



Assessing the role of education level on climate change belief, concern and action: a multinational survey of healthcare professionals in nephrology

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Abstract

Background Climate change poses a significant risk to kidney health, and countries with lower national wealth are more vulnerable. Yet, citizens from lower-income countries demonstrate less concern for climate change than those from higher-income countries. Education is a key covariate. To examine its role in explaining this perception gap, we obtained the perspectives of a highly educated cohort of healthcare professionals.

Methods This was a cross-sectional survey of healthcare professionals involved in kidney care. Responses were compared by the income level of the participant's country (per World Bank).

Results Of the 849 healthcare professionals from 107 countries (63.4% from lower and middle-income countries) that participated, most believed climate change was happening (97.9%), displayed a high level of concern (73.3%), and took personal action to combat climate change (62.0%). While the proportion who believed in climate change did not vary by income level (high:98.1%, upper-middle:97.2%, lower-middle:97.8%, low:100%, $p=0.73$), the proportion with a higher level of concern (high:80.7%, upper-middle:74.9%, lower-middle:67.5%, low:53.8%, $p<0.001$), and who took climate action (high:76.2%, upper-middle:63.1%, lower-middle:51.2%, low:30.8%, $p<0.001$) decreased by national wealth. Barriers to involvement in

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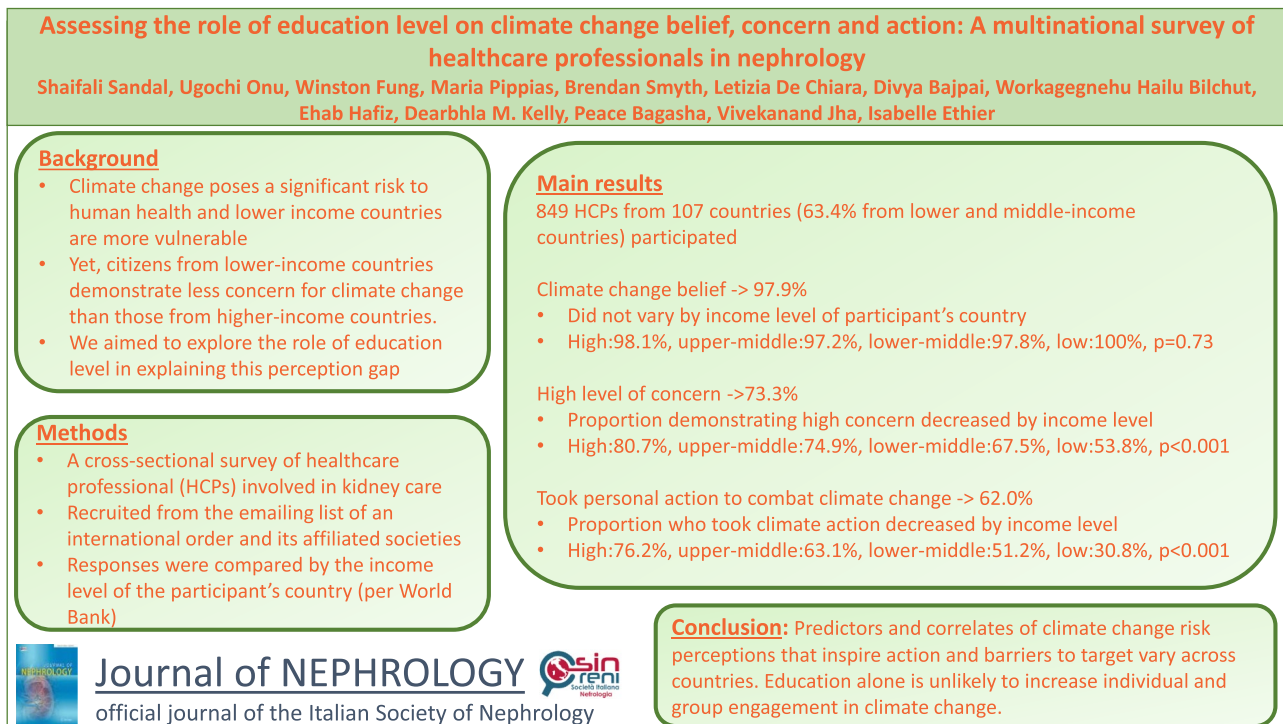
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sustainable kidney care were lack of time (54.4%), knowledge (39.7%), and peer support (30.3%). Only 34.0% were aware of national mitigation plans and barriers related to finances, technologies, tools, methods, research, and evidence were perceived as greater obstacles in lower-income countries.

