

Perception of Medical Students in Spain on the Impact of Climate Change on Human Health

Percepción de los Estudiantes de Medicina en España sobre el Impacto del Cambio Climático en la Salud Humana

Diego Cantalapiedra Asúnsolo ¹, Carlos Santiago Piñel Pérez ^{2*}

¹ Medicine Student of the European University; diego151099@tmail.com

² Obstetrician and Gynecologist at Hospital Quirónsalud San José (Madrid). Associate Professor of the European University; carlos.s.pinel@gmail.com, ORCID ID: <https://orcid.org/0000-0001-6647-8718>

* Correspondence: carlos.s.pinel@gmail.com

Received: 7/11/2023; Accepted: 7/28/2023; Posted: 7/31/2023

Abstract: Background: Climate change is exponentially increasing in magnitude and importance and affects human health in different ways. Some studies have been carried out in other countries trying to see the level of knowledge and awareness about climate change that medical students have. To the best of our knowledge, no study of these characteristics has been carried out in Spain. **Objectives:** Through this study, the aim was to evaluate the knowledge and previous perceptions of medical students about the impact of climate change on health, as well as their desire to address it within the Degree in Medicine program. **Methods:** A cross-sectional study was carried out, based on the application of a questionnaire to 4th, 5th and 6th year Medicine students. An anonymous questionnaire consisting of 24 questions was sent to them. **Results:** A total of 87 students out of 90 respondents participated. 90.5% of the students indicated that climate change was something negative and 85% indicated that it had a negative impact on human health. 72.4% indicated their desire to address issues about it during their degree. **Conclusions:** Most of the participants were aware of the importance of climate change, they know its severity, as well as its causes and consequences. In addition, 72.4% of them expressed their desire to address issues on how climate change can affect human health during their medical studies.

Keywords: climate change; medical education; Medicine students; attitudes; questionnaire

Resumen: Antecedentes: El cambio climático aumenta exponencialmente de magnitud e importancia y afecta a la salud humana de diferentes maneras. Se han realizado algunos estudios en otros países tratando de ver el nivel de conocimiento y concienciación sobre el cambio climático que poseen los estudiantes de medicina. Hasta donde sabemos, no se ha realizado un estudio de dichas características en España. **Objetivos:** Mediante este estudio se pretendió evaluar los conocimientos y percepciones previas de los estudiantes de medicina sobre el impacto del cambio climático en la salud, así como su deseo de abordarlo dentro del programa del Grado en Medicina. **Métodos:** Se realizó el estudio transversal, basado en la aplicación de un cuestionario a estudiantes de 4º, 5º y 6º de Medicina. Se les envió un cuestionario de carácter anónimo formado por 24 preguntas. **Resultados:** Participaron un total de 87 alumnos de 90 encuestados. El 90,5% de los estudiantes indicó que el cambio climático era algo negativo y el 85% indicó que tenía un impacto negativo sobre la salud humana. El 72,4% indicó su deseo por abordar temas sobre éste durante la carrera. **Conclusiones:** La mayoría de los participantes estaban concienciados sobre la importancia que tiene el cambio climático, conocen su gravedad, así como sus causas y consecuencias. Además, el 72,4% de ellos, mostró su deseo por abordar temas sobre cómo el cambio climático puede afectar a la salud humana durante la carrera de medicina.

Palabras clave: cambio climático; educación médica; estudiantes de medicina; actitudes; cuestionario

1. Introduction

Climate change is a global problem that is increasing in magnitude and importance on a daily basis. In 2015, the World Health Organization (WHO) declared climate change the greatest threat to global health in the 21st century. It is estimated that, between 2030 and 2050, it will cause around 250,000 additional deaths each year due to its consequences (1).

