Euras J Fam Med 2026;15(2):86-96. doi:10.33880/ejfm.2026150202 **Original Research**

Medical Students' Perspectives on Climate Change and Health: Is It Only the Climate That Is Changing?

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ABSTRACT

Aim: To examine medical students' perspectives on the relationship between climate change–health, their ability to recognize climate-sensitive diseases, and their interest in receiving education on this topic.

Methods: This descriptive, cross-sectional study was conducted among first- and sixth-year medical students at Marmara University during the 2024–2025 academic year. Data were collected via a 16-item online questionnaire between April and June 2025 covering socio-demographic characteristics, perceptions of climate-related health threats, awareness of climate-sensitive diseases, and views on curriculum integration.

Results: Of the 217 respondents (response rate: 46.6%), 66.8% were female. Most participants stated that climate change threatens human, animal, and environmental health and increases pandemic risk. Moderate climate anxiety was reported by 69.1%. Students most frequently associated climate change with skin cancers, respiratory and infectious diseases, and injuries/deaths due to extreme weather events, while cardiovascular diseases and malnutrition were less recognized. Among vector-borne diseases, malaria, Crimean-Congo haemorrhagic fever, and West Nile virus infection were the most identified. Sixth-year students more often recognized certain low-endemic diseases. Female students reported higher climate anxiety while male students were less willing to receive training. Of the participants, 76.9% expressed interest in climate change–health education, and 57.1% preferred mandatory integration into the curriculum.

Conclusion: Climate change–health education that reflects national risks and does not impose additional burden on the existing curriculum should be integrated into medical education. Family medicine academics can play a leading role in this process.

Keywords: climate change, family practice, medical education, curriculum, medical students, vector-borne diseases

Date of submission: 24.10.2025 / **Date of acceptance:** 08.06.2026

How to cite: Sahin S. Medical students' perspectives on climate change and health: is it only the climate that is changing?. Euras J Fam Med 2026;15(2):86-96. doi:10.33880/ejfm.2026150202.

Conflict of interest: No conflict of interest was declared by the authors.
Financial disclosure: No financial disclosure was declared by the authors.

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Introduction

Climate change is defined as persistent alterations of temperature and typical weather patterns over periods spanning several decades or longer. Although such changes may result from natural processes, there is now robust evidence that anthropogenic activities (combustion of fossil fuels, large-scale deforestation, industrial processes etc.) are the principal driver of current global warming, which is the most significant and widely recognized component of climate change. Global surface temperatures during 2011–2020 were approximately 1.1°C higher than 1850–1900, a rise directly attributable to human influence. Building on this, the 2015 Paris Agreement set the target of limiting the increase in global mean temperature to no more than 1.5°C above pre-industrial levels. However, findings from a recent report demonstrate that this threshold is being rapidly approached. In 2023, the annual global mean surface temperature reached 1.45°C above the pre-industrial baseline—the highest level recorded to date—followed by further exceptional temperature extremes in 2024. This anthropogenic warming is already evident in widespread changes in weather and climate extremes across all regions of the globe. The resulting impacts are profound, encompassing threats to food and water security, adverse health outcomes, economic disruption, and extensive damage to ecosystems (1,2).

The World Health Organization (WHO) has identified climate change as the greatest threat to public health in the 21st century. It is projected that it will cause approximately 250.000 additional deaths annually between 2030 and 2050, primarily due to malnutrition, heat stress, and vector-borne diseases. Climate change represents a multifaceted public health challenge, exerting both direct and indirect effects on human health. Currently, an estimated 3.6 billion people reside in regions highly vulnerable to its impacts. Direct health impacts include increased morbidity and mortality from extreme weather events such as heatwaves, floods, wildfires, and storms. For example, heat-related deaths among individuals aged 65 years and older have increased by 70% over the past two decades. Indirect effects are mediated through ecological disruption and altered interactions between humans, domestic animals, and wildlife, facilitating the emergence and spread of zoonotic diseases. Climate change also amplifies the transmission of water-, food-, and vector-borne infectious diseases. At present, vector-borne diseases account for more than 700.000 deaths annually. Air pollution, further exacerbated by climate change, increases the incidence of respiratory, cardiovascular, and allergic conditions. It is estimated 7 million premature deaths annually are attributable to air pollution exposure—making it the leading environmental risk factor worldwide. Moreover, reduced access to safe food and water undermines nutrition and food security, with approximately 2 billion people lacking access to safe drinking water and 600 million experiencing foodborne illness each year. Beyond infectious disease risks, climate change affects mental health both directly, through extreme weather events causing stress, anxiety, and post-traumatic stress disorder, and indirectly via physical injuries, disrupted livelihoods, displacement, poverty, unemployment, and housing insecurity. Furthermore, climate change disproportionately affects vulnerable groups—such as women, children, older adults, ethnic minorities, low-income communities, migrants, and those with pre-existing conditions—who often have limited resources (3-8). According to the Global Risks Report 2025, the health impacts of climate change are accelerating at an unprecedented pace (9).

