.711         |
| Female (n=586) | 439 (74.9) | 147 (25.1) |               |
| Total     | 680 (75.3) | 223 (24.7) |               |
The majority of participants were females (65%) owing to the presence of more female students in the two medical colleges. The participants were divided into four groups for the purpose of better analysis of the results. First-year MBBS students were the highest (25.2%) and post-graduates (10.7%) were the least, to participate in this study.

**Knowledge of participants regarding climate change**

Similar proportions of knowledge, perception, and behavioral practices were found in the responses from both colleges. Majority of our study participants answered that they have the knowledge of the causes (85%), environmental effects (90%) of climate change, and the ways to reduce (77%) the climate change. Similar findings were reported in the study conducted by Sulistyawati S et al. in Indonesia among adolescents of a senior high school, where most of the participants knew the causes (91%) and consequences (68%) of climate change. Lesser proportion (14%) of our study participants were found to have the knowledge of Sustainable Developmental Goal-13 as a goal for climate action. There are no known previous KAP studies among the students that address the Sustainable Developmental Goal-13. Majority of our study participants (75%) were aware that global warming is reversible. This finding is consistent with the study conducted among senior secondary school students in the
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Fewer numbers of our study participants have responded that they have the knowledge of organisations dealing with climate change in India (23%) and also the government’s actions to reduce global warming (32%). There are no known previous studies addressing these questions. On evaluation, majority of our study participants (75%) were found to have adequate knowledge about climate change and global warming. There are no known previous studies that evaluated for the adequacy of the knowledge of participants about climate change and its impacts.

Perception of participants regarding climate change

Agriculture, Forestry and other land use (AFOLU) activities are the leading contributors (23%) to the global anthropogenic greenhouse gas (GHG) emissions as it involves large areas of land-clearing for crop production so as to meet the food demands of the increasing world population. Only 10% of our study participants responded land-clearing for agriculture to be the cause of climate change. There are no known previous studies which specifically report the perception about land-clearing for agricultural activities as a major cause for climate change. Our study participants perceived deforestation (93%) as the most important cause of climate change followed by pollution from industries and automobile (87%). This finding is consistent with the study of Akrofi MM et al. and Deveci SE et al. Even though research suggest that the negative impacts of livestock industry is massive, both financially and ecologically, surprisingly only less than half of our study participants (42%) in our study know that livestock and over-fishing contributes to climate change.

Climate change has been proved to change the dynamics of disease-causing vectors by mainly affecting their reproductive rates and also affecting the development rates of pathogens that they carry. Increased occurrence of vector-borne diseases (74%) was responded by our study participants, as the second major health impact of climate change following cardiovascular & respiratory diseases (84%). Similar findings about vector-borne diseases were reported in the studies of...
Similar findings were reported by Freije A M et al. [24] among medical students in Bahrain. Majority (86%) of our study participants responded that it’s both Individual and Government responsibility to curb global warming. Contrast findings were reported by Nalgundwar AN et al. [21] who found a positive association between their perception regarding climate change and adaptation of low-carbon models by them.

Association between knowledge and practices regarding climate change

A significant association was observed between knowledge and practices of our study participants regarding climate change. Participants with adequate knowledge about climate change were found to have better environmentally-friendly practices than participants without adequate knowledge. Study conducted by Wenjing Li et al. [28] among the rice farmers of China, have displayed a positive association between their perception regarding climate change and adaptation of low-carbon models by them.

Source of information

Most of the participants in our study responded that they learn information about climate change from Internet (72%), Television (68%) and Newspapers (59%). Contrastingly, the major source of information to know about climate change, among the other studies were by talking with family (84%), Internet (72%), and Radio (68%). Similar findings were reported by Akrofi MM et al. [14] reporting that participants have more than one source of knowledge about climate change, which can lead the way in promoting environmental friendly practices.

Practices of participants regarding climate change

Lesser proportion of our study participants responded to have eco-friendly practices like using public transportation (44%), car-pooling to save fuel (35%), reduced use of plastic items (50%), using solar water heater/cooker (16%). Similar findings were reported by Deveci SE et al. [18] (15%) regarding recycling the used plastic. As a key role models, the medical fraternity should restrict the plastic usage and also should take up plastic free campus or hospital initiatives in their working areas, thus passing the message to the patients and community. The major risk associated with the practice of meat-consumption to the environment and human health has been established scientifically. [26] Nevertheless only fewer (16%) participants in the current study have opted to quit non-vegetarian diet. This finding is consistent with a study among the university students by Akrofi MM et al. [14] in which the participants ranked ‘eating too much meat’ as the last cause of climate change. Majority of the our study participants responded to have eco-friendly practices like turning off the lights when not in use (94%), using energy saving appliances (60%) and buying environmentally friendly products (57%). Similar findings were also reported by Nalgundwar AN et al. [21] were high proportion of eco-friendly practices were observed among participants.
gradually shifted from the television and newspaper in the last decade to learning via internet (72%) in this decade.39

Relevance to the practice of primary care physicians
Climate change pose a threat to many of the achievements in public health and over the last century. Health care team have a crucial role in climate change mitigation and health system adaptation to prepare for emergent health threats and a carbon-constrained future. The Primary care physicians are the best bet in sensitizing the community about the link between climate change and health and can promote environmentally friendly practices in a way to save the planet. In this context, it is the need of the hour to enrich, emphasize and reinforce more about climate change and health among medical graduates in budding stage so that they practice and motivate community in adopting climate friendly practices in their future practice as primary care physicians. The current study may be useful for primary care physicians as it highlights the importance of environment and health subject by eliciting the knowledge, perceptions and practices of medical students towards climate change and global warming also the status of workforce preparedness to counter environmental changes.

Conclusion

Majority of participants agreed that global warming is both a current and future problem and also agreed that people need more information on climate change. The knowledge of climate change and global warming is adequate among majority of the participants. Even though health-care sector is a well-educated community, our study found that major proportion of the study participants don’t adopt environment friendly practices. However the participants with adequate knowledge were significantly found to have better environmental-friendly practices. There is a need to motivate them in translating the knowledge of participants into a deliberate practice.

The evidences in the current study therefore signify the importance of broader integration of climate change communication into medical education, as a preparatory measure. It also calls for an emphasis on the importance of motivating the health care professionals and organizations towards carbon-accounting so as to adopt low-carbon technologies (LTCs) to reduce the carbon-footprint on the planet, thereby ultimately creating an environment that is free of carbon-hotspots.

Limitations and Strengths

As this is a questionnaire based study, we were unable to record the reasons from participants, for not practising certain environment-friendly practices, which can be addressed in the future through further qualitative studies. Nevertheless this study has various strengths like large sample size, inclusion of post-graduates also as participants, covering wide range of questions about climate change many of which were not addressed in any recent studies from India.

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Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Key messages
Need to motivate participants in translating their knowledge into a deliberate practice.

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Conflicts of interest
There are no conflicts of interest.

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