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MEDICAL STUDENTS KNOWLEDGE, ATTITUDE, AND PERCEPTION REGARDING CLIMATE CHANGE: A STUDY OF KABUL UNIVERSITY OF MEDICAL SCIENCES

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Abstract. *Climate change represents a critical global challenge with profound implications for human health, making it essential to understand the knowledge, attitudes, and perceptions of future healthcare professionals. This study aimed to evaluate the knowledge, attitude, and perception of students at Kabul University of Medical Sciences regarding climate change. Employing a cross-sectional research design, an online survey was conducted using self-administered questionnaires to gather data from medical students. Descriptive analysis was utilized to interpret the findings. A total of 84.7% of respondents were male, with a mean age of 21.47 years. Notably, 83.3% of participants reported feeling adequately informed about climate change, while 16.7% expressed uncertainty or acknowledged limited knowledge. Awareness of climate change's implications was strong, with 96.3% recognizing the role of forests in mitigating greenhouse gases and 91.3% identifying greenhouse gas emissions as primary drivers of climate change. However, knowledge of specific greenhouse gases was less robust, with 90.3% correctly identifying carbon dioxide, methane, and nitrous oxide. The average knowledge score was 87.34%. In terms of perceptions, 97.3% acknowledged the reality of climate change and its potential sectoral impacts, though only 88% recognized its link to increased food-borne and waterborne diseases. These findings indicate that while medical students possess a commendable level of awareness and positive attitudes towards climate change, significant knowledge gaps remain regarding greenhouse gases and health impacts, underscoring the need for targeted educational interventions.*

Key words: *climate change, knowledge, attitude, perception, medical students.*

ЗНАНИЕ, ОТНОШЕНИЕ И ВОСПРИЯТИЕ СТУДЕНТОВ-МЕДИКОВ В ОТНОШЕНИИ ИЗМЕНЕНИЯ КЛИМАТА: ИССЛЕДОВАНИЕ КАБУЛЬСКОГО УНИВЕРСИТЕТА МЕДИЦИНСКИХ НАУК

Аннотация. *Изменение климата представляет собой важнейшую глобальную проблему с глубокими последствиями для здоровья человека, что делает необходимым понимание знаний, отношения и восприятия будущих медицинских работников. Целью данного исследования была оценка знаний, отношения и восприятия студентов Кабульского университета медицинских наук в отношении изменения климата. Используя перекрестный дизайн исследования, был проведен онлайн-опрос с использованием самостоятельно заполненных анкет для сбора данных от студентов-медиков. Для интерпретации результатов использовался описательный анализ. В общей сложности 84,7% респондентов были мужчинами, средний возраст которых составил 21,47 года. Примечательно, что 83,3% участников сообщили, что чувствуют себя достаточно информированными об изменении климата, в то время как 16,7% выразили неуверенность или признали ограниченные знания. Осведомленность о последствиях изменения климата была высокой: 96,3% признали роль лесов в смягчении парниковых газов, а 91,3% определили выбросы парниковых газов как основные факторы изменения климата. Однако знание конкретных парниковых газов было менее прочным: 90,3% правильно определили углекислый газ, метан и закись азота. Средний балл знаний составил 87,34%. С точки зрения восприятия, 97,3% признали реальность изменения климата и его потенциальное воздействие на секторы, хотя только 88% признали его связь с ростом заболеваний пищевого и водного происхождения. Эти результаты показывают, что, хотя студенты-медики обладают похвальным уровнем осведомленности и позитивным отношением к изменению климата, сохраняются значительные пробелы в знаниях относительно парниковых газов и воздействия на здоровье, что подчеркивает необходимость целевых образовательных вмешательств.*

Ключевые слова: *изменение климата, знания, отношение, восприятие, студенты-медики.*