Therefore, integrating the health impacts of climate change into medical education has become an urgent priority. Future physicians will increasingly encounter patients whose conditions are directly or indirectly shaped by climate-related factors. They must therefore be equipped to recognize and address these health effects in patient care management. Introducing climate and health content early in the curriculum can help train physicians to safeguard patients from the adverse health consequences of climate change. In this context, medical schools have a clear responsibility to prepare the next generation of doctors to practice effectively in the context of a rapidly changing climate (10-14). However, evidence

suggests that only a limited number of medical schools currently incorporate climate and health education, either as mandatory components of the curriculum or as elective courses. Moreover, fewer studies have been conducted among medical students compared with those in other health sciences, and medical students often report lower levels of concern regarding this issue (15-17).

As a developing country, Türkiye faces significant climate-related risks that are expected to increase in the coming decades (18). Nevertheless, the national medical education curriculum does not currently require the inclusion of climate change and its health impacts. The aim of this study is to explore the perspectives of first- and sixth-year medical students at Marmara University School of Medicine in Istanbul regarding the relationship between climate change and health, to assess their ability to recognize climate-sensitive diseases, and to evaluate their interest in receiving further education on this topic.

Methods

This descriptive, cross-sectional study included students enrolled in either the first or sixth year at Marmara University School of Medicine during the 2024–2025 academic year. First-year students were chosen to capture the perspectives of individuals who had only recently entered medical school, providing insights into their motivations and expectations regarding the profession. Sixth-year students, by contrast, had completed most of their education and clinical training and were therefore able to critically reflect on the curriculum and highlight potential gaps in climate change and health education. As the study sought to include the entire population of 466 students, no sample size calculation was conducted. All students were invited to participate, and recruitment was carried out using a convenience method. While this approach does not guarantee representativeness, it is commonly employed in exploratory research. A questionnaire was developed by the author following a comprehensive review of the literature and underwent multiple revisions. A web-based format was selected to minimize researcher influence and increase the objectivity of responses. The first page of the survey presented an informed consent form, which explained the purpose of the study and invited participation. Participation was voluntary, and responses were collected anonymously. Students were assured that their participation or non-participation would not affect their course grades or academic evaluation. The survey link and a QR code were shared with students via digital platforms, including email and WhatsApp. Data collection was conducted between April and June 2025, with three reminders sent at regular intervals over the nine-week period.

The questionnaire consisted of 16 items: The first three questions collected socio-demographic characteristics; the next four multiple-choice questions assessed students' basic knowledge and perceptions regarding climate change. Two subsequent questions explored students' ability to identify risk factors resulting from climate-related exposures and link specific diseases or medical conditions to climate change. For these questions, participants were permitted to select multiple options. Heatwaves were placed separately from other extreme weather events due to their increasing public health significance in the context of global warming and an aging population. Because vector-borne diseases are among the health outcomes most frequently linked to climate and weather variability, the questionnaire included an item assessing students' ability to recognize such diseases (5,19,20). The list of options comprised diseases that are either endemic to Türkiye, frequently covered in international media recently, or historically significant for the medical profession. Eco-anxiety was evaluated through a single question that categorized responses into little-to-no, moderate, or high levels of anxiety. Adaptation to climate change was assessed with one item asking whether students believed that, if the current lifestyle is maintained, human, animal, and environmental health could adapt to the effects of climate change. The final two questions asked whether students supported integrating climate change and health topics into the medical school curriculum and whether they were personally interested in learning more about this subject.