Today, some of its effects can already be observed in hospitals and health centers in different countries around the globe. Currently 23% of premature deaths worldwide are due to environmental factors and in Europe 20% of the total incidence of diseases is due to these exposures (2). Climate change will affect health in very different ways: Producing the triggering of great droughts and natural disasters, generating heat waves and other extreme weather events, causing potential outbreaks of known and unknown diseases, generating malnutrition in the population, as well as classic diseases such as various types of cancer, cardiovascular diseases and other pathologies related to environmental pollution. Highlighting some of the effects that it can cause, is for example the mobilization of some species of animals, especially mosquitoes such as *Aedes aegypti*, *Culex* or *Anopheles*, which participate as vectors in the transmission of some infectious diseases such as dengue, the virus West Nile or Malaria (3-4). This will mean a new therapeutic challenge for the not too distant future in the areas closest to the equatorial strip, where these zoonoses are usually found, so that Spain, and in general the rest of the Mediterranean coast, will be one of the regions that it is anticipated to be under increased threat. Unfortunately, the latter are not the only species whose area of distribution around planet Earth will be modified. Some extremely serious and important diseases such as yellow fever (5), Ebola or leprosy, some species of parasites such as *Ascaris*, *Schistosoma*, *Fasciola* or *Echinococcus*, and some bacteria such as *Chlamydia trachomatis* or *Mycobacterium ulcerans* (6) they will also be displaced by continuous environmental changes.

At first you might think that many of these impacts are exclusive to geographic areas with limited resources, but recently we have seen some of these direct effects on human health in our own country. The most obvious of all is the sudden appearance of the SARS-COV2 pandemic in 2020, which has already caused more than 120,000 deaths in Spain at the time of writing this article (7). Shortly after, we have experienced weather-related events, such as the *Filomena* squall (8) that put the healthcare system in check due to transport difficulties, affecting, for example, the transport of obstetric emergencies and the risks derived from early postpartum hemorrhage without available treatment, or the increased risk of myocardial infarction associated with shoveling snow (9). Globally, the destruction of the ozone layer together with the increased incidence of ultraviolet rays will increase the prevalence of ophthalmological diseases such as pterygium, cataracts or glaucoma (10). Scarcity of clean water and resources and large variations in rainfall and temperatures will also worsen human fertility (11). In addition to triggering other associated health risks (12).

Health professionals must ensure the health of the population and, therefore, should have the necessary knowledge to deal with the effects of climate change on human health. Their responsibility, in this sense, ranges from healthcare medicine to political measures in public health, since the implementation of specific programs and policies is essential (13). Although all that has been said seems obvious, there is currently a gap in medical training programs regarding the influence of climate change on human health. If the doctor of the future is going to have to safely face the effects of climate change on people's health, shouldn't they be trained from the start to face such a challenge? In recent years, there has been an awakening in this regard, such that several authors have carried out research on

the degree of knowledge and perception capacity of students regarding the effects that climate change may have on human health (14-16). Other authors go a step further and begin to call for the introduction of knowledge and skills on climate change in the curriculum of health careers (17).

In 2019, the American Medical Association highlighted the importance of this aspect and decided to take measures to increase the education of doctors, starting with medical students, on the effects of climate change on human health, focusing the measures on providing basic knowledge on the science of climate change and its inherent health risks (18). It seems difficult, however, to introduce these elements into the already extensive program of medical degrees, especially in a country like Spain, where the current model tends more and more to transmit knowledge that is excessively focused on the horizon of the future MIR exam.

This fact means that, apart from considering what concepts and how they should be integrated into the curriculum of the doctor in training, it is legitimate to ask if the medical student wants to acquire this knowledge and is interested in it. What knowledge do they have about climate change? What perception do you have about its impact on human health? What relevance do you sense it has for your future work looking after people's health? In order to answer these questions and be able to establish a starting or stopping point for a potential future effort to integrate climate change concepts into medical programs, this study has been designed, based on a questionnaire that aims to find out the knowledge and perceptions *a priori* that medical students have about climate change in our center, as well as to evaluate their interest in acquiring the knowledge that will allow them to face future health challenges caused by this cause.

2. Methods

A cross-sectional study was designed based on the design and application during the 2022/2023 academic year of a questionnaire on climate change for fourth, fifth and sixth year medicine students from the European University who are studying their second cycle studies at the R ber Hospital Complex. Juan Bravo and Hospital Quir nsalud San Jos  (Madrid). For the development of the questionnaire, an adaptation of the questionnaire used by Yang et al. in their 2018 study (17), with three defined sections, with questions derived from previous literature. The first of these sections explores the general perceptions of respondents about the nature and impacts of climate change. Respondents were asked to rate their opinions on a six-point Likert scale with no neutral midpoint, in order to better capture participants' bias. In the second section, respondents were asked to identify the health impacts of climate change from a list of 10 health-related problems. These 10 aspects have been widely accepted as potentially important health impacts of climate change (19,20). The third section assesses the knowledge of the respondents about the causes of climate change. A list of four statements (21) was presented and respondents were asked to judge whether they were true or false. The study protocol was approved by the local ethics committee. All respondents gave their consent to participate in the study and participation was voluntary. The questionnaire was hosted in Microsoft Forms. One student from each of the evaluated courses was in charge of distributing the link to the questionnaire among their classmates.