INTRODUCTION

Climate change is an escalating global crisis that significantly impacts human health and well-being. In 2015, the World Health Organization (WHO) identified climate change as the greatest threat to global health in the 21st century, projecting approximately 250,000 additional deaths annually between 2030 and 2050 due to its consequences [1]. The Intergovernmental Panel on Climate Change (IPCC) defines climate change as a persistent alteration in climate conditions, characterized by changes in key variables such as temperature, precipitation, and wind patterns over extended periods [2]. The implications of climate change on health are multifaceted and alarming, leading to severe droughts, natural disasters, heat waves, and other extreme weather events. These changes not only exacerbate existing health issues but also contribute to the emergence of new diseases. For instance, warmer temperatures and altered rainfall patterns facilitate the spread of vector-borne diseases such as dengue fever, malaria, and West Nile virus. Dengue, in particular, has seen a resurgence in many regions, with the WHO reporting that climate change has expanded the habitats of Aedes mosquitoes, the primary vectors for the virus [3]. The incidence of dengue has increased dramatically, with estimates indicating that there are now 390 million infections annually, many of which correlate with climatic shifts [4]. Moreover, climate change can trigger outbreaks of diseases not previously seen in certain areas. As temperatures rise, the range of mosquitoes expands, leading to potential outbreaks of diseases like chikungunya and Zika. The health implications extend beyond infectious diseases; climate change also contributes to malnutrition and exacerbates chronic conditions such as cardiovascular diseases and respiratory illnesses influenced by air quality [5]. Environmental factors are responsible for 23% of premature deaths globally, with 20% of disease incidence in Europe attributable to these exposures [6]. Given these pressing concerns, it is crucial to assess the knowledge, attitudes, and perceptions of medical students regarding climate change at Kabul University of Medical Sciences (KUMS). Understanding the views of future healthcare professionals can inform effective strategies to tackle the health challenges posed by climate change. Medical students' knowledge, attitudes, and perceptions are significantly shaped by their understanding of climate-related health impacts and environmental health principles. Awareness of both the physical and psychological effects of climate change is essential for fostering a proactive stance among these students [6]. Integrating climate change education into medical curricula can enhance their understanding and equip them with the skills necessary to address these challenges effectively.

Furthermore, knowledge of sustainable healthcare practices can encourage future physicians to adopt environmentally responsible behaviors in their medical careers [7]. Despite the critical importance of this knowledge, many medical professionals have reported inadequate training in recognizing and addressing the diverse health impacts of climate change [8]. At Harvard Medical School (HMS), efforts led by Gaurab Basu are underway to bridge this knowledge gap by incorporating climate change into medical curricula, continuing education, and public discourse [9]. These initiatives build on the pioneering work of the Center for Climate, Health, and the Global Environment (C-CHANGE), founded by HMS alumnus Eric Chivian [9].

By integrating climate change into medical education, these efforts aim to prepare future healthcare professionals to effectively confront the health challenges posed by our changing climate.

Materials and Methods

Research Design: This study employed a cross-sectional research design utilizing an online survey questionnaire to assess the knowledge, attitudes, and perceptions of medical students regarding climate change.

Research Setting: The research was conducted at Kabul University of Medical Sciences (KUMS), Abu Ali Ibn Sina, Afghanistan. The online survey ensured accessibility and convenience for participants

Research Period: Data collection took place over approximately one month, from November 2023 to December 2023.

Study Population: The statistical population consisted of all medical students enrolled at KUMS. A sample was selected from this population to participate in the study.

Eligibility Criteria

Inclusion Criteria: Medical students aged 16 to 28.

Exclusion Criteria: Participants who refused to sign the informed consent form or submitted incomplete questionnaires (less than 50% completed) were excluded.

Sample Size Determination and Sampling Technique

The sample size was calculated using an online sample calculator based on the Cochran formula. With a population size of 3,761 undergraduate students, a 95% confidence level, and a 4% margin of error, a minimum sample size of 350 was determined. Convenience sampling was employed, with participants randomly selected.

Research Tool: A previously validated questionnaire was utilized, consisting of two sections: demographic information (gender, marital status, age) and 24 questions assessing knowledge, attitudes, and perceptions regarding climate change.

Data Analysis Procedures

Socio-demographic data were treated as independent variables, while knowledge, perception, and attitude scores were dependent variables. Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS, Version 22).

Descriptive statistics, including frequencies and percentages, were utilized to present findings in tables and charts.

Ethical Statement: The study received approval from the relevant committees at KUMS.

Participants were informed about the study's significance and provided with anonymous questionnaires to ensure confidentiality and ethical compliance. Participation was voluntary, and informed consent was obtained from all participants.

Result

Background characteristics of the respondents*:* Out of the 350 medical students who received the questionnaire, 300 completed and returned it, yielding a response rate of 85.71%. Among the respondents, 254 (84.7%) were male, with an average age of 21.47 years (±1.87). Participants were distributed across various faculties: 105 (35%) from Medicine, 103 (34.3%) from Public Health, 59 (19.7%) from Nursing, 19 (6.3%) from Dentistry, 11 (3.7%) from Allied Health, and 3 (1%) from Midwifery. Regarding marital status, the majority of participants (286, 95.3%) were single. The household size among respondents varied, with a minimum of 2 and a maximum of 22 members, resulting in a mean household size of 8.85. Further details about the demographic characteristics of the participants are presented in Table 1.

