GEORGE MASON UNIVERSITY
CENTER *for* CLIMATE CHANGE COMMUNICATION

# A Global Review of Research on Effective Advocacy and Communication Strategies at the Intersection of Climate Change and Health

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# Table of Contents

# Acknowledgements

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# Executive Summary

In this review, we summarize research on the understanding of the health impacts of climate change among the public, health professionals, and public officials, outline effective strategies to communicate these impacts and future risks, and advocate for solutions to reduce these risks. The primary objective of this literature review is to leverage existing research to identify practical recommendations for effectively communicating the health risks linked to climate change and the health benefits of climate solutions. We also identify potential avenues for further investigation in this important field.

A previous version of this review developed for the World Health Organization focused on English-language studies identified through Google Scholar. With support from the Wellcome Trust, this expanded and revised edition includes non-English language studies and additional research found in three other English-language databases, focusing primarily on studies published between 2000 and July 2023. Specifically, this report covers relevant research published in English, Chinese, French, German, Japanese, Korean, Portuguese, and Spanish. To accomplish this, we conducted a literature search across several databases, including PubMed, Web of Science, ScienceDirect, Google Scholar, SciELO, CnKi, Erudite, J-Stage, Korean Citation Index, and CyberLeninka, selected for their extensive coverage of social science research on an international scale. The selection of relevant non-English language databases was determined in consultation with a research librarian.

To screen the search results, we established specific inclusion and exclusion criteria, which can be found in the Methods section (page 46). These criteria served as the basis for identifying a total of 182 English-language studies and 13 non-English-language studies. A list of the articles reviewed, the language in which they were published, their geographical scope, and information on the populations sampled can be found in Appendix 1. Within each section of the review, we discuss the strength and geographical scope of the available evidence base. Additional details about the methods can be found in Section 13.

Following typical literature review practice, we conducted a narrative synthesis of the studies identified in the review studies. These studies provide insights into the perspectives of public audiences, health professionals, and public officials on climate change and health. A complementary scholarly publication based on the evidence in this report is under development and will be published in a peer-reviewed journal at a future date.

Based on existing research, the majority of which has been carried out in the Global North with few exceptions, we find that providing information about the health relevance of climate change holds significant promise for increasing public engagement with the issue and building greater support for climate solutions.We also find that health professionals are trusted voices to deliver this information, and that many health professionals would welcome this and related climate advocacy roles.

Our findings also suggest that public officials worldwide possess varying levels of understanding of the health consequences of climate change, underscoring the need to strengthen their knowledge and willingness to actively engage in addressing climate change and its associated health impacts. Specific findings from each section of the report are detailed below.

### How do public audiences perceive climate change and health?

Globally, there has been surprisingly little research to assess public understanding of the health risks and impacts of climate change, although the evidence base is growing. In the USA, Canada, and the UK, where most research has been conducted, studies suggest that there is increasing recognition that climate change causes multiple threats to human health, although few are able to name specific ways in which climate change harms health. Perceptions of the health impacts of climate change vary considerably from country to country.

Drawing definitive conclusions about public perceptions in many regions of the world remains challenging due to the scarcity of high-quality, representative survey data. Many studies rely on limited sample sizes or narrow their focus to specific cities or subnational regions within a country. Consequently, more research is needed to gain a comprehensive understanding of public awareness regarding the health impacts of climate change, particularly in non-Western contexts.

## How do public audiences respond to health-framed information?

Research conducted in China, Germany, India, UK, and USA strongly suggests that framing climate change as a public health issue can be an effective way to enhance public engagement with the issue and generate support for pro-climate policies and action. Further, health-framed messaging can be particularly valuable in increasing support for climate action across the political spectrum, including among those who tend to be less concerned about climate change. Given that people from all political backgrounds tend to care about health, highlighting the health risks of climate change and the health benefits of climate solutions can help make the issue of climate change less politically divisive. Furthermore, a multinational study conducted with participants from China, Germany, India, UK, and USA found that a health frame is generally more effective when positively valenced (focusing on the benefits of action), and discussed as a global-scale issue that is affecting people now as opposed to far off in the future. While the evidence for the effectiveness of framing climate change as a health issue is largely positive, a few studies show null or counterproductive effects under certain conditions, such as when audiences have difficulty identifying with the people being impacted by climate change, and when they are simultaneously exposed to messaging that opposes action on climate change. Moreover, research in the USA suggests highlighting climate-related risks to people's personal health can sometimes be demobilizing by making them feel more vulnerable and therefore less capable of investing resources into actions to address climate change. Although more research is needed to better understand how to cultivate the full potential of such communication, it may be possible to address some of these limitations by helping audiences develop a sense of empathy for those affected by climate change, inoculating people by forewarning them about misinformation used in oppositional messaging, and providing people with a greater sense of self-efficacy by talking about the health benefits of climate and health solutions.

## How do public audiences respond to information on the health risks of climate change and air pollution?

Research conducted primarily in the USA suggests that informing people about the health harms of climate change and the burning of fossil fuels can increase their concern about the issue, support for clean energy use, and willingness to advocate for climate policies with elected officials, making it an important first step for building public and political will for climate action. Information specifically about the neurological harms to children from exposure to air pollution appears to be especially engaging among Americans across partisan lines. A multinational study found that in Germany, a more negative focus on the health threat of climate change increased support for climate change mitigation policies relative to a more positive message focused on the health benefits of climate action, whereas the opposite pattern was observed in other countries, including China, the UK, and the USA. While additional research would be helpful—especially beyond the United States—the existing evidence strongly suggests the value of communicating about the health harms of air pollution and climate change.

## How do public audiences respond to information on climate and health solutions?

Research conducted in multiple countries, including the USA, UK, and China, find communicating about the health benefits of climate change solutions also appears to be an effective way to increase political engagement in support of pro-climate policies. Indeed, highlighting the health benefits of taking action (i.e., a gain frame) appears to be even more effective than highlighting the health risks of climate change (i.e., a loss frame)—although both are helpful, as is highlighting the social norm that most people are concerned about climate change. Solutions-focused messages may also help build climate policy support, mobilize people to engage in advocacy, and activate positive, motivating emotions, like hope. In addition, climate and health messages that first evoke fear and then follow up with hope-inspiring content may also strengthen people's intentions to engage in climate advocacy. Future research should include different geographies and strengthen the evidence on the effectiveness of communication centered around the health benefits of climate solutions.

## What do we know about integrating equity in climate change and health communication?

Unfortunately, there is limited research on communicating the inequities associated with climate change and health. Although some vulnerable populations may already perceive their health to be at risk because of climate change,

studies in the USA have shown that most Americans do not understand that climate change will have disproportionate impacts on some types of people's health. Messaging that informs people about the disproportionate impacts of climate change on the health of the most vulnerable populations—including people in low-wealth communities, ethnic and racial minorities, women, children, people with chronic illnesses, and people who earn their livelihoods outdoors—may hold both promise and pitfalls. It may increase engagement among some audiences but may also have the paradoxical effect of undermining concern and support for action among audiences that are less vulnerable. Strategies that help people understand the health equity considerations associated with climate change should be informed by existing research and developed in consultation with members of vulnerable groups.

## How to harness the power of visual communication

There has been little research on the use of climate and health visual imagery, although the existing evidence (primarily from the USA and UK) suggests that visuals depicting impacts of climate change heighten perceived issue importance, whereas visuals depicting solutions tend to enhance people's belief in their capacity to engage in individual mitigation behaviors such as shifting to a climate-friendly diet. One UK-based study found that images depicting air pollution were more effective than images of floods, heat stress, and infectious diseases in generating both concern about climate change and enhanced self-efficacy. More research is needed to better understand how visual communication can be leveraged to enhance both issue importance and self-efficacy.

## Public trust in health professionals

Although health professionals are viewed as one of the most trusted professions globally, less is known about public trust in them as sources of information about climate change. Recent research in the USA, however, found that Americans see their primary care doctor as a highly trustworthy source of information about global warming. Given this potential, additional context-based evidence could offer an opportunity to communicate effectively and urgently through trusted voices in the health care profession.