Survey responses were automatically captured on

the online platform and subsequently exported to Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Following data quality checks and necessary adjustments, statistical analyses were conducted using R Commander (v4.5.1). Age was summarized as mean±standard deviation, and categorical variables as counts and percentages. Chi-square and Fisher's exact tests were used for categorical comparisons. Binary logistic regression identified predictors of willingness to receive climate and health education. A p-value <0.05 was considered statistically significant.

The study was conducted in accordance with the ethical standards of the Declaration of Helsinki. Ethical approval was obtained from the Marmara University Ethics Committee for Non-Drug and Medical Device Research, Protocol code: 09.2025.25-0186.

Results

A total of 217 students participated in the study (overall response rate 46.6%), with the majority being female (66.8%). The response rate was 57.7% (n=142) for first-year students and 34.1% (n=75) for sixth-year students. Their mean ages were 19.3±0.9 and 24.5±1.05 years, respectively. The majority reported moving from outside Istanbul or the Marmara region to pursue medical education, while only a small number (n=5) had relocated from rural areas to the metropolitan city of Istanbul. Nearly 90% of participants provided the correct definition of climate change. The vast majority agreed that climate change poses a threat to human, animal, and environmental health (94%), increases the risk of future epidemics and pandemics (90.8%), and will expose physicians to diseases that are either unfamiliar or rarely encountered (92.6%). Regarding the psychological impact, 69.1% of students reported experiencing moderate level anxiety about climate change - indicating concern without disruption to daily life- while 12.4% reported little to no anxiety. When asked whether human, animal, and environmental health could adapt to the effects of climate change if current lifestyles persist, 31.8% of students responded affirmatively, whereas 45.6% believed that adaptation and mitigation strategies would be needed. Furthermore, 76.9% of students expressed interest in receiving training on the health impacts of climate change, whereas 23.1% did not. Concerning medical education, more than half of the participants (57.1%) supported the inclusion of climate and health content as a mandatory part of the curriculum, while 35.1% preferred it to be offered as an elective. No statistically significant differences were observed between first- and sixth-year students across the measured variables (Table 1).

Table 1. Socio-demographic characteristics, climate change and health perspectives, and educational preferences among 1st- and 6th-year medical students

	1st-year n (%)	6th-year n (%)	Total n (%)
Gender			
Female	97 (68.3)	48 (64)	145 (66.8)
Male	42 (29.6)	27 (36)	69 (31.8)
Other	3 (2.1)	-	3 (1.4)
Did you come from outside the city to study at a medical school in Istanbul?			
Yes	104 (73.2)	44 (58.7)	148 (68.2)
No	38 (26.8)	31 (41.3)	69 (31.8)
If your answer is yes, which region is the city you came from located in? (% out of 'yes')			
Marmara	37 (35.6)	11 (25)	48 (32.4)
Southeast Anatolia	20 (19.2)	2 (4.5)	22 (14.9)
Eastern Anatolia	6 (5.8)	5 (11.4)	11 (7.4)
Central Anatolia	7 (6.7)	1 (2.3)	8 (5.4)
Black Sea	6 (5.)	4 (9.1)	10 (6.7)
Aegean	14 (13.5)	4 (9.1)	18 (12.2)
Mediterranean	11 (10.6)	15 (34.1)	26 (17.6)
Missing	3 (2.9)	2 (4.5)	5 (3.4)
Which of the following best describes the place where you have lived the longest?			
City center	106 (74.6)	61 (81.3)	167 (76.9)
Town	31 (21.8)	14 (18.7)	45 (20.7)
Village/rural	5 (3.5)	-	5 (2.3)
What is global climate change? (% of correct vs incorrect)			
Correct	124 (87.3)	70 (93.3)	194 (89.4)
Incorrect	18 (12.7)	5 (6.7)	23 (10.6)
Do you think climate change poses a threat to human, animal, or environmental health?			
Yes	133 (93.7)	71 (94.7)	204 (94)
No	6 (4.2)	-	6 (2.8)
I do not know	3 (2.1)	4 (5.3)	7 (3.2)
Do you think climate change will increase the risk of epidemics/pandemics in the future?			
Yes	126 (88.7)	71 (94.7)	197 (90.8)
No	5 (3.5)	-	5 (2.3)
I do not know	11 (7.7)	4 (5.3)	15 (6.9)
Do you think climate change will lead physicians to face diseases they are unfamiliar with or rarely encounter more often in the future?			
Yes	131 (92.3)	70 (93.3)	201 (92.6)
No	4 (2.8)	1 (1.3)	5 (2.3)
I do not know	7 (4.9)	4 (5.3)	11 (5.1)