The data obtained were analyzed with the statistical analysis software STATA. Knowledge of the impacts of climate change was described taking into account the total score (0-10) which reflected the total number of problems that had been correctly identified by each of the respondents. With this, the average number of problems identified was calculated. To describe knowledge of the causes of climate change, a total score (0-4) was

calculated for each of the respondents that reflected the number of causes that they were able to correctly identify. This percentage was classified in turn as "Nil" (0/4), "Poor" (1/4), "Scarce" (2/4), "Notable" (3/4) and "Complete" (4/4). In addition, the mean number of correctly identified causes was determined.

After describing the preference for addressing issues related to climate change throughout the degree according to the answers obtained in the questionnaire (yes, no, I don't care), the students were stratified into two unique groups. The first of them was the group "0" in which were all the students who had answered the options of "no" or "I don't care" in the survey. The second group ("1") was made up of the students who answered "yes" in the survey. In order to achieve the main objective, Spearman's correlation coefficient was used to analyze the association between the identification of the consequences produced by climate change and the knowledge of the causes that produce it. Student's t test was used for the comparison of two means and the ANOVA test was used for the comparison of several means.

3. Results

Participant characteristics

The survey was delivered to 90 students, of which 87 responded to the survey, so the study had a participation rate of 96.6%. The average time that the students used to complete the questionnaire was 8 minutes and 44 seconds. The baseline characteristics of the participants are summarized in Table 1. 79.1% were women. Regarding the distribution of the participating courses, 21.9% were in the fourth year of medicine, 31% in the fifth year and 47.1% were in the sixth year of medicine. Almost all of the participants rated their state of health as good (44.8%) or very good (48.3%). The mean age was 23.5 years (95%CI 23.2-23.8).

Perceived impact of climate change

58.6% of the subjects believed that climate change is controllable, compared to 17.3% who said it was uncontrollable (Table 2). Most rated it as "very bad" (56.3%) or "quite bad" (34.5%). Similarly, most of the students indicated that climate change has a negative impact on human health, considering it to be "very bad" (42.5%) or "quite bad" (42.5%) for it. Study participants were able to identify an average of 8.9 consequences, out of 10 possible, (95% CI: 8.5 - 9.3) of climate change (Table 3). The consequences that were identified by the greatest number of participants were; diseases related to air quality (97.7%), alterations in health care (95.4%) and diseases transmitted by water (94.3%). In contrast, the consequences that were identified by a smaller number of subjects were; mental health conditions (82.8%) and foodborne illnesses (82.8%).

Table 1. Demographic characteristics of the population.			
		n	(%)
Sex	Women	68	79.1
	Male	18	20.9
	Mean	Standard deviation	Confidence Interval 95%
Age	23.5	1,3	23.2 – 23.8
Course	4th	19	21.9
	5th	27	31
	6th	41	47.1
Health condition	Average	6	6.9
	Well	39	44.8
	Very good	42	48.3
	Poor	0	0

Table 2. Distribution of the variables of perception of the impact of climate change			
Variables of perceived impact of climate change		n	(%)
Climate change is controllable	Yes	51	58.6
	No	21	24.1
	Neither controllable nor uncontrollable	15	17.3
Climate change in general	Very bad	49	56.3
	Pretty bad	30	34.5
	A little bad	7	8
	A little good	1	1,2
	Pretty good	0	0
	Very good	0	0
Climate change for people's health	Very bad	37	42.5
	Pretty bad	37	42.5
	A little bad	11	12.7
	A little good	2	23
	Pretty good	0	0
	Very good	0	0

Table 3. Distribution of correct answers in the identification of consequences of climate change		
Consequences of climate change	n (hits)	(%)
Vector-borne diseases	74	85.1
Flood related displacements	81	93.1
mental health conditions	72	82.8
Diseases related to air quality	85	97.7
foodborne illness	72	82.8
Alterations in health care due to climatic events	83	95.4
waterborne diseases	82	94.3
cold related illnesses	75	86
Diseases related to the availability of water	76	87.4
malnutrition	76	87.4

Knowledge about the causes of climate change

Table 4 shows the correct answers to the causes of climate change. With the maximum possible score being 4, the average number of correct answers obtained by the students was 2.6 (95%CI 2.4-2.9). 2.2% of the subjects obtained a "null" rating (0/4), 13.8% obtained a "poor" rating (1/4), 18.4% a "poor" rating (2 /4). It stood out 48.3% of subjects who obtained the qualification of "remarkable" (3/4) and finally 17.2% who obtained the qualification of "complete" by correcting all the questions.