Conclusions Our results highlight that predictors and correlates of climate change risk perception vary across countries. Education alone is unlikely to increase individual and group engagement in climate change. A better understanding of these factors can inform strategies towards climate action in different settings.

Graphical abstract



Keywords Climate change · Environmentally sustainable nephrology · Healthcare professionals · Comparative analysis · Income level

Introduction

Climate change poses a significant risk to human health, economic growth, and the natural environment [1–6]. Approximately 13 million deaths annually are due to the direct (through air pollution, increased disease, and extreme weather events) or indirect (exacerbating vulnerabilities, forced displacement, and food and water insecurity) effects of climate change [2, 3, 7]. With the rise in extreme weather events and the lag in mitigation efforts, it is projected that from 2030 to 2050, an additional 250,000 deaths/year will occur due to undernutrition, malaria, diarrhea, and heat stress alone [8]. Thus, the United Nations recognizes climate change as the “*single biggest health threat facing humanity*” [7].

Lower-income countries are generally more vulnerable to the effects of climate change [2, 3, 9–14]. While a better

understanding of factors associated with resilience is needed, this is likely due to a combination of insufficient infrastructure, limited adaptive capacity, and other economic factors [8, 14, 15]. It is estimated that by 2100 unmitigated climate change will make 77% of countries poorer than they would be without climate change [11]. This would further exacerbate climate change-related health and economic impacts.

Despite these grim projections, citizens of countries with lower national wealth are not more concerned about climate change than those from high-income countries, with most surveys demonstrating significantly less concern [16–23]. Sociological explanations have been proposed for this perception gap, as well as the variability in how perception was assessed as it can denote a range of psychological constructs [17, 24–28]. Regardless, the role of education has been highlighted in explaining this observation [14, 18–20, 24, 25, 29]. Education is “a

cognitive resource which facilitates the understanding of a phenomenon” [19]. Level of education correlated with positive trends in perception of the impact of climate change on health and other dimensions, such as biophysical, economic, and national security. [14, 18–20, 24, 25, 29] In addition, prioritizing climate change may be more likely among citizens of higher-income countries as these nations tend to have a higher proportion of educated citizens and those with the economic security to focus on other issues [17, 19]. A comparative assessment of the perspectives of a more homogeneous and similarly educated group of individuals can assess the role that education level plays in climate change perception.

Healthcare professionals (such as physicians and nurses) have one of the highest levels of education in most societies. They are less likely to have climate change information deficit, i.e., gaps in information between scientists and the public due to lack of information or knowledge [30, 31]. They also have more civic engagement and communication access to engage in climate change advocacy and the ability to influence practice and policy [20, 32]. Their work sensitizes them to the health harms of climate change and increasingly they are becoming aware that the healthcare sector itself is a significant contributor to climate change [1, 5, 33, 34].

Thus, we aimed to identify and compare the perspectives of healthcare professionals on climate change across countries of different income levels. We also aimed to identify their awareness of national climate mitigation strategies and quantify and compare individual and national barriers to mitigation.