Table 1. (Continued)

Do news and scientific reports about climate change increase your level of anxiety or stress?			
Yes, I feel a serious level of anxiety	24 (16.9)	16 (21.3)	40 (18.4)
Yes, but it does not affect my daily life	99 (69.7)	51 (68)	150 (69.1)
No, I do not feel anxious about climate change	19 (13.4)	8 (10.7)	27 (12.4)
If we as human beings continue our current lifestyle, do you think human, animal, and environmental health will be able to adapt to the effects of climate change?			
Yes	44 (31)	25 (33.3)	69 (31.8)
No	66 (46.5)	33 (44)	99 (45.6)
I do not know	32 (22.5)	17 (22.7)	49 (22.6)
Do you think the health effects of climate change should be included in the medical education curriculum?			
Yes	75 (52.8)	49 (65.3)	124 (57.1)
No	10 (7)	7 (9.3)	17 (7.8)
Only as an elective course	57 (40.1)	19 (25.3)	76 (35.1)
Would you like to receive training on the health effects of climate change?			
Yes	107 (75.4)	60 (80)	167 (76.9)
No	35 (24.6)	15 (20)	50 (23.1)
Total n (%)	142 (65.4)	75 (34.6)	217 (100)

Students were asked which risk factors they considered to be associated with climate change and its effects on health. The most frequently recognized was extreme weather events, identified by more than 80% of students in both groups. Air pollution, access to safe drinking water, spread of vectors carrying diseases and heatwaves were identified as the key concerns (Figure 1).

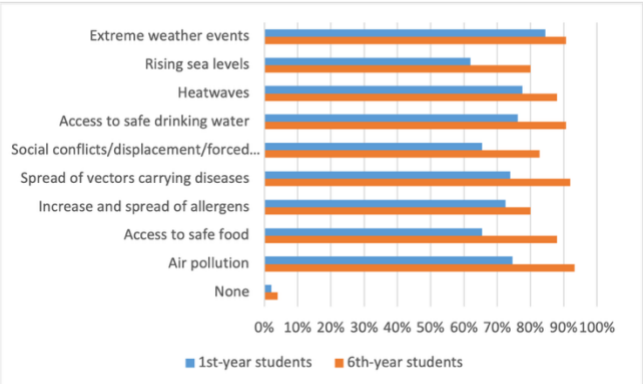


Figure 1. Distribution of responses from 1st- and 6th-year medical students regarding risk factors associated with climate change and its health impacts

When asked about specific health outcomes associated with climate change, the most frequently identified conditions included skin cancers, respiratory diseases, infectious diseases, and injuries/deaths due to extreme weather events. Cardiovascular diseases and nutritional deficiencies were the least frequently recognised. Across all categories, sixth-year students reported higher recognition rates compared with first-year students (Figure 2).

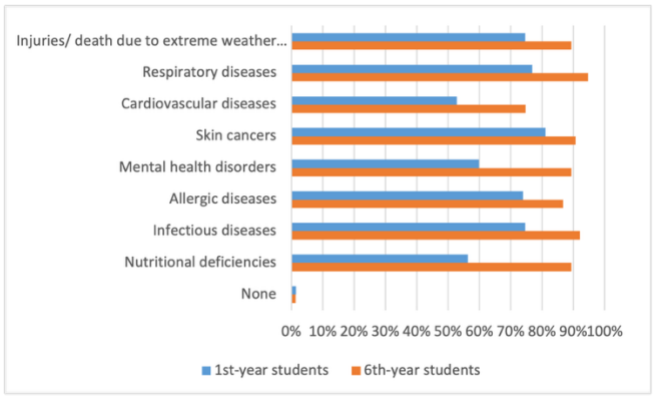


Figure 2. Distribution of responses from 1st- and 6th-year medical students regarding health outcomes associated with climate change