## Health professionals' knowledge of climate change and willingness to engage

Globally, many health professionals have at least a general understanding of the fact that human-caused climate change is harmful to human health, although most also say they lack detailed knowledge. Globally, many health professionals also express interest in learning more about climate change and health, and about what they can do to be effective educators and advocates. A recent multi-national survey of health professionals found that understanding the health relevance of climate change and the extent of the scientific consensus about human-caused global warming are strongly associated with feeling that health professionals have a professional responsibility to engage in the issue. This perceived sense of responsibility, in turn, is strongly associated with health professionals' willingness to engage in advocacy for policies to protect the climate and human health. As trusted sources of information and willing advocates for climate action, health professionals need the support and partnership of public officials and key stakeholders to be highly effective and impactful.

Collaborating with health professionals can ensure that their expertise informs policy decisions and that their messages resonate with a wider audience, contributing to improved climate change and health outcomes.

## Activating health professionals as trusted voices

Health professionals from many countries, such as Canada, UK, India, Australia, New Zealand, and South Africa, show interest in addressing climate change through their clinical practice and in the public arena. As trusted voices, efforts by health professionals to set personal examples of climate-health action, to decarbonize the health care sector, and to advocate for climate-informed health policy, may be viewed as more credible. Emerging research suggests that climate and health policymaking could benefit from better dialogue between policymakers and health professionals. Multinational research has shown that interested health professionals experience—or at least perceive—barriers to their ability to engage. These include the lack of knowledge, resources, and time, a range of social challenges including issue polarization, fear of damaging professional relationships, and the perceived lack of peer support. Despite evidence of interest from students of health professions from China, the USA, Canada, Finland, and Australia in climate-focused coursework, such curricula are rare. Developing climate and health content for such curricula will require tailored assessments of needed programming and any barriers to adding new educational material. Implementing various strategies—such as providing education and communication trainings, creating resources like

patient education materials to incorporate into existing practitioner routines and policy briefs, giving actionable guidelines on how to achieve climate-friendly health workplaces, promoting workplace and professional policies and cultures that encourage and support advocacy, and providing training to engage in high-impact political advocacy actions—may help reduce these barriers and make it easier for health professionals to collaborate and engage in climate education and advocacy.

### Understanding of and engagement with climate change and health among public officials

Although there is limited evidence, research suggests that public officials display varying levels of knowledge about climate-related health threats. While some exhibit an awareness of the issue, others express uncertainty or a lack of knowledge often influenced by barriers like funding availability, absence of strong leadership, and legal mandates. Advocates should seek to better understand such barriers in order to develop strategies to help alleviate them. Searching for case studies where other organizations have addressed such barriers effectively would serve as a useful model.

In the USA, there is evidence of polarization around beliefs about regional climate and health impacts among local health department directors. Further, two other US studies found that majorities of public health officials do not believe that climate change is currently a priority for their department. Advocates should learn what issues are perceived as priorities for health officials so that they can help them consider how climate change may be linked to those issues and how best to be responsive to such concerns.

These findings highlight the need for education and communication efforts to enhance public officials' engagement with climate change and health; however, there is little systematic research on how to do so effectively. One potential strategy is to increase public engagement with climate change and health and strengthen opportunities for constituents to signal their concern to public officials in order to give officials a stronger mandate to prioritize the issue and take more ambitious actions.

*Image credit: Climate Visuals*

# Introduction

As climate change continues to worsen, so do the associated impacts on human health and health systems. Effective advocacy and communication about the intersection of climate change and health is necessary to fully prepare for and address climate change's current and future impacts. Over the past several decades, climate and health communication research has been a burgeoning field, producing an ever-growing collection of knowledge that can be leveraged to help inform and engage the public, policymakers, health professionals, corporations, and other stakeholders.

In this review, we summarize research on effective advocacy and communication strategies at the intersection of climate change and health for public audiences, health professionals, and public officials. First, we synthesize research on public audiences, including their perceptions of climate change and health, public responses to health-framed climate information, climate and health risks and solutions, information about vulnerable populations and equity considerations, climate- and health-related visual communication and imagery, and their perceptions of health professionals. Then, we provide an overview of research on health professional audiences, including their role in climate and health communication and advocacy, knowledge of the connections between climate and health, willingness to engage with the topic and in climate-relevant actions, and ways to encourage this engagement. Next, we delve into public officials' perspectives and comprehension of the relationship between climate change and health. At the end of each section, we provide a number of key takeaways and practical implications for communication, engagement, and advocacy. Lastly, we end with recommendations for a research agenda to fill the gaps illuminated in this review and foster a growing field on climate and health insight and engagement.

# 1. How do public audiences perceive climate change and health?

As climate change increases, the associated harms to health and challenges to health systems are becoming more frequent, severe, and widespread. A key tenet in the field of public health is that people should be informed about threats to their health and well-being (Maibach et al., 2007). When people possess sufficient information and understanding of how they are at risk, they are more likely to engage in individual and collective actions to minimize the risk (Ferrer & Klein, 2015)

Globally, there has been surprisingly little research to assess public understanding of the health risks and impacts of climate change, although the research that has been conducted suggests that understanding is limited but growing (Hathaway & Maibach, 2018). An early cross-national comparative study conducted in the USA, Canada, and Malta found that, in response to closed-ended survey questions, a large majority of people in all three nations acknowledged that climate change poses significant health risks; however, few participants in any of the countries answered open-ended questions in a fashion that suggested they held a top-of-mind association between climate change and health harms (Akerlof et al., 2010).

*Image credit: commonwealthfund*

## 1.1 USA, Canada, and UK

In the USA, in 2014, about six in ten Americans reported having given "little or no thought" to how global warming may impact human health (Maibach et al., 2015). Further, when asked specific open-ended questions, only 27% were able to name at least one specific health harm associated with climate change or who would be especially vulnerable to these harms (Maibach et al., 2015).

However, in at least one state (Maryland), a majority (59%) said that climate change was a moderate or major risk to their health and well-being (Akerlof & Maibach, 2015). In another survey of Maryland residents, participants recognized that people with health conditions (59%) and the elderly (55%) are vulnerable to climate health impacts (Akerlof et al., 2015). Additionally, Americans surveyed in 2013 viewed the health risks of climate change as more serious in the more "distant" groups impacted (e.g., the entire country or the world), suggesting they did not view themselves or their communities as being at high risk (Stoutenborough et al., 2015). However, by 2020, Americans' understanding of the health consequences of climate change had increased significantly (Kotcher et al., 2020; Roser-Renouf et al., 2021). For example, in 2014, only 26% of Americans said they expected their community to experience an increase in bodily harm due to wildfire smoke over the coming decade; by 2020, this had risen to 54%. A 2019 study found that while over 73% of Americans reported being aware that air pollution from fossil fuel combustion harms health, only 55% were able to name even one health impact of such air pollution (Kotcher et al., 2019a).

In the USA, perceptions of the health consequences of climate change are greatly tied to people's broader climate attitudes and beliefs (Cutler et al., 2018; Roser-Renouf et al., 2021). Between 2014 and 2020, the audience segments known as Global Warming's Six Americas1—ranging from the Alarmed (i.e., those who understand the threat of climate change and are very worried about it) to the Dismissive (i.e., those who think climate change is not real and are likely to believe it is a hoax)—learned about the links between climate change and health at vastly different rates, with considerable learning among the Alarmed, Concerned, Cautious, and Disengaged segments—and little or no learning among the Doubtful and Dismissive segments (Roser-Renouf et al., 2021).

Additionally, political ideology, age, race, and income have been shown to predict heat wave risk perception with white people, conservatives, high-income, and younger individuals perceiving lower risks (Cutler et al., 2018). Evidence also suggests that socio-economic vulnerability predicts heat-related health risk perceptions (Cutler et al., 2018) and that social and health vulnerability predict overall climate health risk perceptions (Akerlof et al., 2015). Additionally, low-income New Yorkers were more likely to be concerned about heat-health risks, and that heat waves due to climate change would harm their health, than higher-income survey participants, although the same was not true for some other high-risk groups (i.e., Blacks and the elderly) (Madrigano et al., 2018).