Perception of the importance of climate change in the future.

The vast majority of those surveyed agree fairly (41.4%) or completely agree (41.4%) that the impact of climate change on human health will be significant in Spain in the next 20 years (Table 5). At a global level, they assessed the importance of the impact on human health in the next 20 years in the world, with 51.7% of the students fully agreeing and 35.6% quite agreeing. Finally, 72.4% of the students expressed their interest in the possibility of addressing issues in the medical career focused on the impact of climate change on human health (figure 1).

Correlation between knowledge of the causes and perceived impact on climate change

Spearman's correlation coefficient was determined (figure 2) to study the correlation between the level of knowledge of the causes of climate change and its perceived impacts. The test result was 0.0961 ($p = 0.3758$). Participants who scored complete knowledge (4/4) about the causes of climate change identified an average of 9.5 problems caused by climate change (out of 10 possible). Participants who scored zero knowledge (0/4) about the causes of climate change identified an average of 7.9 problems caused by climate change (out of 10 possible).

Association between sex and knowledge and perceived impact on climate change

There were no significant differences in the identification of problems between the sexes ($p = 0.999$). Neither in the mean score obtained in the knowledge of the causes ($p = 0.890$). Neither were differences found in identification ($p = 0.095$) and qualification ($p = 0.311$) between academic courses.

Association between the desire to study climate change in the career and knowledge and perceived impact of this

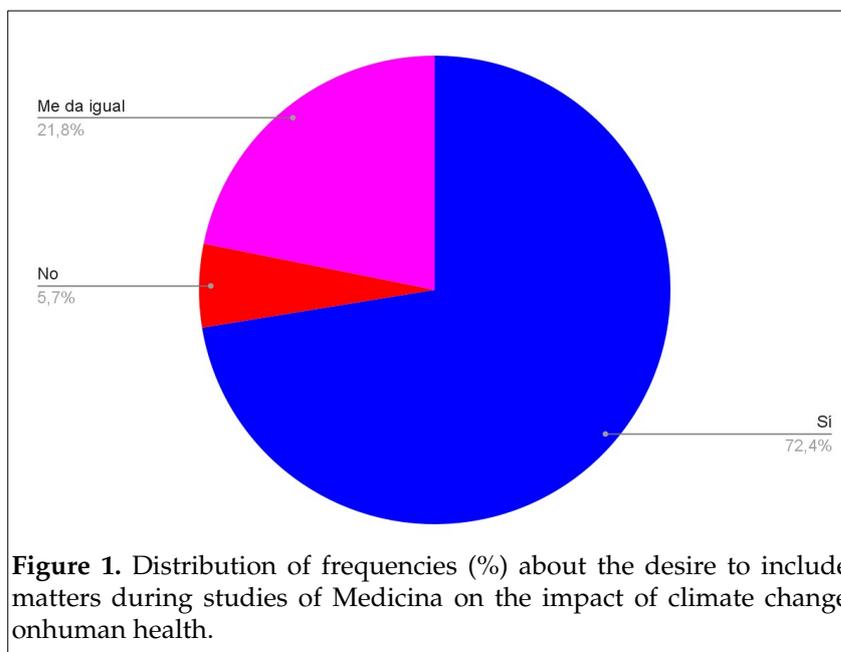
The mean identification of problems obtained in the group of students who did not want to address climate change issues during their studies or were indifferent to it was 8.17 (95% CI 7.10 - 9.23). The mean in the group that did want to address climate change issues throughout their degree was 9.19 (95% CI 8.84 - 9.54). The difference between these two groups was statistically significant ($p = 0.017$). However, these significant differences in knowledge of causes were not found between these two groups of students ($p = 0.193$).

Table 4. Distribution of correct answers in the identification of causes of climate change and key concepts

Causes of climate change	Correct answer	
	n	(%)
Human activities as the main cause of climate change	75	86.2
CO2 increase in the last 250 years	73	83.9
The temperature increase in the last century has been the greatest in the last thousand years	66	75.9
Current CO2 concentration has already occurred in the last 650,000 years	16	18.4

Table 5 . Distribution of absolute (n) and relative (%) frequencies on the different perception that students have about the importance of climate change within 20 years both in Spain and in the rest of the world.