In the third question of the climate-sensitive diseases section, students were asked to identify vector-borne infectious diseases from a provided list. Overall, malaria, Crimean-Congo haemorrhagic fever (CCHF), West Nile virus infection, and Lyme disease were the most frequently recognized, whereas bubonic plague, a historically significant vector-borne disease, and tularaemia were the least recognized. Notably, among sixth-year medical students, malaria, and Lyme disease (low-endemicity in Türkiye) were identified as vector-borne more frequently than CCHF, leishmaniasis, and tularaemia, all of which are highly endemic in the country (Figure 3).

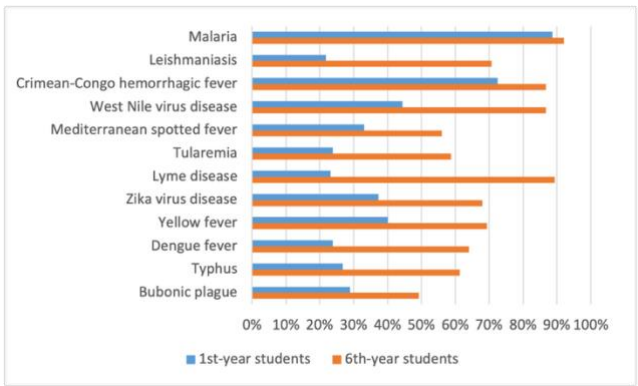


Figure 3. Distribution of responses from 1st- and 6th-year medical students regarding vector borne diseases

For the purpose of analyzing the association between gender and selected variables, responses coded as 'other' in the gender question were excluded, and gender was dichotomized as female and male. Although the proportion of students reporting moderate levels of climate anxiety was similar across first and sixth grades, women more frequently reported high levels of anxiety compared to men. With respect to willingness to receive education on climate and health, men were significantly less willing than women. When the relationship between climate anxiety and support for curricular integration was examined, a clear trend emerged: as the level of anxiety increased, the proportion of students agreeing that climate change and health should be part of medical education also increased. Similarly, when willingness to receive such education was assessed, the vast majority of students with climate anxiety (both moderate and high levels) expressed interest (~81%). However, among students with little-to-no anxiety, the opposite pattern was observed—more than half (51.9%) reported that they did not wish to receive this education (Table 2).

Given that gender was found to be associated with both climate anxiety and willingness to receive education, a regression analysis was performed. The results indicated that climate anxiety significantly influenced students' willingness to receive education. Students with little-to-no climate anxiety were significantly less likely to express willingness compared to those with moderate anxiety (OR=0.26, 95% CI:0.11–0.64, p=0.002). However, no significant difference was observed between students with high-level anxiety and those with moderate-level (OR=1.03, 95% CI:0.39–2.62, p=0.945). The effect of gender was not statistically significant (female vs. male, OR=1.82, 95% CI:0.93–3.57, p=0.088), suggesting that gender does not act as a confounding factor in this relationship. These findings indicate that climate anxiety is an independent determinant of motivation to receive education, underscoring the importance of addressing students' climate-related concerns within medical education curricula.

Table 2. Association of gender and climate anxiety levels with willingness to receive education and preferences for curriculum integration

	Climate anxiety			p value
Gender	Little-to-no-level	Moderate-level	High-level	X^2=12.172 p=0.002
Female	12 (8.3)	99 (68.3)	34 (23.4)	
Male	15 (21.7)	48 (69.6)	6 (8.7)	
Willingness to have education				
Gender	Yes	No		X^2=5.652 p=0.02
Female	118 (81.4)	27 (18.6)		
Male	46 (66.7)	23 (33.3)		
Integration to curriculum				
Climate anxiety	Yes	No	Elective	
Little-to-no-level	9 (33.3)	7 (25.9)	11(40.7)	X^2=22.452 p<0.001
Moderate-level	85 (56.7)	7 (4.7)	58 (38.7)	
High-level	30 (75)	3 (7.5)	7 (17.5)	
Willingness to have education				
Climate anxiety	Yes	No		
Little-to-no-level	13 (48.1)	14 (51.9)		X^2=14.494 p=0.002
Moderate-level	121 (80.7)	29 (19.3)		
High-level	33 (82.5)	7 (17.5)		