Canadians appear to be somewhat more aware than Americans of the health harms associated with climate change. A recent study found more than half (58%) of Canadians can name one or more health impacts of climate change when unprompted, with the most common impacts related to food security and agriculture, air quality, temperature-related morbidity and mortality, and extreme events (Casson, et al., 2023). However, this level of awareness represented a slight decline compared with a previous survey that found 63% in 2008 were able to name one or more health impacts of climate change in an open-ended question (Environics Research Group, 2008). Overall, it appears that there has not been a significant increase in public awareness of the health impacts of climate in Canada in the past decade (Casson, et al., 2023).

Studies from the UK suggest public perceptions vary by climate impact and personal experience with climate effects. For instance, a representative survey of UK adults found widespread concern about the effects of climate on UK residents' health, particularly air pollution and severe floods, with those who had experienced air pollution and flooding in the past year twice as likely to say local governments should prioritize addressing those impacts (Harrison & Graham, 2022). However, participants from qualitative interviews conducted in England said they were unsure if the UK was experiencing climate change and found it difficult to see the connection between climate change and health (Martin-Kerry et al., 2023).

## 1.2 Other regions

Several studies have found relatively high levels of risk perceptions about the health impacts of climate change in regions and countries such as Bangladesh, China, Cyprus, Ethiopia, India, Hong Kong, Kenya, Tanzania, Thailand, Laos, Germany, Chile, Malaysia, South Africa, Vietnam, and the Caribbean (Alfaro & Cortés, 2020, Bambrick et al, 2015; Drewry et al., 2022; Fitchett & Swatton, 2020; Gao et al., 2020; Hossain et al., 2021; Kabir et al., 2016; Konstantinou et al., 2022; Leiserowitz et al., 2022a; Li et al., 2019; Mayala et al., 2015; Mahata & Shekar, 2023; Ock et al., 2018; Rahman et al., 2014; Rahman et al., 2021; Toan et al., 2014; Tripathi et al., 2021; van Baal et al., 2023; van Wijk et al., 2020). For instance, a recent survey of Hong Kong residents found that over half perceive the health risks of climate change to be high (Gao et al., 2020). Similarly, a survey of Germans revealed that a majority believe that climate change exists (85%) and has an impact on human health (83%), although they perceive populations elsewhere around the globe to be more strongly impacted than Europeans, Germans, and themselves personally (van Baal et al., 2023). Qualitative interviews with a small sample of residents in the Cerro Blanco Agricultural Community in Chile found that a majority of interviewees perceived significant consequences of climate change on their quality of life and well-being. Specifically, 96% of the interviewees reported impacts on their physical health, and 23% expressed concerns regarding the effects on their psychological well-being (Alfaro & Cortés, 2020). Likewise, in Laos and Thailand, more than 80% of those surveyed in each country believed climate change affects dengue fever; however, only about one-third of those surveyed in each country reported taking actions to reduce dengue risk from climate impacts, such as floods, droughts, and storms (Rahman et al., 2021). In a small focus-group study conducted in South Korea with health professionals and the public, participants shared their experiences of either directly or indirectly encountering aggravated symptoms and increased incidence of diseases associated with climate change. They also expressed concern that health inequalities may be exacerbated, and that the incidence of climate change-related diseases and their treatment may differ according to socioeconomic status (Ock et al., 2018).

By contrast, a study of Kenyan public audiences and health experts found that the public had extremely low awareness of climate health impacts, and while health experts were much more likely to associate climate change with health impacts, they possessed some false beliefs about links between climate science and health (Hussey & Arku, 2019). In another example of low perceived climate-health risk, Millennial and Generation Z participants interviewed in Romania displayed low awareness of connections between climate change and physical health or anxiety, despite noting changing summer and winter temperatures (Petrescu-Mag et al., 2023).

Some additional research suggests that people perceive increasing health harms related to lived experiences of changing conditions in their area, such as droughts or changes in rainfall (de Moura Brito Júnior et al., 2023; Haque et al., 2012; Hossain et al., 2021; Kabir et al., 2016; Mahata & Shekar, 2023; Toan et al., 2014; Torres-Slimming et al., 2021; Li et al., 2019). For example, two surveys of Bangladeshi households from 2010 and 2012 found that a majority of respondents felt that extreme weather events (consistent with climate change) would impact their health (Haque et al., 2012; Kabir et al., 2016).

Also in Bangladesh, riverine island dwellers, who are especially vulnerable to climate change due to geographic and socio-economic factors, reported through surveys and focus groups an increasing experience of health impacts due to climate change that vary by season and during natural disasters (Hossain et al., 2021). In the Kolkata metropolitan region in India, residents who participated in a qualitative study reported experiencing heat-related illnesses, including mental health issues, due to climate change. This impact was particularly pronounced among the elderly and those working outdoors or on low-income thresholds (Mahata & Shekar, 2023). In Hanoi, Vietnam, large majorities (more than 90%) of people from higher-income and lower-income groups surveyed mentioned health impacts as the most important effect of climate change, with follow-up focus groups and interviews describing experiences with rainfall and weather changes and a range of health impacts, such as temperature-related illness, infectious and cardiovascular diseases (Toan et al., 2014). In a qualitative study across three regions of Peru, participants reported being acutely aware of how climate change directly impacts their families and communities. Extreme weather events and pollution were identified as major contributors, resulting in adverse effects on their health (Torres-Slimming et al., 2021). A survey of residents in a region in southwest China revealed that 80% of respondents were overall aware of climate warming. Furthermore, 92% of the participants perceived heat-related health risks, with ethnic minorities showing higher perceptions (85%) compared with Han Chinese (69%). However, Han Chinese had higher perceptions of aggravated diseases due to heat (41%) in comparison with ethnic minorities (31%) (Li et al., 2019).

The inequitable distribution of the impacts of climate change, with many regions of Africa experiencing some of the first and worst effects, is reflected in the findings of many of the studies conducted in these regions. In Tanzania, interviews with heads of households revealed a general awareness that rain and

temperature patterns were changing, contributing to growing food shortages and insecurity reported by the participants (Mayala et al., 2015). In Tanzania, survey results showed that individuals who had been diagnosed with recent HIV/AIDS, cholera, or malaria, as well as those with neglected tropical disease (NTD) comorbidities, were more likely to perceive greater health risks of climate change (Armah et al. 2015; Boamah et al., 2017). In rural Nigerian communities, residents surveyed reported knowledge of many health risks of climate change, with illness/disease for adults (47%) and children (70%) being the most prevalent, followed by increased stress and suffering for adults (25%) and delayed/poor growth for children (8%) (Asekun-Olarinmoye et al., 2014). A majority of residents of two urban communities in Ethiopia contacted via survey and focus groups viewed several climate-sensitive health conditions, including those connected to access to clean water such as typhoid, diarrhea, and polio, to be life-threatening (Bambrick et al., 2015). In Uganda, indigenous women participating in focus groups shared that long-term changes in seasonal patterns (i.e., "climate change") are exacerbating seasonal food insecurity, in turn affecting maternal health during pregnancy and infant health (Bryson at al., 2021). A survey of residents in Kisumu County, Kenya found that 74% of respondents reported an increase in the prevalence of vector-borne diseases such as malaria in association with changes in climatic patterns such as heavy rainfall and floods (Ajuang et al., 2016). A study conducted in Zinginchor, Senegal, found that people living in districts near the Casamance River experienced more frequent environmental effects of climate change, such as heavy rainfall and flooding, and also perceived greater health risks associated with climate change than people living in districts with comparatively less exposure to extreme climatic events (Mbaye, 2015).