Methods

This was a cross-sectional multinational survey that used a convenience sample of healthcare professionals involved in kidney care who were recruited via the mailing list of a national order (International Society of Nephrology (ISN)), its affiliated societies, and the social media pages of our team. Also, the environmental burden of kidney diseases is disproportionately high, and several recent initiatives are ongoing to increase climate change literacy among healthcare professionals in nephrology [35, 36]. This project was led by the Emerging Leaders Program (ELP) cohort 2, a global collaborative with the overarching goal of advancing climate change advocacy in kidney health and environmentally sustainable kidney care [37, 38]. Ethics approval was obtained from the Research Ethics Board of the McGill University Health Centre in Montreal, Canada (ID:MP-37–2024-9717).

Survey creation

Our approach was domain identification, question preparation and options creation, and validation and pilot testing [39, 40]. Following an environmental scan and scoping review of the literature, we identified several domains of interest. We have previously reported on the domains that aimed to identify the knowledge and practice gaps among healthcare professionals on the bidirectional relationship between kidney disease and climate change in a multinational context [41]. This paper reports on the following domains: individual perceptions and action related to climate change, barriers to being more involved in sustainable kidney care, knowledge of national climate change mitigation plans/strategies, and barriers to implementation.

We first defined climate change as follows: “refers to the idea that the world’s average temperature has been increasing for the past 50 to 100 years primarily due to human activities, may increase more in the future, and the world’s climate may be changing as a result”. We then framed the questions to gauge participant’s belief, concern and action. We examined participant’s knowledge of national mitigation plans/strategies and then asked them to assess barriers. To characterize personal barriers, we used options from a prior survey [42]. To characterize national barriers, we developed options using the findings from the health and climate change global survey report of the World Health Organization [43]. A commentary box, where eligible, was provided to allow open-ended responses. The relevant survey questions are presented in Supplementary Table 1.

We used several best practices in survey design and tried to minimize the risk of social acceptability bias [44–46]. A 5-point Likert scale was used, where possible, to decrease the risk of acquiescence bias. The survey was designed by two team members (SS, UO) and assessed by all others for content and face validation by rating each question and associated options as satisfactory or unsatisfactory on a validation matrix. If unsatisfactory, reasons and suggestions for improvement were provided and the survey was revised. Once validated by all members, the survey was pilot-tested by 16 healthcare professionals. Only minor changes were made, and all responses were included in the analysis.

Participant recruitment and survey administration

The survey was administered electronically in English using the SurveyMonkey platform from August 21, 2023, to October 18, 2023, to the ISN membership. They were emailed twice, one month apart, with an invitation to participate and a link to the survey. In addition, the social media platforms of our team and the assistance of several ISN-affiliated societies were used to recruit participants.

Data analysis

Descriptive statistics were used as appropriate to describe survey responses. Open-ended responses were analyzed using an inductive approach to generate themes from the text (generated by SS and confirmed by IE). Where the Likert scale was used, the proportion of participants who selected the two highest categories (scores 4 or 5) was calculated and the Chi-square test was used to compare responses by the variables of interest (country income level, job title, years of experience, age, and sex). A similar approach was used to analyze questions with dichotomous responses. Income level was categorized using the World Bank 2022 classification (high-income countries [HICs], upper-middle-income countries [UMICs], lower-middle-income countries [LMICs] and low-income countries [LICs]) [47], while the other variables were self-reported. To ensure the analysis was robust, a sensitivity analysis was conducted by excluding the responses from countries that had > 50 participants. We also assessed how climate change belief was associated with concern and action, using Chi-square tests. All analyses were performed using Stata/SE 15.1 for Mac (College Station, Texas) and a significance level using $p < 0.05$ was reported.