Perception of the importance of climate change in the future		n	(%)
The impact of climate change on human health in Spain will be important in the next 20 years	Completely agree	36	41.4
	Pretty much agree	36	41.4
	Somewhat agree	12	13.8
	Somewhat disagree	1	1.1
	Pretty much disagree	0	0
	Strongly disagree	2	2.3
The impact of climate change on human health in the world will be important in the next 20 years	Completely agree	45	51.7
	Pretty much agree	31	35.6
	Somewhat agree	7	8.1
	Somewhat disagree	3	3.5
	Pretty much disagree	0	0
	Strongly disagree	1	1.1



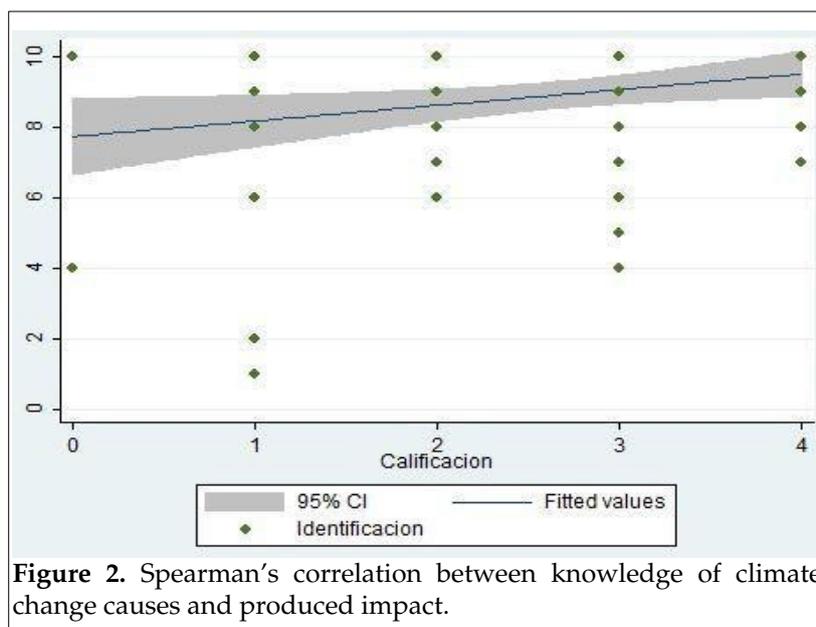


Figure 2. Spearman's correlation between knowledge of climate change causes and produced impact.

4. Discussion

This work determined that 58.6% of the survey participants thought that climate change was controllable, but, above all, the vast majority of the subjects perceived it as something very negative (they answered "very bad" or "quite bad") in general (90.8%) and very negative for human health (85%). These results were similar to those found by Saborit-Rodríguez et al. (2021) (15) in Cuba (87.95%) and showed greater concern than those obtained by Salazar-Ceballos et al. (2014) (14) in Colombia, with close to 69% of the students surveyed who considered climate change harmful; and Yang L et al. (2018) (17) in China, where only 56.3% of those surveyed had a very negative perception of it for the world in general and only 57.7% perceived it as something very negative for the health of people. Therefore, the students in this study viewed climate change much more negatively. It is possible that this is partly due to the fact that the Chinese study is earlier (2018), and although not much time has passed since then, the awareness of China has been increasing progressively, especially since the United Nations Conference on Climate Change (COP26) in November 2021. In it, China delivered its climate commitments that showed a clear attempt to transition towards a "green economy" and adopted a more ambitious position regarding the objectives agreed at the conference of Paris of 2015, which contemplated that the temperature would not increase more than two degrees taking pre-industrial values as a reference. On the other hand, in Spain, at present, from the administrations and news media, it is urged daily to be aware of climate change, advice is given through news, documentaries and social networks to promote the reduction of the carbon footprint. and individuals, companies or public administrations who want to make the change towards cleaner energy are subsidized, gradually promoting greater concern and social awareness.