A number of studies find that, in certain cases, respondents in certain Asian countries tend to recognize the health harms of changing weather patterns, if not explicitly attributing them to climate change per se (Hathaway & Maibach, 2018). For example, a recent survey in India found that 63% said global warming would cause a great deal of harm to Indians (although only 9% said they knew a lot about global warming) (Leiserowitz et al., 2022a). Furthermore, over half or more said global warming will cause many more disease epidemics (59%), severe heat waves (54%), severe cyclones (52%), and droughts and water shortages (50%) in India over the next 20 years if nothing is done to address it (Leiserowitz et al., 2022b). Similarly, a survey of residents in the Tanahu district of Nepal found that about half or more respondents perceived a change in overall climate (55%), including increased temperatures in the summer (54%) and winter (50%), and increased rainfall during the rainy season (49%) (Mishra et al., 2015). Moreover, about half of respondents also perceived an increase in the occurrence of disease in the summer (50%), the winter (49%), and during the rainy season (49%). In the Chinese city of Jinan, residents surveyed reported high perceived concern and severity about the health-related risks of heat waves (Ban et al., 2019).

A survey of people in 10 Caribbean countries found that 76% said that climate change would have a moderate or large impact on human health. An even larger majority (86%) indicated that Caribbean nations must make a large-scale effort to protect people's health in the wake of a changing climate (Drewry et al., 2022). A survey of Colombian Andean farmers found that they perceive climate change to be harming their health in a variety of ways (Rodríguez et al., 2020). For example, 41% said that increased heat is causing sleep disruptions, and a number also perceived higher rates of illnesses caused by climate change, including diarrhea (67%), dengue (43%), chikungunya (40%), Zika (34%), and allergies (27%). A survey of urban Tibetans indicated that most respondents had heard about climate change and its impact, and over 78% found rising temperatures to be a "very" or "somewhat" serious threat to their health or daily lives (Bai et al., 2013). A survey conducted in Malta found that the perception that climate change poses a risk to health and general well-being was a strong predictor of support for climate change policies and willingness to take action to mitigate climate change (DeBono et al., 2012).

Several studies examined knowledge of the climate-health connection among young people. More than 60% of high schoolers surveyed in Indonesia said climate change affects human health and is already having an impact, but only 15% said climate change is an important problem and 26% said the evidence for climate change was not convincing (Sulistyawati et al.,2018). A survey of primary school children in 12 Chinese cities found that risk perception (perceived risk and health threat of climate change, perceived barriers of mitigation, and perceived benefits of adaptive behavior) along with knowledge and attitude were associated with health-related adaptive behavior, including for extreme weather and climate-related infectious diseases (Wang et al., 2022). A majority of Malaysian university students (70%) surveyed in 2014 reported that climate change had affected their country in the past 10 years, with female students more aware of the resultant impacts on psychological health and malaria and male students more aware of heat-related stress (Rahman et al., 2014). Most of these studies found that people were already reporting personal experience with the effects of climate change and perceived health impacts. However, in one exception, a small survey of 122 high school students in the Philippines found

participants had a poor understanding of basic concepts about climate change, especially in terms of its impacts to health and well-being (Pitpitunge, 2013).

As research on public awareness of the health harms of climate change is sparse and does not always use representative samples—especially outside the USA, Canada, and the UK—much is left to be learned about people's understanding of health and climate change. Research in the USA, Canada, and the UK suggests that while many people in those countries appear to recognize that climate change harms health, few seem to understand the specific ways in which that occurs. Within the 13 studies conducted in the USA, Canada, and the UK, the majority were carried out in the USA (8), followed by Canada (2) and the UK (2). Most of these studies utilized nationally representative samples, with only three not meeting this criterion. Of these, two were conducted with residents of two states in the USA, while one in the UK was a qualitative study with a smaller sample size.

The evidence is less clear regarding public perceptions in other countries due to small or unrepresentative sample sizes, often focused exclusively on specific cities or subnational regions within a country. Out of the 39 studies identified, 18 were conducted in Asia, 11 in Africa, 4 in South America, 4 in Europe, 1 in the Caribbean, and 1 was multi-continental. Among these, only three studies—one in Asia and two in Europe—utilized nationally representative samples. Evidence from several studies suggests that people outside of the USA, Canada, and UK already perceive health harms from climate change and extreme weather, although few studies assess knowledge or awareness of the specific ways in which climate change harms health.

## Key takeaways:

- Public awareness of the health risks from climate change has improved in the USA in recent years, although few Americans possess a deep understanding of these risks. While Canadian awareness of these health risks appears to be somewhat stronger than in the USA, Canadian public awareness has changed little in the past decade. In the UK, a majority of people perceive that climate change is harmful to human health, although comparable evidence about understanding of specific health impacts or changes in understanding over time is unavailable.
- People in regions outside of the USA, Canada, and UK generally recognize that climate change impacts health, although few studies assess knowledge or awareness of the specific ways in which climate change harms health. Moreover, evidence in these regions is limited by small, unrepresentative sample sizes.
- Efforts to educate the public about the specific health harms caused by climate change are especially important because they help clarify how individuals and communities can focus their limited resources to develop effective protective actions against the health impacts that are most relevant to them.
- Public officials advocating for proactive policies to mitigate health risks related to climate change should prioritize educating their constituents about the direct and indirect health impacts of climate change and emphasize the health benefits associated with climate action. At the same time, they must seek to learn about and be responsive to the specific ways in which their constituents may already be experiencing health impacts in their regions.

# 2. How do public audiences respond to health framed information?

Research conducted in the USA suggests that raising public awareness of the health impacts of climate change can enhance public engagement with the issue (Kotcher et al., 2018). One way this can be done is through a communication process called framing—i.e., emphasizing the health relevance of climate change rather than other aspects of the issue (Nisbet, 2009). Research demonstrates that communicating the health harms of climate change and framing climate change as a public health issue—as opposed to an environmental or economic issue—can be an effective way to engage the public (Maibach et al., 2010; Myers et al., 2012; Petrovic et al., 2014; Walker et al., 2017). For example, in a study of US adults, Myers et al. (2012) compared the effectiveness of a public health frame to other frames, such as an environmental frame and a national security frame, in eliciting emotions aligned with support for climate action efforts. The researchers found that emphasizing the health aspect of climate change was associated with more positive emotions and a greater sense of hope, suggesting that framing climate change as a public health issue may be an effective way to communicate with the public and build support for action. Another study of UK university students found that framing climate policies with a public health focus resulted in significantly greater support than frames that only emphasized climate-related benefits (Walker et al., 2017). In the USA, Petrovic et al. (2014) suggest that focusing on the direct health impacts of air pollution from fossil fuels is more engaging than the environmental effects of climate change.


*Image credit: Climate Visuals*

More recently, a large multinational study conducted in five countries—China, Germany, India, the UK, and the USA—examined the effects of four different types of message attributes: frame (economic, environmental, health, and migration), valence (positive vs. negative), scale (individual, community, country, and global), and timeframe (2050, 2030, now) (Dasandi et al., 2022). The effects of the different frames were consistent across the five countries. The health and environmental frames elicited higher public support for climate policies than the economic and migration frames. Framing climate change as a global-scale issue with immediate consequences was also more effective at increasing public support for climate policies. The authors also found that positive, health-framed messages increased support for climate mitigation policies in the USA, the UK, and China, even among those who were not particularly concerned about climate change. The latter finding—that health-frame messaging is particularly effective amongst those not concerned about the effects of climate change—is consistent with results from other studies as well (Kotcher et al., 2018; Kotcher et al., 2021a; Maibach et al., 2010; Myers et al., 2012), indicating that a health frame resonates across the political spectrum and may be helpful in reducing political polarization regarding the need for urgent and effective climate solutions.

In a similar vein, research conducted in the USA suggests messages highlighting the negative health impacts of fossil fuels and air pollution have been found to increase public understanding of the issue, support for clean energy, and willingness to engage in advocacy for solutions (Hart & Feldman, 2021; Kotcher et al., 2019b; Kotcher et al., 2021a). Particularly, US studies find that messages about poor air quality resulting from climate change are especially compelling and likely to increase political engagement aimed at limiting emissions (Hart & Feldman, 2021; Hart & Feldman, 2018; Kotcher et al., 2021a). Another study in the USA found that justifying clean energy policies in terms of their contribution to reducing air pollution as opposed to climate change are more likely to gain the support of American conservatives (i.e., Republicans; Feldman & Hart, 2018).