Results

Nine-hundred seventy-two healthcare professionals opened the survey link and completed the first section of the survey. Completion rates for all sections of the survey were 62% (606), and the completion rate for the section most relevant to our current research aims was 87% (849). These 849 participants were from 107 countries with varied health systems: 36.6% were from HICs, 21.1% from UMICs, 37.7% from LMICs, and 4.6% from LICs. Four countries with > 50 participants were India (14.7%), Nigeria (10.2%), Canada (9.7%), and China (8.4%) (Supplementary Fig. 1). Our survey was taken by nephrologists (62.9%), nurses (16.6%), other types of doctors/physicians (9.2%) as well as allied health professionals. Over 50% had at least 10 years of experience working in kidney care. Providing information on age and sex was optional. Excluding missing responses, the cohort included a balanced representation of males and females (52.8% female) and representation from a wide age range (Table 1).

Climate change belief, concern, and action

Most respondents believed climate change is happening (97.9%) and displayed a high level of concern (73.3% selected scores of 4 or 5 on the Likert scale). Almost two-thirds of participants (62.0%) reported taking action to combat the effects of climate change. Described actions

were categorized as (1) 5Rs of waste management (refuse, reduce, reuse, repurpose, recycle); (2) transportation-related changes; (3) water and electricity conservation; and (4) adopting an eco-friendly lifestyle (Supplementary Fig. 2).

The interrelationship of belief, concern, and action

Climate change belief, level of concern, and the likelihood of taking climate change action were associated with each other such that those who believed in climate change were more likely to be concerned about it and were more likely to take action. For example, 74.8% of the participants who responded ‘yes’ to the belief question selected scores of 4–5 on the concern question, while 100% of those who did not believe in climate change selected scores of 1–3 for their level of concern ($p < 0.001$). Similarly, participants who reported taking action were more likely to select higher scores (4–5) on the concern question than those who did not report taking any action (72.8% vs. 32.2% $p < 0.001$) (Supplementary Table 2).

Climate change belief, concern, and action by income level and other factors

The proportion who believed in climate change did not vary by income level (HIC: 98.1%, UMIC: 97.2%, LMIC: 97.8%, LIC: 100%, $p = 0.73$). However, the level of concern of participants from lower-income countries decreased significantly in a step-wise manner with decreasing national wealth (HIC: 80.7%, UMIC: 74.9%, LMIC: 67.5%, LIC: 53.8%, $p < 0.001$), as did the percentage who reported taking action to combat climate change (HIC: 76.2%, UMIC: 63.1%, LMIC: 51.2%, LIC: 30.8%, $p < 0.001$). When excluding the responses obtained from four countries that had > 50 participants, similar trends remained (Fig. 1 and Supplementary Table 3).

When comparing responses by the other variables of interest (job title, years of experience, age, and sex) none were associated with the level of concern. For the climate change belief question, the number of participants who responded ‘no’ was too small to make any meaningful inferences. Participants with ≥ 6 years of work experience, and those aged ≥ 45 years were more likely to report taking action to combat climate change. Additionally, a higher proportion of males in our cohort reported taking climate change action (males: 56.8% and females: 41.5%, $p = 0.02$) (Supplementary Table 2).

Individual barriers

The top-rated barriers to greater involvement in sustainable kidney care initiatives (based on those who selected scores of 4 or 5 on a scale of 1–5, where 1 is no impact at all

Table 1 Characteristics of participants

Characteristic (<i>n</i> = 849)	% (<i>n</i>)
Income level	
High income	36.6 (311)
Upper middle income	21.1 (179)
Lower middle income	37.7 (320)
Low income	4.6 (39)
Job description	
Nephrologist	62.9 (534)
Another physician/doctor	9.2 (78)
Nurse	16.6 (141)
Scientist (basic/translational/clinical)	1.9 (16)
Pharmacist	1.2 (10)
Social worker	0.3 (3)
Dietitian	1.1 (9)
Technician	0.3 (3)
Manager/administrator	1.5 (13)
Trainee (specify under other)	2.5 (21)
Other (please specify)	2.5 (21)
Years of experience	
< 1 year	4.9 (42)
1–5 years	22.3 (189)
6–10 years	17.4 (148)
11–20 years	23.1 (196)
> 20 years	32.3 (274)
Funding model	
Publicly funded by government and free at the point of delivery	27.1 (230)
Publicly funded by government but with some fees at the point of delivery	15.6 (133)
A mix of publicly funded and private systems	38.5 (327)
Multiple systems—programs provided by government, NGOs, and communities	7.1 (60)
Solely private and out-of-pocket	9.1 (77)
Solely private through health insurance providers	1.9 (16)
Other (please specify)	0.7 (6)
Sex*	
Male	32.5 (276)
Female	37.8 (321)
Prefer not to say	1.1 (9)
Missing	28.6 (243)
Age*	
< 25	0.2 (2)
25–34	11.1 (94)
35–44	23 (195)
45–54	21.1 (179)
55–65	8.6 (73)
65+	6.1 (52)
Prefer not to say	1.3 (11)
Missing	28.6 (243)