Table 1. Socio-demographic and professional characteristics of respondents.

Variable	Information	Frequency	Percentage
Sex	Male	254	84.7
	Female	46	15.3
Marital Status	Single	286	95.3
	Married	14	4.7
Faculties'	Medicine	105	35
	Public Health	103	34.3
	Nursing	59	19.7
	Dentistry	19	6.3
	Allied Health	11	3.7
	Midwifery	3	1

Source of Information	School/University	89	29.7
	Radio/TV	66	22
	Internet	60	20
	Social Media	43	14.3
	Print Media	9	3
	Other	33	11
Parent Occupation	Formal employment	69	23
	Informal Employment	182	60.7
	Unemployment	49	16.3
Parent Educational level	None/primary level	196	65.3
	Secondary	27	9
	Tertiary	77	25.7

Self-Perceived Knowledge Adequacy on Climate Change

The majority of respondents (83.3%) reported having sufficient knowledge about climate change and its causes. In contrast, 16.7% expressed uncertainty or acknowledged inadequate knowledge in this area.

Students' Knowledge on Climate Change

When questioned about climate change, students demonstrated strong awareness of several key aspects. Specifically, 96.7% recognized that forests play a crucial role in mitigating climate change by decreasing the concentration of greenhouse gases (GHGs) in the atmosphere.

Additionally, 91.3% correctly identified the emission of GHGs into the atmosphere as a primary driver of climate change. However, knowledge regarding greenhouse gases was relatively weaker, with only 90.3% of students correctly identifying carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) as greenhouse gases. Overall, students achieved an average knowledge score of 87.34% on climate change (Table 2).

Table 2: Students' Knowledge on Climate Change.

Statement	True(%)	False (%)
Climate change can be identified by changes in the mean or variability of its properties persisting for decades or longer.	77.7	22.3
Carbon dioxide (CO_2) is the principal greenhouse gas.	80.7	19.3

Methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O) are all greenhouse gases.	90.3	9.7
Emission of greenhouse gases (GHGs) into the atmosphere is responsible for climate change.	91.3	8.7
Forests can reduce climate change by decreasing the amount of GHGs in the atmosphere.	96.7	3.3

Students' Perception of Climate Change

Among students, there was a strong consensus regarding perceptions of climate change. A significant majority (97.3%) acknowledged its reality, while 96.3% recognized its potential impact on key sectors, including the environment, human health, food security, natural resources, and physical infrastructure. However, students demonstrated a relatively lower understanding of the link between climate change and the increased incidence of food-borne and waterborne diseases, such as diarrhea, with only 88% perceiving this connection (Table 3). The overall score for students' perception of climate change was 93.25%.

Table 3: Students' Perception of Climate Change

Statement	True (%)	False (%)
Climate change is real.	97.3	2.7
Climate change will affect key sectors such as environment, human health, food security, and natural resources.	96.3	3.7
Climate change will increase the incidence of flooding, fire, and drought.	93.3	6.7
Education can play a major role in mitigating the effects of climate change.	91.3	8.7
Climate change will increase the incidence of food-borne and waterborne diseases, such as diarrhea.	88.0	12.0
Human activities are responsible for 21st-century climate change.	93.3	6.7

Students' Attitude towards Climate Change Issues

The overall score for students' attitudes towards climate change issues was 86.2%.

Questions that received attitude scores above 80% indicated a generally positive stance among students. Notably, 96.7% expressed a willingness to plant trees as a means to mitigate the impacts of climate change. Similarly, 95.3% demonstrated readiness to use public transport for this purpose. Furthermore, 93.3% were willing to reduce energy consumption, 89.3% showed openness to joining climate change advocacy groups, and 86% expressed a desire to learn more about climate change. Additionally, 85.3% indicated a willingness to pay more for cleaner and environmentally-friendly energy sources to help mitigate climate change impacts (Table 4).