While the health frame has shown potential for increasing public concern and support for climate solutions, some studies have identified limitations in its effectiveness (Bernauer & McGrath, 2016; Hart & Nisbet, 2012; Levine & Kline, 2017; McCright et al. 2016). For instance, Hart and Nisbet (2012) found that presenting information about the health impacts of climate change strengthened support for climate mitigation policy among US Democrats (liberals), but reduced it among Republicans (conservatives), especially when the health harms were described as occurring to people in distant communities. McCright et al. (2016) found that the effectiveness of the health frame was not robust when Americans, especially conservatives, were also exposed to a climate change denial counter-frame, highlighting the challenge of communicating effectively about the health relevance of climate change in the face of misinformation and denial. Similarly, another study with Americans found little or no empirical evidence for the effectiveness of using health benefits as a frame to justify and build support for climate policy relative to a frame that focuses on environmental risks (Bernauer & Mcgrath, 2016). The authors speculate that the lack of difference between the environmental and health frames might be attributable to the fact that the language differences between the two messages were very subtle, and that participants may have already had strongly held views on climate change (Bernauer & Mcgrath, 2016). Wynes et al. (2021) also found no significant differences in the effectiveness of public health-framed messages versus environment-framed messages in prompting pro-climate tweets from Members of the Canadian Parliament. Nonetheless, their findings suggest that receiving emails from constituents has the potential to motivate policymakers to talk more frequently about climate change and the need for action.

Levine and Klein (2017) found that framing climate change as a risk to personal health can have a paradoxical effect among Americans; it increased their concern about climate change but reduced their willingness to engage in collective political action to address it (i.e., sign an online petition addressed to politicians to end fossil fuel extraction and move towards clean energy). The authors suggest that reminding people of their own health vulnerabilities may have made them feel less capable of investing personal resources into political participation. To counteract this effect, it may be important to emphasize the collective health risks of climate change (vs. the personal health risks) and boost people's sense of response efficacy by focusing on the health benefits to be gained from climate policy as opposed to the health harms avoided (Dasandi et al., 2022; Levine & Kline, 2017).

Largely, the evidence base for the effectiveness of framing climate change as a health issue is positive, with only a few studies showing null or counter-productive effects under certain conditions. However, more research is needed, especially in more diverse geographic contexts beyond the USA. Of the 16 studies on the topic, only one study is multinational, one was conducted in the UK, and the remaining 14 focused on the USA.

People from all political backgrounds care about their health and that of those around them. Focusing on the health risks of climate change and the health benefits of participating in solutions can help make the issue less politically divisive (Dearing & Lapinski, 2020). Additionally, presenting climate change in a health context makes it more concrete, rendering it salient and relevant to the

the public. Moreover, it appears that the success of this frame in enhancing pro-climate attitudes and actions may be contingent at least in part on several factors, such as perceived frame relevance, audience identification with the victims of health impacts, the presence of information about the health benefits of climate policy, prior climate beliefs, and skillful integration with other frames. Climate and health advocates, campaigners and communicators would be wise to consider these factors and also carefully evaluate the potential to elicit resistance or pushback.

Moreover, it is important to note that even powerful messages may have only limited and fleeting effects, although these effects can accumulate over time and become durable with adequate levels of message repetition from trusted sources (Maibach et al., 2023). Communication scientists note that significant communication effects come in many forms including small effects occurring among many people in the population; larger effects occurring among a smaller segment of the population; and decisive effects directly on policymakers and other people who are in a position to implement the necessary actions (see Goldberg & Gustafson, 2022).

## Key takeaways:

- Based on research conducted primarily in high-income countries (particularly the USA and UK), framing climate change as a health issue can increase public engagement and provide people with a greater sense of hope about the issue, compared with framing it as an environmental, economic, or national security issue.
- Focusing on the direct health threats from air pollution caused by burning fossil fuels (without reference to climate change) is another strategy that appears to be promising in terms of encouraging greater advocacy for climate change solutions.
- Importantly, a health frame is especially effective at engaging audiences who tend to be dismissive of climate change and action to address it. Thus, it has the potential to reduce political polarization around the issue.
- Evidence is still emerging, but some factors may inhibit the effectiveness of health-framed information about climate change, such as a lack of audience identification with the portrayed victims of health threats, the presence of an opposition message, or a perceived lack of agency due to a heightened sense of personal vulnerability.

# 3. How do public audiences respond to information on the health risks of climate change and air pollution?

A small but growing body of research suggests that informing people about how climate change and the burning of fossil fuels harms health can increase people's concern about these issues and their engagement with them (Kotcher et al., 2018; Kotcher et al., 2019b; Kotcher et al., 2021a; Kreslake et al., 2016). For example, a US survey experiment found that providing people with specific information about the impacts of climate change increased their belief in the reality that climate change indeed harms health as well as their concern about it (Kotcher et al., 2018). Moreover, providing information about the direct health effects of air pollution from fossil fuels also increases support for clean energy use and decreased support for fossil fuel use, with information about air pollution's neurological harms to children being of greatest concern to Americans across partisan lines (Kotcher et al., 2019b). Using a nationally representative US sample, Kotcher et al. (2021a) found that providing information about the health risks of climate change increased people's intentions to contact their elected officials to advocate for climate and health solutions. Messages that focused on poor air quality were seen as the most compelling, followed by those that focused on food-borne illness and extreme weather (Kotcher et al., 2021a). This pattern of findings was consistent among people across the US political spectrum.

According to another study conducted in the USA, messages emphasizing the climate-induced health risks of mosquito-borne illnesses, like dengue fever, led to an increase in climate change mitigation policy support among people who are skeptical about climate change (Motta et al., 2023).

*Image credit: Climate Visuals*

Similarly, another study found that when exposed to information about the health risks associated with climate change, people who identified as "somewhat conservative" displayed the greatest increase in perceived harm to themselves (Kim et al., 2021). However, other research with Americans found that conservatives' response to stories about the health impacts of climate change varies depending on who is portrayed as the victim of health impacts (Hart and Nisbet, 2012). For Republicans, but not Democrats, exposure to stories that had victims who were socially distant (i.e., those that live outside of the USA) from them decreased support for climate mitigation, producing a boomerang effect (i.e., the opposite of the intended message effect).

A US-based study examined the effectiveness of a narrative format compared to a didactic format in presenting information to pregnant women on the health risks of climate change. The findings revealed that narrative-based information was more effective than didactic information in enhancing pregnant women's knowledge, risk perceptions, self-efficacy, and intentions to adopt risk-reducing behavior. Importantly, narrative-based information had a significantly greater impact on subsequent information-seeking behavior among pregnant women. Those presented with didactic information were less likely to seek additional information, resulting in a boomerang effect (Adebayo et al., 2020).

Additionally, research suggests that vulnerable populations (people with chronic health conditions, low socioeconomic status, and those exposed to environmental hazards) may already perceive their health to be at risk (Akerlof et al., 2015). Providing climate and health information is likely to increase their knowledge, the certainty that climate is impacting their health, and intentions to change their behavior to reduce their risks (Kreslake et al., 2016).

While most research has focused on how people respond to information about the health risks of climate change, few studies have examined responses to information about the financial costs associated with increased health harms caused by climate change. An initial study conducted in the USA suggests that informing people about the health care costs associated with climate change can increase risk perceptions of climate change, especially when communicated in terms of costs on a per household scale as opposed to a national scale (Limaye & Toff, 2023). Given the importance of informing people about the health harms associated with climate change, more research is needed on who responds most to such information and on how best to present the information, especially beyond the USA. All of the ten studies cited in this section about audience responses to climate health risks, including air pollution, rely on US samples. It is important for climate and health communicators to understand the nuances of different audiences and tailor their messages in a way that avoids triggering unintended reactions, especially as the health harms may vary by location and responses may be culturally specific. By targeting specific segments of the public and focusing on messages that resonate with them, communicators can increase the likelihood of their messages being received and acted on.