Discussion

Climate change is recognized as the greatest global threat of the 21st century. In this study, most students correctly defined climate change, acknowledged its risks to human, animal, and environmental health, and recognized its potential to increase epidemics and expose physicians to unfamiliar diseases, consistent with prior national (21-25) and international findings (16,26,27). From a general health sciences perspective, a recent review highlighted that students were generally aware of the health consequences of climate change and acknowledged its importance for their profession, fewer studies have been conducted among medical students, who remain uncertain about their professional responsibilities (17). Therefore, the mere implementation of this study may have contributed to exposing first-year students to the topic of health and climate at an early stage, while also enabling final-year

students to broaden their perspectives.

In the present study, female students compared to their male peers participated at higher rates and reported greater levels of climate anxiety as well as a stronger willingness to receive education on climate change and health. Similarly, the literature indicates that women are generally more likely to participate in such studies (28-32) and tend to demonstrate higher levels of awareness about climate change, greater knowledge of the climate–health relationship, increased levels of concern, and stronger educational demands (28,29,31,33). No significant differences were observed between junior and senior students in our study, regarding perceived health risks of climate change and educational preferences, a finding that is consistent with previous research (22,26,28). However, in contrast to our results, some studies have reported that students in more advanced years of medical education expressed a greater willingness to receive training on this subject (25). The consistently higher awareness and educational demand among female students suggest that they may show greater intrinsic interest in climate change and health topics. Universities might therefore consider prioritizing women as a target group for the initial implementation of educational initiatives in this area. Although male students may be less likely to engage initially, their interest may increase over time through peer interaction and shared educational environments.

It is anticipated that changing climate and weather conditions will increase the incidence of many diseases, either directly or indirectly. In this study, students most often linked extreme weather, air pollution, unsafe water, disease-carrying vectors, and heatwaves to health impacts. They most identified skin cancers, respiratory and infectious diseases, and weather-related injuries/deaths, while cardiovascular diseases and nutritional deficiencies were less noted. Studies in Türkiye show regional differences: medical students in Eastern Anatolia are most recognized air-pollution-related respiratory diseases and skin cancers, while Aegean students associated climate change more with food shortages, waterborne, and respiratory diseases (30,33). Students in this study linked air pollution to respiratory diseases but rarely to cardiovascular diseases, and they associated climate change less frequently with food security or malnutrition. Similarly, a study in India found that while cardiovascular and respiratory diseases were widely recognized, only half of the students noted malnutrition as a climate-related health outcome (32). These findings indicate that medical students recognize the health impacts of climate change but have a limited understanding of climate-sensitive diseases, particularly regarding food safety and chronic condition exacerbation.

Vector-borne diseases are well-studied climate-sensitive conditions and Türkiye, situated in the temperate–subtropical transition zone, faces moderate-to-high risk from mosquito-, tick- and sandfly-borne infections (18,19,20,34). In this study, malaria, CCHF, West Nile virus infection, and Lyme disease were most frequently identified in general. Notably, senior medical students more often recognized low-endemic vector-borne diseases than highly endemic conditions. Although no directly comparable literature was found regarding this finding, it is important to emphasize that countries should conduct risk assessments considering their specific climatic and geographic characteristics (35). These assessments can help determine which topics should be prioritised in medical education. This approach will ensure that future health professionals are well-equipped and prepared to address the climate-sensitive diseases expected to increase the most.

Climate change affects mental health through multiple pathways (8). In this study, most students reported moderate climate anxiety—concern that does not disrupt daily life—which influenced their motivation for climate-health education. National and international studies report similar trends, showing high eco-anxiety among medical students. However, some studies suggest that a certain degree of stress does not necessarily lead to depressive or anxious symptoms (16,33,36,37). According to a review, moderate ecological worry is an adaptive response. Regular concern about environmental issues can be healthy, enhancing awareness, preparation, and

proactive action, and becomes problematic only if it disrupts daily life (7).