*Optional question

and 5 is a great deal of impact) were lack of time (54.4%), lack of knowledge (39.7%), and lack of support from their peers (30.3%). Four categories varied significantly across

income levels: “lack of time” (HIC:61.8%, UMIC:53.8%, LMIC:47.9%, LIC:40.0%, $p=0.01$), “it won’t make a difference if I do” (HIC:14.5%, UMIC:23.9%, LMIC:28.8%,

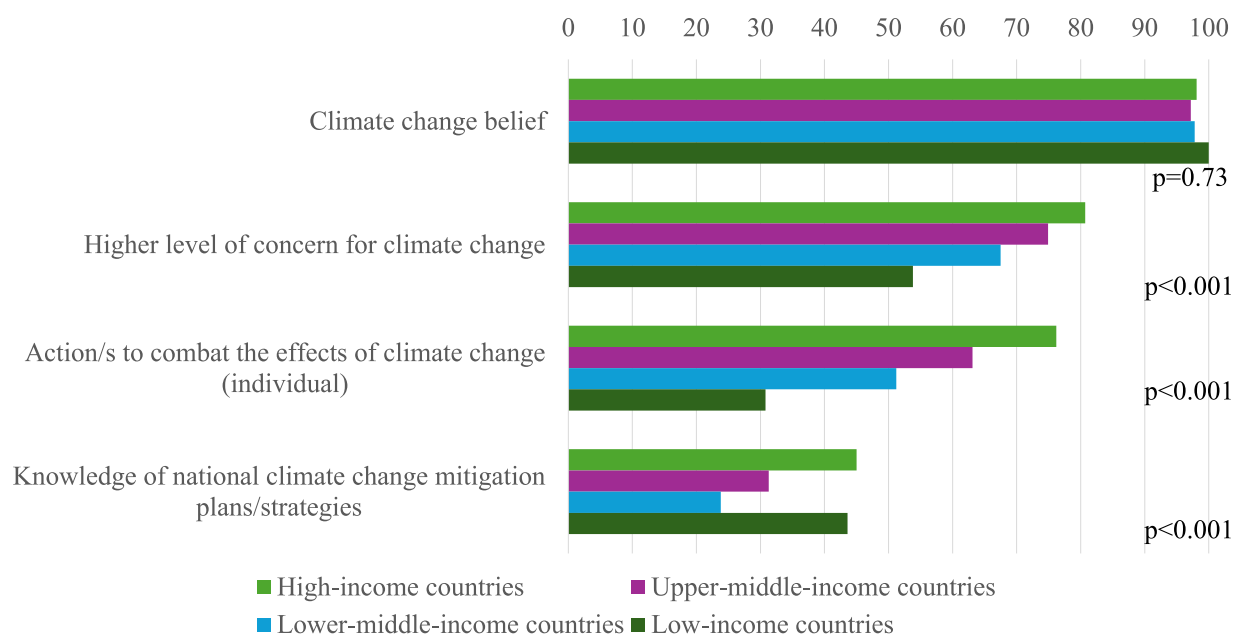


Fig. 1 In a multinational survey of healthcare professionals involved in kidney care from 107 countries, the proportion of participants who believed in climate change, reported high levels of concern, took

action to combat the effects of climate change, and had knowledge of national mitigation plans/strategies segregated by the income level of their country are presented

LIC:16.0%, $p=0.002$), “this topic is too controversial” (HIC:7.2%, UMIC:18.8%, LMIC:19.2%, LIC:24.0%, $p<0.001$) and “lack of support from my peers” (HIC:22.1%, UMIC:45.3%, LMIC:30.6%, LIC:40.0%, $p<0.001$) (Table 2).