## Key takeaways:

- Providing information about the specific health harms of climate change and air pollution can serve as a powerful catalyst for increased support for clean energy transitions and informed action. Research in the USA demonstrates that messages that discuss the enduring impacts of air pollution on the children's cognitive development and other air-pollution related health concerns resonate with people across all political party lines.
- The public can play a critical role in increasing political will for policies that mitigate the health risks of climate change or place health at the core of climate action. For example, when people grasp the implications of climate change on vector-borne diseases, they may be more inclined to lobby their local government officials to implement policies aimed at reducing these risks. They may also be more likely to adopt protective actions and personal behaviors to minimize the risk of vector-borne illnesses.
- Skillfully integrating information about health impacts of climate change with information about other risks, such as economic risks, may have potential to further enhance the overall effectiveness of messaging. For instance, highlighting the individual health care expenses associated with climate risks and the health-related economic advantages of proposed solutions may be beneficial.
- Increasing public awareness and knowledge about the health risks of climate change is an important prerequisite to building public and political will to take action on climate change. However, the success of such communication efforts depends on the initial step of conducting a thorough audience analysis to identify key characteristics, values, and concerns of different demographic and social groups. For example, vulnerable groups may benefit from information that highlights how specific vulnerabilities can exacerbate their risks. Conservatives, on the other hand, may be persuaded by information about local health risks than on a global, distant scale.

# 4. How do public audiences respond to information on climate and health solutions?

Relatively little research has been conducted on communicating the health benefits of climate solutions, especially outside of the USA; however, the evidence collected thus far strongly suggests it may be helpful. For instance, an early study (Maibach et al., 2010) conducted in the USA found that people rated information about the health benefits of climate mitigation policies to be clearer and more useful than information about the health impacts of climate change. Notably, these differences were most pronounced among the Dismissive segment of Global Warming's Six Americas—individuals who tend not to believe in the reality of climate change.

Further, a survey experiment conducted in five nations—China, Germany, the UK, India, and the USA—found that emphasizing the benefits of climate mitigation efforts strengthens public support for climate policies more than emphasizing the impacts (Dasandi et al., 2022). Another study found that a majority of Americans favor renewable energy policies if they are presented with information highlighting the benefits to public health and job creation (Stokes & Warshaw, 2017). Emphasizing the benefits of reduced air pollution was especially effective in increasing support for a renewable energy policy among more conservative audiences (i.e., Republicans). Another study found that Americans are most likely to respond to information that includes the risks posed by climate change to health, potential solutions, and a call-to-action (Kotcher et al., 2021a). Of these three message categories—impacts, solutions, calls-to-action—solutions information was the most effective, although the messaging that included all three was substantially more effective than messaging that included only one or two categories of information.


*Image credit: Climate Visuals*

As noted above, most research on how people respond to solutions regarding climate change has been conducted with US participants. Only a few studies have been conducted in non-US contexts, mostly in Europe (Amelug et al., 2019; Herrmann et al., 2020). For instance, research in four countries—France, Germany, Norway, and Sweden—found that households that received information on direct health benefits were more willing to adopt individual mitigation actions than households provided with information on financial savings from adopting mitigation actions (Amelung et al., 2019).

Additionally, compared with communication that emphasizes a reduction in health risks (i.e., loss frame), communication that highlights the health benefits to be achieved from taking action (i.e., a gain frame) tends to be more effective at building support for climate policy (Spence & Pigeon, 2010; Dasandi et al., 2022), more likely to mobilize people to engage in advocacy (Levine & Klein, 2017), and more effective in evoking hope (Nabi et al., 2018).

Presenting solutions-focused information may also be helpful in avoiding undue anxiety or distress and activating positive emotions. Positive emotions, like hope, have been found to be strongly associated with pro-climate intentions (Chadwick, 2015; Feldman & Hart, 2016; Nabi et al., 2018; Ojala, 2012). Evoking negative emotions, like fear and anger, can also be motivating, but social science theories suggest that fear appeals are most effective when they contain both a threat as well as an efficacy aspect that can evoke hope and a sense of agency (Witte, 1992). A study found that climate and health messages that first evoke fear and then hope are more likely to strengthen people's intentions to engage in climate advocacy than messages that only evoke fear, only evoke hope, or present the messages in the opposite order (i.e., hope first, then fear; Nabi et al., 2018).

More research is needed outside the Global North, particularly as perceptions of solutions may be influenced by local cultural and political context. Only one of 12 available studies—a cross-national survey experiment that relied on samples representative in age, gender, and region from the UK, Germany, China, and India— included participants outside the USA, UK, or European Union. Furthermore, while two of the US-based studies used representative samples, several of the other studies used non-representative or student samples. Yet overall, existing research strongly suggests that highlighting the health benefits of climate change solutions is an effective way to promote support for climate policies and advocacy.

## Key takeaways:

- Highlighting the benefits of clean energy, reduced air pollution, and improved public health can be more effective in building public support, mobilizing people to take action, and evoking hope.
- Messages that include three elements—information on the health risks posed by climate change, potential solutions, and a clear call to action—have been shown to be more effective than messages that only consist of one or two elements. Messages that first evoke fear and then transition to hope are more likely to strengthen individuals' intentions to engage in climate action.
- Information about the health benefits of climate change solutions appears to be a promising way to engage audiences that tend to be more dismissive of climate action (e.g., political conservatives).
- While most research has been conducted with US participants, conducting similar studies in different countries and regions can help tailor messages to local contexts and preferences.

# 5. What do we know about integrating equity in climate change and health communication?

Regrettably, little research has been conducted on communicating the inequities associated with the disproportionate impacts of climate change on the health of the most vulnerable populations, including people in low-income communities, ethnic and racial minorities, women, children, people with chronic illnesses and disabilities, and people who earn their livelihoods outdoors (Pearson et al., 2017). Despite this gap in research, there are a few studies that suggest that this type of messaging may have both promise and drawbacks, as it may increase engagement among some audiences while also exacerbating polarization.

Many people have little understanding of the disproportionate impacts of climate change on the health of marginalized groups (Maibach et al., 2015), and it can be a difficult topic to communicate for various reasons: the topic can raise deeply rooted biases about personal responsibility; climate change is perceived by many as politicized; and discussing fair ways to address inequities can be challenging due to long-standing conscious and unconscious prejudices related to age, income, gender, race, and disability (Seaver et al., 2021). Furthermore, members of vulnerable groups may not view themselves as being at greater risk. For instance, patients undergoing pulmonary rehabilitation in alpine Switzerland and Germany did not report feeling more vulnerable to climate change than healthy tourists to those areas, although both groups expected to be more affected in the future (Götschke et al., 2017). Similarly, a recent survey of Chinese construction workers found overall low heat-risk awareness (Han et al, 2021).

*Image credit: Climate Visuals*

However, a recent focus group study with Americans suggested a potentially useful narrative for helping people understand climate and health equity considerations among ethnic and racial groups (Seaver et al., 2021). First, establish people's widely shared desire for healthy, safe, and stable communities. After establishing this shared connection, communicate how changes in the environment threaten our shared desire for stability, and how those changes can harm our health. Then, explain that while climate change can harm everyone, pre-existing inequities cause some groups of people to be harmed first and worst, starting broadly by naming some of the drivers of inequities before discussing racial inequities. End with optimism about solutions by providing examples of how they are already being implemented and emphasize that individuals have a role to play in supporting these solutions (Seaver et al., 2021). While this narrative has thus far only been illuminated by focus group findings with small sample sizes, future research should empirically test these recommendations on a larger scale.