Integrating climate and health topics into the medical curriculum is now widely recognized as essential. In the present study, 77% of students expressed willingness to receive climate-health training, with 57% supported mandatory inclusion and 35% elective. Similarly, two national studies among medical students reported that approximately 80% believed integrating climate and health topics into medical curricula would be both beneficial and necessary (29,33). In a German study, 79.4% of students supported teaching about climate change and its curricular integration (31). In Italy, 99.3% of medical students considered the climate crisis an important and urgent issue for human health (16). In the United States, students suggested adding climate and health content in the first year of medical school but noted challenges in fitting it into an already dense curriculum. They also expressed concern that offering it as an elective might imply it is non-essential and limit exposure (38). Overall, medical students support integrating climate change and health topics, though debates continue over whether they should be mandatory or elective. Undoubtedly, recent epidemics and the growing health impacts of climate change underscore the need to address this issue in medical education. Medical schools could initiate programs that provide basic knowledge of the science of climate change at varying intensities in their medical curriculum (12). One approach could be to expand existing courses on certain diseases to include a climate change perspective (38). Alternatively, climate change and health education could be integrated longitudinally across the medical curriculum (16). In this context, Family Medicine can play a key role. The 2023 revision of the World Organization of Family Doctors (WONCA) iconic 'tree' model recognized One Health, Planetary Health, and Sustainability as foundational values of Family Medicine/General Practice (39,40). These updated principles acknowledge the interconnectedness of human, animal, and environmental health and highlight the responsibility of family physicians in addressing climate-driven health challenges.

Limitations:

This study has several limitations. Because first-year students were expected to progress in their learning over time, and data collection was scheduled before the examination period for all participants, the survey had to be administered within a limited timeframe. Consequently, the online survey achieved a response rate of 46.6%. Although the target population was not fully reached, a recent meta-analysis reported an average response rate of 44.1% for online surveys, indicating that our rate is comparable (41). As noted earlier, consistent with findings in the literature, the results are more representative of female students. Furthermore, as the study was conducted at a single institution, the findings may have limited generalizability. In the absence of standardized climate and health education in undergraduate medical curricula in Türkiye, multiple-choice questions were chosen as an approach that serves the aim of the study. Additionally, climate anxiety was assessed using a single multiple-choice question rather than a validated scale to shorten survey completion time. This approach may not have fully captured participants' levels of eco-anxiety. As with all self-report surveys, the accuracy of responses cannot be ensured, and self-reporting bias is possible. Nevertheless, this study provides valuable insights into the integration of climate change and health into the medical curriculum. Few national studies have examined how students link climate change to specific diseases in clinical practice, and none have focused on vector-borne diseases, underscoring the study's unique contribution.

Conclusion

Medical students are aware that climate change poses a significant threat to health. However, there is an educational gap in linking this threat to diseases encountered in direct clinical practice. This awareness, and the concern it generates, should be viewed as an opportunity to foster interest in climate and health education. Given that climate change threatens public health in diverse ways, it should be addressed

considering each country's specific conditions, risks, and priorities. Integrating this topic into medical education is undoubtedly necessary; however, solutions should be sought that do not overburden the already intensive curriculum.

With their community-oriented perspective and holistic approach —considering both social and environmental determinants of health— Family Medicine academics are well positioned to lead the integration of climate change and health content into medical curricula.

Acknowledgements

The data collected from first-year students in this study were used as part of a student assignment for the *Introduction to Research in Medical Education* course, and the students presented the results as a poster at the Marmara University Medical Student Congress (MASCO 2025, May, İstanbul).

I want to thank the first-year medical students Rana Baran, Elifnaz Çufadar, İlayda Nur Ebik, Deren Demirel, Hayrunnisa Ensari, Etem Rüzgar Anaç, as well as the sixth-year medical student Elif Nazlı Lale, for their valuable contributions in helping the author reach the target group during the data collection process.

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