The study participants demonstrated great knowledge about the consequences of climate change on human health, being able to identify an average of 8.9 consequences out of ten possible ones (89% correct). Therefore, they reflected greater knowledge than the students who were submitted to practically the same questionnaire in the study by Yang L et al. (17) that was carried out in different universities in China, where the average number of consequences identified was 9.5 out of 12 possible consequences (80% correct). It is true that this last study was carried out on medical, nursing and public health students, but if

we look at the figures, only for medical students, we can see that they obtained an average of 9.7 out of 12 (80%), which is still a success rate lower than that obtained by the participants in this study. Diseases related to air quality were the ones that were mostly correctly identified (97.7%) as one of the consequences of climate change, coinciding in this facet with the study by Yang L et al. (17) and showing differences with the study by Nigatu A. S, et al. (16) carried out in Ethiopia, where the most frequently identified problems were those related to water availability or flooding. This is probably due to the fact that in Spain and even more so in China, numerous reports, news, studies and documentaries have been published in recent years in which the serious problem that not having good air quality can cause is reported. and the supply of water for human consumption has been assured until now, in addition to having better infrastructures in case of floods.

On the other hand, the average number of causes of climate change correctly identified was 2.64 (66% correct). Said results were, once again, superior to those published by Yang L et al. (17), where they collected an average of 2.31 correctly identified causes (57% correct). The cause that fewer participants were able to identify was the one that spoke about the variation in the CO₂ concentration in the last 650,000 years. Only 18.4% correctly identified it (compared to 15.7% in the study carried out in China). In conclusion, these data reflected a higher degree of average knowledge about climate change in the students participating in this study.

The results showed some association, indicating that the students who identified a greater number of causes of climate change also identified a greater number of its consequences on human health. However, this association was not significant.

The vast majority of students were aware of the impact of climate change in the next 20 years in Spain (82.8% of those surveyed stated that they "completely agree" or "quite agree"), and even more in the world in general (87.3% of respondents). These results showed a slight increase in the degree of awareness about the importance of climate change in the future with respect to the Chinese study, where 76.6% of medical students perceived that it would have a significant impact in China in the next 20 years. and 77.5% in the world in general.

The sex of the participant was not associated with a greater degree of knowledge about the causes of climate change, showing minimal differences between groups. Nor was gender associated with a higher average number of problems identified, typical of the comparison of two groups that were practically identical in this regard. It is logical to think that this is the case, since both the men and women in the study have had access to the same education during school, institute and university, and with the use of social networks and the Internet, they can access the new information, news and reports on climate change with the same ease. These results also coincide with those obtained with Nigatu A. S, et al. (16) where, although minimal differences between sexes can be observed, these are not statistically significant.

The academic year was not a determining factor either in the average number of causes of climate change correctly identified ($p = 0.311$), or in the average number of problems identified ($p = 0.095$). These results make sense knowing that currently in medical study programs climate change is not addressed, and the information that students have, therefore, is independent of the course in which they are. However, they contrast with those found by Salazar-Ceballos (2014), in which students in the sixth semester or higher were 60% more likely to recognize that they can get sick from climate change and 63% more likely to perceive it as harmful (14).

72.4% of the survey participants expressed interest in the possibility of addressing issues in the medical career focused on the impact of climate change on human health and only 5.8% of them expressed their desire not address them. There were no differences in the average number of causes of climate change correctly identified in the group of people who were not interested (they answered "no" or "I don't care") for addressing climate change issues in the medical course with respect to the yes. Where statistically significant differences were found was when it came to identifying the problems of climate change on human health ($p = 0.017$). Therefore, we can conclude that most of the participants showed an interest in knowing more about climate change, and that this interest was associated with a greater degree of knowledge about the possible problems that it produces on human health. It is possible that knowing how damaging climate change can be fuels the desire to know more about it, with the intention, in this case, of practicing medicine more fully.

The present work, based on the questionnaire used by Yang L et al. (17) has gone one step further, in such a way that it has not only collected the level of knowledge and awareness that medical students have about climate change, but also their desire to learn more information about it in order to, in a future, take it into account when carrying out clinical practice and research. Even knowing the great effort that students have to make throughout the degree, they are willing to add more content, in order to increase their knowledge of the subject.

It should be noted that this interpretation and these results are not exempt from possible errors, or at least do not reflect reality as accurately as possible, since the study has certain limitations. One of its limitations is the lack of previous bibliography similar to the topic we are dealing with, in order to compare our results. Except for the already mentioned study by Yang L et al. We have not been able to find references of such similarity, especially from Spain or from countries that are members of the European Union: the greatest similarities have been found in studies carried out in China or even in Ethiopia. Therefore, the differences obtained between the studies when comparing their results may be due to differences in education, culture or perception of how the world works. Another limitation of this study is the number of participants. The fact of having had a total of 87 people may give rise to data that does not resemble those that would be obtained from a larger study population. For this reason, a new work is recommended, in which the associations are studied in a larger study population.