Targeting messages specifically to members of vulnerable populations may be another strategy to help avoid unintended consequences. For example, a small mixed-method study in the USA with participants from low-socioeconomic status communities with chronic health conditions found that targeted educational materials designed to help them understand how climate change exacerbates certain chronic health conditions were effective at increasing knowledge of these health effects and intentions to engage in protective behaviors (Kreslake et al., 2016). However, members of vulnerable populations may not always view risk information specifically about their own group as more concerning than risk information about other groups. In one study, older adults and members of low-income communities viewed information about the disproportionate neurological impacts of air pollution from fossil fuels on babies and young children as far more concerning than comparable information about the heightened vulnerability of older adults and low-income communities to such air pollution (Kotcher et al., 2019b).

While these strategies seem promising, a recent review paper highlighted three potentially problematic assumptions often made about the enhanced effectiveness of equity- and identity-based messaging that may not hold up in practice: (1) that racial and ethnic majority and minority groups view messaging encouraging diversity as inclusive; (2) that highlighting specific groups based on their identity will engage the targeted audiences; and (3) that enhancing the salience of climate-related inequities bolsters public support for efforts to reduce those inequities (Tsai & Pearson, 2022). Those developing climate and equity messages should therefore be wary of these assumptions, as they are often developed with the expectation of enhancing message effectiveness, while in reality they may produce the opposite of the desired effect. Empirical research is needed to test these assumptions and the boundaries within which they either enhance or undermine the goal of communication.

The evidence base on integrating equity into communication about climate change and health is thin, with three studies, conducted in the USA, China, and Switzerland and Germany, that examined people's understanding of the inequities associated with the health impacts of climate change. Only two empirical studies, both conducted in the USA, investigated the impact of communicating those inequities.

## Key takeaways:

- Although research on equity in climate change and health communication is somewhat scarce, a key takeaway is that practitioners and policymakers must strive to develop and use messages that are clear, accessible, and relevant to the experiences and concerns of the target audience.
- Some members of vulnerable groups may not believe they are at greater risk of climate and health impacts. Targeted communication materials for vulnerable populations about the health impacts of climate change may help increase their understanding of these impacts and willingness to take protective behaviors.
- At the same time, practitioners must be mindful of potential unintended consequences and should avoid making assumptions that may not hold up in practice. For example, messages intended to highlight health disparities may not necessarily be effective at building support to reduce those disparities, especially among less vulnerable audiences who may feel that such concerns are not personally relevant to them. Working with researchers and experts to evaluate the impact of different communication approaches, especially with more diverse samples that include members of vulnerable groups, can help effectively promote understanding of climate change inequities and build support for efforts to address them.

# 6. How to harness the power of visual communication

In the context of climate change communication, visual imagery can be a particularly effective tool. Although research is sparse on climate and health imagery, prior studies on public engagement with climate visuals offer valuable insights. O'Neill et al.'s (2013) study with participants from the USA, UK, and Australia found that concrete images that depict the impacts of climate change, such as aerial views of a flood or pollution, had the greatest potential to increase perceived issue importance. On the other hand, imagery that depicted climate solutions, such as solar panels or pro-climate lifestyle choices, had the greatest potential to enhance perceptions of self-efficacy to engage in individual mitigation behaviors. A follow-up study by Metag et al. (2016) in Germany, Switzerland, and Austria yielded similar results.

Although fear-inducing images associated with climate impacts have been effective at capturing people's attention, some research has found that such images can lower self-efficacy, i.e., participants feel less capable of doing anything about climate change (O'Neill & Nicholson-Cole, 2009) and prompt strong negative emotions (Leviston et al., 2014; Chapman et al., 2016). Images of climate solutions, conversely, have been shown to be associated with greater perceived self-efficacy but lowered issue saliency (O'Neill et al., 2013; Metag et al., 2016). However, other research fails to find this apparent trade-off. Research conducted in Germany, the UK, and the USA found that while images of climate impacts generated negative emotions, they also had greater positive effects than images of climate solutions on various outcomes including:

*Image credit: Climate Visuals*

Other research found that images where the subjects were perceived to be 'real' people (as opposed to imagery with politicians or protestors that was perceived to be staged or clichéd), especially with direct eye contact, were perceived as more credible and authentic and elicited greater concern and motivation to act among participants (Chapman et al., 2016). Based on the available evidence, imagery that is centered around authentic representations of people in their everyday contexts and combines depictions of climate impacts with solutions and calls-to-action may foster the use of imagery as an effective communication tool.

Finally, in what stands as perhaps the only study so far on how the public perceives imagery that specifically communicates the health impacts of climate change, a survey of UK citizens found that images depicting air pollution were most effective (more so than images of floods, heat stress, and infectious disease) in generating concern about climate change as well as perceived self-efficacy, i.e., the belief that they can do something to mitigate or adapt to the issue (Climate Outreach, 2020). About three in four respondents (75%) said that air pollution was a climate impact that they could personally do something about; relatively few people felt that was true about heat stress (12%), floods (6%), and infectious disease (7%). Imagery that emphasizes and builds on air pollution as a health impact of climate change may be an effective strategy.

There is also some evidence to suggest that current media portrayals of climate impacts on health do not accurately portray the issue. A recent study of visual news coverage of the 2019 heatwaves in France, Germany, the Netherlands, and the UK found that the majority of media images portrayed heat waves as fun with leisure activities such as spending time at the beaches, pools, and fountains. In instances where the images sought to highlight the hazards associated with heat waves, people were often excluded from the frame (O'Neill et al., 2022).

Visual imagery is a powerful communication tool that has been largely unexplored in the context of climate change and health. To date, of the seven studies identified, three used qualitative analysis with smaller sample sizes, two relied on large-scale surveys, one employed mixed methods, and another conducted a content analysis of visual discourse on this subject. Notably, all seven studies were conducted in the Global North. More research is needed to understand the standalone effectiveness of visual imagery as well as its effectiveness when combined with the written communication strategies highlighted in the previous sections.

## Key takeaways:

- Practitioners would be wise to use visual imagery that strikes a balance between showing the health impacts of climate change, such as air pollution or extreme-heat-related illnesses, and showing practical climate solutions. Showing climate impacts can raise the perceived importance of climate change, while highlighting solutions can boost self-efficacy and motivation to take action.
- Compared with other types of climate-related health impacts, people are more likely to believe they can personally do something to protect themselves from air pollution. Using visuals depicting air pollution as a climate and health impact—instead of those associated with extreme heat, flooding, and diseases—may therefore be an effective communication strategy to encourage action.
- Visuals that feature 'real' people, especially those with direct eye contact, make communication more credible and relatable. Authentic representations of people in their everyday contexts can elicit greater concern and motivation from the audience.
- Media portrayals of climate-related health harms can sometimes downplay the severity of the issue. Practitioners should work with journalists to improve the use of visuals that depict real people experiencing climate-related health impacts and taking protective measures to mitigate these harms.

# 7. Public trust in health professionals and why it matters for climate and health communication

In 2022, doctors were viewed as the most trusted profession across the world (IPSOS Global Trustworthiness Index, 2022). In US and UK national surveys that also included public trust in other categories of health professionals, nurses and pharmacists are perceived to be just as trusted, if not more trusted, than doctors (Inc, 2023; IPSOS Veracity Index, 2022).

A 2022 poll in the USA found that people see their primary care doctor as a highly trustworthy source of information about global warming (Leiserowitz et al., 2022a). The high degree of trust in one's primary care doctor as a source of information about global warming was notable among conservative Republicans who were surveyed, who ranked primary care doctors as the second-most-trusted source of information about global warming besides their friends and family. In the same study, the American Medical Association was also highly ranked as a trusted source, although not as highly as people's primary care doctors. Additionally, a 2021 survey conducted by ecoAmerica found that 64% of Americans trust health professionals for climate change information (Speiser & Hill, 2021).

Few studies have examined trust in health professionals as a source of information about climate change in countries outside of the USA. In one exception, a survey of 90 patients in French Polynesia found that more than half (53%) of the patients said they had never thought about the link between climate change and health. Further, while more than eight out of ten (83%) patients reported having high confidence in their doctors as a source of information about environmental issues and health, only just over one out of ten (13%) patients had ever discussed the topic with them (Walter et al., 2022).