National mitigation plans/strategies

Only 34.0% of respondents were aware of national health and climate change plans or strategies that have been implemented in their country. These varied by income level, such that participants from HICs (45.0%) and LICs (43.6%) were more likely to report this than those from UMICs (31.3%) and LMICs (23.8%), $p<0.001$ (Fig. 1). These strategies

were (1) waste management; (2) promoting/incentivizing the use of alternative energy; (3) addressing the transportation sector; (4) targeting and promoting individual behaviors; (5) organizational and leadership strengthening; and (6) preserving nature and natural habitats (Supplementary Fig. 3).

Barriers to implementation of national mitigation plans/strategies

Insufficient prioritization or competing priorities (77.1%), insufficient multi-sectoral collaboration (72.8%), and incomplete or lack of comprehensive plan or strategy (74.9%) were the top-rated barriers to implementation of national plans/strategies for climate change mitigation. Some factors were

Table 2 Characterizing and comparing individual barriers to being more involved in sustainable kidney care initiatives: the percentage of respondents who selected scores of 4 or 5 on a scale of 1–5 (1 having

no impact at all and 5 having a great deal of impact) are reported and compared by the income level of the respondent’s country

	Overall (610)	HIC (249)	UMIC (117)	LMIC (219)	LIC (25)	P value
My lack of knowledge	39.7	42.2	41.0	36.5	36.0	0.62
My lack of time	54.4	61.8	53.8	47.9	40.0	0.01
It won’t make a difference if I do	21.5	14.5	23.9	28.8	16.0	0.002
This topic is too controversial	14.4	7.2	18.8	19.2	24.0	<0.001
Lack of support from my peers	30.3	22.1	45.3	30.6	40.0	<0.001
It is too risky for me professionally or personally	8.9	5.2	12.0	11.0	12.0	0.07

Significant values are in bold

HIC high income countries, UMIC upper-middle income countries, LMIC lower-middle income countries, LIC low-income countries

identified as greater barriers by participants from lower-income countries: insufficient finance/budget (HIC:60.5%, UMIC:70.4%, LMIC:74.1%, LIC:74.4%, $p = 0.002$), insufficient technologies, tools and methods (HIC:44.7%, UMIC:67.6%, LMIC:67.5%, LIC:76.9%, $p < 0.001$), and insufficient research and evidence (HIC: 29.9%, UMIC: 58.1%, LMIC: 60.6%, LIC: 69.2%, $p < 0.001$). COVID-19-related constraints were identified as a bigger barrier by participants from UMICs (HIC: 16.7%, UMIC: 33.5%, LMIC: 23.4%, LIC: 15.4, $p < 0.001$). For the rest, the proportion of participants who selected options 4 or 5 was similar by national wealth. When analyzing open-ended responses, three new themes emerged: electoral and political issues (corruption, interference, need to please voters), lack of public engagement, and prevalence of disinformation (Table 3).

Discussion

We synthesized and compared the perceptions of a relatively homogeneous group of healthcare professionals from 107 countries. Most participants believed that climate change is happening and expressed a high level of concern, with many reporting taking action to combat climate change. While belief in climate change did not vary by national wealth, the proportion who demonstrated more concern and took action decreased with decreasing national wealth. Several individual barriers to engagement were identified, some of which varied by national wealth. Additionally, only a third of participants were aware of national mitigation plans. We identified the top barriers to implementing these plans, with those related to finances, technologies, tools, methods, research, and evidence being perceived as greater obstacles by healthcare professionals in lower-income countries.