Finally, given the results obtained in which a large number of participants agreed that lessons on climate change should be taught in the medical career, two possible lines of work are proposed; the inclusion of a new subject of medicine based on climate change or the teaching of seminars and master classes in the different subjects of the degree, on how climate change affects each of these medical specialties and the paradigm that is presented in the near future. The most complete would probably be the inclusion of a new subject in which lessons on medicine based on climate change are implemented on a semester or yearly basis. However, the medical study programs are rigid, with many hours of rotations and daily practices and, in Spain, moreover, they are very focused on covering the knowledge necessary for the subsequent MIR exam.

The study published by Goshua, A et al. (22) shows how various universities in the United States, such as the Icahn School of Medicine at Mount Sinai in New York or the University of San Francisco in California, are offering their students courses that last between one and two weeks. Others, such as Georgetown University, teach modules and seminars in the subjects of first and third year students. It is possible that it is more feasible

to carry out the latter in Spanish universities. You can try to give seminars in the different subjects and have each specialist hold a seminar on how climate change affects their subject. In this way, students can better understand the association of clinical practice with this global problem and also ensures that they study lessons on this problem several times during their degree, which would improve their knowledge compared to seeing it once during a year. module for a couple of weeks and then not come back to it so specifically. It would be interesting to carry out studies on how the level of knowledge of the students changes, taking tests on climate change before and after attending the seminars or asking their personal assessment of what it contributes to them as a citizen and as a health professional.

5. Conclusions

- The vast majority of the medical students who participated were aware of the importance of climate change, they know its seriousness, as well as its causes and consequences.
- In addition, 72.4% of them expressed their desire to address issues on how climate change can affect human health during their medical studies.
- Additionally, 72.4% of them expressed a desire to address topics related to how climate change impact human health during their medical education.
- It would be interesting in the future to assess different possibilities for incorporating knowledge about climate change into Spanish medical programs and to study its quantitative and qualitative impact on students.

Funding: There has been no funding.

Acknowledgments: We thank the medical students Javier Cáceres and Patricia Salgado for their collaboration, who collaborated in disseminating the questionnaire.

Declaration of conflict of interest: The authors declare that they have no conflict of interest.

Contributions of the authors : Diego Cantalapiedra collaborated in the elaboration of the protocol, in the dissemination of the questionnaire and in the analysis and interpretation of the results. Carlos Piñel supervised the entire study and collaborated in the preparation of the protocol and in the analysis and interpretation of the results.

References

1. WHO (October 30th 2021) Climate change and health. *World health Organization*. <https://www.who.int/es/news-room/fact-sheets/detail/climate-change-and-health>
2. SESCAM. Impact of climate change on health. *Castilla-la Mancha Health Service (SESCAM)*, visited on 7/27/2023. <https://sanidad.castillalamancha.es/cambio-climatico/impacto-del-cambio-climatico-sobre-la-salud#:~:text=El%20calor%20y%20el%20aumento,m%C3%A1s%20problemas%20respiratory%20and%20cardiovascular>.
3. Booth M. Climate Change and the Neglected Tropical Diseases. *Advances in parasitology*. 2018; 100, 39–126. <https://doi.org/10.1016/bs.apar.2018.02.001>
4. Confalonieri, UE, Menezes, JA, & Margonari de Souza, C. Climate change and adaptation of the health sector: The case of infectious diseases. *Virulence*, 2015; 6 (6), 554–557. <https://doi.org/10.1080/21505594.2015.1023985>