Table 4: Students' Attitude towards Climate Change Issues

Statement	Agree (%)	Disagree (%)
I am willing to plant trees to mitigate climate change.	96.7	3.3
I am ready to use public transport to reduce my carbon footprint.	95.3	4.7
I will reduce my energy consumption to help combat climate change.	93.3	6.7
I am open to joining climate change advocacy groups.	89.3	10.7
I am prepared to learn more about climate change.	86.0	14.0
I am willing to pay more for cleaner, environmentally-friendly sources of energy.	85.3	14.7

DISCUSSION

The present study aimed to investigate the knowledge, attitude, and perception of climate change among the students of Kabul University of Medical Sciences. The findings provide valuable insights into students' awareness and attitudes towards climate change, which can be interpreted in the context of previous research. In our study, the primary sources of information about climate change among students were schools and universities, followed by radio and television. This finding aligns with the study conducted by Rufi et al., which also identified schools and universities as the main sources of climate change information for students [4]. Similarly, a majority of students in our study regarded climate change as a factual phenomenon, consistent with Rufi et al.'s findings that most students acknowledged climate change as an established reality [4]. The results of our study align with previous research indicating a high level of knowledge among university students regarding climate change [5]. Most students claimed to possess sufficient knowledge about climate change and its causes. However, specific knowledge concerning greenhouse gases, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), was notably weaker.

This knowledge gap warrants attention; recent studies, such as that by Smith and Leiserowitz (2020), highlighted the necessity for targeted education on greenhouse gas emissions and their impacts. Our findings indicated a strong consensus among students regarding the reality of climate change and its potential impacts across various sectors [6]. However, there was a comparatively lower understanding of the association between climate change and the increased incidence of food-borne and waterborne diseases. Recent studies have explored climate change perceptions among different demographics, revealing the importance of understanding public attitudes to effectively communicate climate change risks and initiate behavioral changes. For instance, Dixon, McAndrew, and Horton (2021) reviewed global public opinion literature on climate change, emphasizing the need for effective communication strategies [7]. The positive attitudes expressed by students in our study towards climate change issues are consistent with previous research [8]. Many students demonstrated a willingness to engage in climate change mitigation efforts, such as tree planting, using public transport, and reducing energy consumption. Research has shown that educational initiatives significantly influence attitudes towards climate change. For example, Wang, Cui, and Yao (2021) conducted a comprehensive review highlighting the critical role of education and awareness campaigns in fostering positive attitudes and encouraging sustainable behaviors among college students in China [14].

Additionally, studies from various contexts, including Germany and Ethiopia, have underscored the importance of integrating climate change education into medical curricula to enhance awareness and adaptive practices among future healthcare professionals [15][16][17].

Furthermore, findings from Ofori et al. (2023) indicate that undergraduate students in Ghana also possess a strong desire to address climate change, aligning with our results [19].

Similarly, the work of Odonkor et al. (2020) highlights the knowledge, attitudes, and adaptation strategies of students in Ghana, reinforcing the necessity for targeted educational interventions [20]. In summary, while our study indicates a generally high level of awareness and positive attitudes towards climate change among students, there remains a critical need for targeted educational efforts to address specific knowledge gaps, particularly concerning greenhouse gases and their health impacts. This reflects the findings of Haq and Ahmed (2020), who reported similar gaps in understanding among university students in Bangladesh [18].

Engaging students through practical initiatives and integrated curricula can empower them to be effective advocates for climate action.

CONCLUSION

This study reveals a relatively high level of knowledge and awareness among medical students regarding climate change. However, there remains significant room for improvement, particularly in understanding the connections between climate change and health-related issues.

These findings contribute to the existing body of knowledge on climate change education and highlight the necessity for targeted interventions aimed at enhancing students' understanding and engagement with climate change issues. By addressing these gaps, educational institutions can better prepare future healthcare professionals to advocate for and implement strategies that mitigate the impacts of climate change on public health.

*R*ecommendations

- Expand research to diverse student populations for a broad understanding of climate change knowledge and attitudes.
- Integrate climate change into curricula and promote interdisciplinary collaboration for holistic education.

Limitations of the Study

- Generalizability: This study was conducted at Kabul University of Medical Sciences (KUMS), which may limit the generalizability of the findings. Caution is advised when extrapolating these results to other contexts with different demographic and cultural characteristics. Additionally, the use of self-administered questionnaires may introduce a declaration bias, potentially affecting the reliability of the quantitative assessments of students' knowledge, attitudes, and perceptions toward climate change.

Conflicts of Interest

The author(s) declare(s) that there are no conflicts of interest regarding the publication of this paper.

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