The most important finding of our study is that even in a highly educated population of healthcare professionals, the climate change perception gap is prevalent. As prior surveys of citizens and the general population have demonstrated [16–20], more concern for climate change was skewed towards participants from higher-income countries; however, belief in climate change was nearly unanimous. Social scientists have put forth some arguments to explain this perception gap. A pro-environmental attitude might stem from a shift in people's values from materialism to post-materialism as they accumulate wealth and become less preoccupied with the economic struggle for survival [26–28]. To account for within-country differences, the prosperity hypothesis emphasizes the importance of individuals' relative income position within a country [25]. Another proposal relates to higher consumption patterns that can translate to more guilt and concern about changing one's lifestyle among participants from HICs [18, 21]. Also, in lower-income settings, climate change policy decisions can be perceived as a trade-off between development and climate mitigation, leading to lower prioritization of the latter [48]. Overall, our findings suggest that factors underlying the different levels of concern regarding climate change among individuals across the world are likely complex and need further exploration.

Higher concern is associated with taking action to combat climate change. This is in line with existing literature reporting that concern influences behavior [25]. Notably, a lower proportion of participants in lower-income countries reported making lifestyle changes. We suspect that individuals in lower-income countries are less likely to report taking climate change action because they likely have lower consumption and a smaller carbon footprint [13]. Other possible factors include limited availability and access to resources needed to make these changes, such as clean

Table 3 National barriers to the implementation of climate change mitigation strategies: the percentage of respondents who rated the importance of the barrier by selecting options 4–5 on a scale from

1 to 5 (1 being not important at all and 5 being extremely important) are reported and compared by the income level of the respondent's country

	Overall (849)	HIC (311)	UMIC (179)	LMIC (320)	LIC (39)	<i>P</i> value
Insufficient finance/budget	68.3	60.5	70.4	74.1	74.4	0.002
Insufficient human resource capacity	58.8	57.2	67.0	56.6	51.3	0.08
COVID-19-related constraints	22.7	16.7	33.5	23.4	15.4	<0.001
Insufficient research and evidence	49.2	29.9	58.1	60.6	69.2	<0.001
Insufficient technologies, tools and methods	59.6	44.7	67.6	67.5	76.9	<0.001
Insufficient prioritization or competing priorities	77.1	77.5	77.1	76.6	79.5	0.98
Insufficient multi-sectoral collaboration	72.8	71.7	74.9	74.1	61.5	0.34
Incomplete or lack of comprehensive plan or strategy	74.9	71.4	81.0	75.3	71.8	0.12
Lack of endorsement by the Ministry of Health	65.1	61.1	70.9	66.6	59.0	0.12

Significant values are in bold

HIC high income countries, UMIC upper-middle income countries, LMIC lower-middle income countries, LIC low-income countries

energy alternatives, climate-friendly housing or transport options, access to public transport, or affordable electric vehicles.

In 2015, the Paris Agreement, a multilateral climate change process treaty, was adopted by 196 parties with the overarching goal of limiting the increase in the global average temperature [49]. However, most countries have made insufficient progress to achieve set targets [50]. In our survey, only a third of healthcare professionals were aware of national mitigation plans. These were an interesting range of strategies related to waste management, alternative energy sources, transportation, citizen behavior, organizational and leadership strengthening, and nature preservation. An overwhelming majority of the public demands more national political action [51]. A prior survey from the World Health Organization listed a set of barriers to the implementation of climate change mitigation initiatives [43]. We have quantified and compared these barriers by resource setting and this may have policy implications.