5. Kraemer M, Sinka M. The global distribution of the arbovirus vectors *Aedes aegypti* and *Ae. albopictus*. *eLife* 2015; 4:e08347. <https://elifesciences.org/articles/08347>
6. Garchitorena, A., Ngonghala, C., Texier, G. *et al.* (2015). Environmental transmission of *Mycobacterium ulcerans* drives dynamics of Buruli ulcer in endemic regions of Cameroon. *Sci Rep* 2015; 5, 18055. <https://doi.org/10.1038/srep18055>
7. Ministry of Health. Current situation SARS-COV2 2023; <https://www.sanidad.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov/situacionActual.htm>
8. AEMET State Meteorology Agency. Squall Filomena 2021; https://www.aemet.es/es/conocermas/borrascas/2020-2021/estudios_e_impactos/filomena
9. Jiménez Martínez, C., Hernando Marrupe, L., & Botas Rodríguez, J. The other side of Filomena: risk of myocardial infarction associated with snowshoveling. The other side of Filomena: risk of myocardial infarction associated with shoveling snow. *Clinical medicine*, 2022; 158 (5), 243–244. <https://doi.org/10.1016/j.medcli.2021.05.022>
10. El Hamichi, S., Gold, A., Murray, TG, & Graversen, VK. Pandemics, climate change, and the eye. *Graefé's archive for clinical and experimental ophthalmology*, 2020; 258(12), 2597–2601. <https://doi.org/10.1007/s00417-020-04947-7>
11. Jegasothy, R., Sengupta, P., Dutta, S., & Jeganathan, R. Climate change and declining fertility rate in Malaysia: the possible connexions. *Journal of basic and clinical physiology and pharmacology*, 2020; 32(5), 911–924. <https://doi.org/10.1515/jbcpp-2020-0236>
12. Romanello, M., Di Napoli, C., *et al.* The 2022 report of the lancet countdown on health and climate change: health at the mercy of fossil fuels. *The Lancet discovery science* 2022; 400, 1609-1654. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(22\)01540-9/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(22)01540-9/fulltext)
13. Rossati A. Global Warming and Its Health Impact. *The international journal of occupational and environmental medicine*, 2017; 8(1), 7–20. <https://doi.org/10.15171/ijoem.2017.963>
14. Salazar Ceballos A, Álvarez Miño L, *et al.* Perception of risk to climate change and its effects on health and infectious diseases in university students, Santa Marta, Colombia. *Rev. Cuid.* 2014; 5(1): 613-22. <https://revistas.udes.edu.co/cuidarte/article/view/99/pdf4>
15. Saborit-Rodríguez A, Piñera-Castro HJ *et al.* Perception of risk in the face of climate change in medical students of the University of Medical Sciences of Havana. *Univ Méd Pinareña (UMP)* 2022; 18(1):e808. <http://www.revgaleno.sld.cu/index.php/ump/article/view/808>
16. Nigatu, AS, Asamoah, BO *et al.* Knowledge and perceptions about the health impact of climate change among health sciences students in Ethiopia: a cross-sectional study. *BMC Public Health* 2014; 14,587. <https://doi.org/10.1186/1471-2458-14-587>
17. Yang L, Liao W, *et al.* Associations between Knowledge of the Causes and Perceived Impacts of Climate Change: A Cross-Sectional Survey of Medical, Public Health and Nursing Students in Universities in China. *International journal of environmental research and public health*, 2018; 15(12), 2650. <https://doi.org/10.3390/ijerph15122650>
18. American Medical Association: Climate Change Education across the Medical Education Continuum. In Proceedings of the 2019 Annual Meeting of the American Medical Association House of Delegates, Chicago, IL, USA, June 6–13, 2019; A19-302; 540. <https://www.ama-assn.org/system/files/2020-01/a19-resolutions.pdf>
19. Polivka BJ, Chaudry RV, Mac Crawford J. Public health nurses' knowledge and attitudes regarding climate change. *Environmental Health Perspective.* 2012; 120(3): 321-325. <http://doi.org/10.1289/ehp.1104025>
20. Bedsworth L. Preparing for climate change: a perspective from local public health officers in California. *Environmental Health Perspective.* 2009; 117(4): 617-623. <http://doi.org/10.1289/ehp.0800114>
21. Shi, J.; Visschers, VHM; Siegrist, M.; Arvai, J. Knowledge as a driver of public perceptions about climate change reassessed. *Nat. Climate Chang.* 2016, 6, 759–762. <https://doi.org/10.1038/nclimate2997>
22. Goshua, Anna; Gomez, Jason *et al.* Addressing Climate Change and Its Effects on Human Health: A Call to Action for Medical Schools. *Academic Medicine* 2021; 96(3): 324-328.

https://journals.lww.com/academicmedicine/Fulltext/2021/03000/Addressing_Climate_Change_and_Its_Effects_on_Human.15.aspx



© 2023 University of Murcia. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution-NonCommercial-No Derivatives 4.0 Spain (CC BY-NC-ND) license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).