Our study compares the climate change belief, concern, and action of one of the most educated groups across countries of different income levels. We received a strong global representation allowing cross-country comparisons and 63.4% of participants were from low and middle-income countries, substantially mitigating the risk of inequalities in knowledge production. An inductive analysis of open-ended responses allowed us to generate rich data across several analyzed domains. However, we acknowledge the following limitations. First, education level may not correlate with climate change literacy and findings may not be completely generalizable as this was a convenience sample of healthcare professionals in nephrology recruited via an international society. However, many kidney therapies have a disproportionately higher climate burden and there have been several recent initiatives in sustainable kidney care. This likely increases the literacy and awareness of our sample. Second, this survey was at risk of non-response bias, and it is possible that only those more aware and interested volunteered to participate. We also acknowledge that our approach examines data aggregated at the macro level and does not utilize poverty-related metrics or analyze responses based on inequalities between individuals within the same country [10, 13]. Lastly, our study did not employ a sociological and qualitative approach, which may be necessary for analyzing the differences in risk perception.

Despite this, our findings are relevant to the global community, as they highlight that predictors and correlates of climate change risk perceptions vary across countries. A better understanding of these factors can inform strategies towards climate action in different settings. Given public fatigue, political discourse and increased climate skepticism, our findings suggest that education alone will unlikely engage individuals, especially in lower-income

countries. Even in a high-income setting, the effect of education and self-reported understanding of climate change beliefs and concerns varied by the political affiliations suggesting that educational attainment may just enable individuals to support their ideological beliefs [52]. Individual views on climate change are shaped by a combination of personal, ideological, cultural, religious, psychological and sociologic factors [18–21, 24, 25, 51, 53–56]. A multi-disciplinary approach is needed to better understand what motivates beliefs, concerns, behaviors and actions on climate change across different societies with varied resources [20, 54]. Engaging the public can then increase political commitment and action [24, 51, 55].

In conclusion, we report that even among the most educated individuals who believe in climate change, climate change concern and action are skewed toward higher-income countries. A better understanding of what motivates individual and group beliefs, concerns, behaviors, and actions on climate change across different resource and cultural settings is needed to explain this perception gap. This will help target those less engaged in climate change and help reach widespread participation, investment, and commitment in climate change adaptation and mitigation approaches.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s40620-024-02195-0>.

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Author contributions Conception: SS; Design: SS, UO; Validation: IE, WF, DB, WHB, PB, LDC, EH, BS, DK, MP, VJ; Guidance on design and mentorship: VJ; Survey administration/data acquisition: SS, IE, UO, WF, DB, WHB, PB, LDC, EH, BS, DK, MP; Data analysis: SS, IE; Data interpretation: SS, IE; Drafted the first draft of the manuscript: SS; Reviewed the manuscript critically for important intellectual content: IE, UO, WF, DB, WHB, PB, LDC, EH, BS, DK, MP, VJ. All authors approve the final the version to be published and agree to be accountable for all aspects of the work.

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Data availability De-identified data that support the findings of this study are available on request from the corresponding author (SS) and following ethics approval and a contract agreement between institutions.

Declarations

Conflict of interest Dr Smyth has received a grant from Baxter Healthcare relating to local implementation of sustainable kidney care. Dr. Jha has received grant funding from GSK, Baxter Healthcare, and Biocon and honoraria from Bayer, AstraZeneca, Boeringer Ingelheim, NephroPlus, and ZydusCadilla, under the policy of all honoraria being paid to the organization. He is also the International Society of Nephrology person in charge of the Emerging Leaders Program group and member of the Green-K initiative. All authors are members of the second cohort of the International Society of Nephrology's Emerging Leaders 2022 Program that is undertaking several initiatives to increase awareness of the climate and environmental impact of health care among the members of the nephrology community and promote environmentally friendly practices in nephrology.

Ethical approval Ethics approval was obtained from the Research Ethics Board of the McGill University Health Centre in Montreal, Canada (ID:MP-37-2024-9717).

Informed consent to participate The first section of the survey explained the details of the survey and the consent process.

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