*Image credit: Richard Amoako*

Little is known, however, about how the public reacts to health professionals who engage with the topic of climate and health in ways beyond providing information, like engaging in advocacy. One US study tested people's responses to different types of climate activists, including both doctors and nurses. They found that being a doctor or nurse made little difference (positive or negative) in terms of people's perceptions of the activist (Stenhouse & Heinrich, 2019). Another US study examined how information about doctors engaging in different types of advocacy influences trust in health professionals as a source of information about climate change. Specifically, the study tested vignettes about doctors acting alone or as a group to educate their communities, advocate with policymakers, and engage in nonviolent civil disobedience to stop the local development of fossil fuel infrastructure. The author found that exposure to information about doctor(s) engaging in different types of advocacy led to an overall increase in trust in health professionals as a source of information about climate change, with the exception of information about an individual doctor engaging in nonviolent civil disobedience (Campbell, 2023). The findings from these studies suggest that health professionals engaging in climate advocacy may not be polarizing.

On the whole, several long-running, representative surveys (one multinational survey that includes representative samples in 28 countries, as well as one in the USA and two in the UK) provide compelling evidence that health professionals are among the most trusted professions in the world. In addition, two large-scale surveys conducted in the USA underscore the high level of trust in health professionals as reliable sources of information on climate change. Outside the United States, only one smaller study has examined patients' trust in health professionals as sources of information on climate change issues.

In addition, only two studies, both conducted in the USA, have examined public reactions to health professionals engaging in high-impact actions such as advocacy. However, it's clear that the current body of evidence needs to be expanded to fully understand how the public would respond to the range of actions that health professionals could take to advance solutions to both climate and health issues.

## Key takeaways:

- Health professionals, notably doctors, nurses, and pharmacists, are widely perceived as highly trusted sources of information for the public. Public trust in these professionals extends to their role as a source of information about climate change, including among politically conservative groups, making them effective messengers for communicating important information about climate change and health. Practitioners and policymakers should consider collaborating with health professionals, medical associations, and organizations on climate and health communication initiatives.
- Research has shown that public responses to health professionals who engage in climate advocacy are generally positive, enhancing rather than diminishing trust. Practitioners should provide training and create opportunities for health professionals to engage in climate change advocacy.

# 8. Unique and necessary roles for health professionals in supporting societal action

Because health professionals are highly trusted, scholars suggest they are well-positioned to educate their patients, the public, and policymakers about the human health relevance of climate change and advocate for systems-level climate and health solutions (Charles et al., 2021; Kreslake et al., 2017; Maibach et al., 2019; Maibach, Miller, Armstrong, et al., 2021; Maibach, Frumkin, & Ahdoot, 2021; Wynes, 2022; Chang & Gundling, 2023). Indeed, some have argued that health professionals have a unique and necessary role to play if global warming is to be limited to 1.5 to 2.0 degrees Celsius (Maibach et al., 2019). To be certain, this does not mean that all responsibility for advancing societal action on climate change and health falls upon health professionals. We highlight their role here, in part because they are on the frontlines of this issue, they are highly trusted messengers, and because a considerable degree of research has focused on supporting engagement within this community of practice.

Most fundamentally, health professionals can educate their patients, members of their community (including their professional community), and their policymakers about how climate change harms human health and health systems, and what can be done to protect the health of people and the health of the climate. As a trusted source of climate and health information, health professionals are among those best situated to effectively engage in these types of dialogues. For instance, in a study conducted at a pediatric clinic in the USA, a total of 234 families were exposed to a carefully crafted, standardized message concerning the impacts of climate change on children's health.

*Image credit: Climate Visuals*

A survey of those patients indicated a significant increase in knowledge acquisition, with a majority (89%) of participants reporting a heightened understanding of climate-change-related health risks subsequent to their clinic visit, including self-identified political conservatives (86%) whose prior awareness of climate health harms was significantly lower than others (57% vs. 90% for liberals and 78% for moderates) (Lewandowski et al., 2021). Importantly, none of the families expressed any dissatisfaction with the counseling they received from their physician. In a German study, Reismann et al. (2021) found that 71% of patients surveyed expressed willingness to participate in climate-friendly behavior if physicians informed them about climate-related health risks. Patients who received climate specific medical advice from their physician demonstrated heightened risk perception of climate change and greater concern about its impact on their health compared with those without such advice.

Limited survey and interview research with non-representative samples suggests that the personal climate actions of climate scientists (Attari et al., 2016) and high-profile individuals (Westlake, 2017) influence others' climate intentions. As trusted messengers, health professionals who engage in personal climate action may influence bottom-up approaches to implementing climate and health solutions (Maibach, Frumkin, & Ahdoot, 2021; Wynes, 2022).

Health professionals can also participate in efforts to transform health institutions including clinics, hospitals, and health systems, as the health sector's greenhouse gas emissions account for approximately 5% of global greenhouse gas emissions (Health Care Without Harm, 2019; Pichler et al., 2019; Romanello et al., 2022) and around 10% in the USA (Health Care and the Climate Crisis, 2022). Given their trusted status, advocating for these changes can potentially set important new norms that can influence markets and policymakers, while also greatly reducing the carbon footprint of the health sector (Dzau et al., 2021; Howard et al., 2023). For instance, important institutional changes can include decarbonizing operations by producing and/or purchasing renewable energy and adopting other sustainable practices; and increasing the resilience of health facilities to climate impacts (Dzau et al., 2021; Maibach, Frumkin, & Ahdoot, 2021; Wynes, 2022).

In their communities, state or provincial capitals, and national capitals, health professionals can also advocate for policies and programs that will protect the climate and promote health benefits—like replacing fossil fuels with clean energy; electrifying buildings, appliances, and vehicles so they operate on clean energy rather than fossil fuel combustion; promoting active transportation options, including walkable and bikeable neighborhoods and cities, reduced city parking, and enhanced public transit options; and promoting climate-smart foods and food systems (Böhler et al., 2022; Maibach, Frumkin, & Ahdoot, 2021; MSCCH, 2022; Wynes, 2022).

Lastly, as a global problem, addressing the health harms of climate change requires international action. To do so, health professionals and health organizations can work together to influence international agreements, including advocating for strengthened commitments during the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP) and signing and promoting the international call for a Fossil Fuel Non-Proliferation Treaty[2].

While health professionals are well-positioned to support climate action due to their status as trusted messengers, only two studies assessed the results of direct provider-patient climate-health counseling (Lewandowski et al., 2021; Reismann et al., 2021; Quitmann et al., 2023). Additional research from a variety of national and clinical contexts is needed to determine whether those results are generalizable. Evaluating the efficacy of health professionals' advocacy within their own institutions and with external policymakers can offer evidence about a promising approach.

## Key takeaways:

- Health professionals have a unique and essential role in educating patients, communities, and policymakers about the health implications of climate change.
- When health professionals provide information about climate-related health risks, patients report increased awareness and willingness to engage in climate-friendly behaviors.
- In many contexts, health professionals have the potential to help contribute to change, not only through education, but also by taking climate-friendly actions in their personal and professional lives such as reducing their carbon footprint and advocating for institutional changes within the health sector to reduce greenhouse gas emissions.
- Health professionals can also work to advocate for policies that protect people from the health effects of climate change at subnational, national, and international levels. Moreover, health professionals can work with policymakers to help build and sustain public support for such actions via their role as trusted messengers.

# 9. Health professionals' knowledge of the health relevance of climate change

Research has shown that many health professionals across the world have at least a general understanding that human-caused climate change is harmful to human health, though many also say they lack detailed knowledge. Examples of this research include studies from the USA, Canada, Australia, Ethiopia, Finland, India, Kenya, and China that show that large majorities of health professionals perceive climate change as a threat to human health and possess varied degrees of confidence in their knowledge of the topic (Bedsworth, 2009; Hawkins et al., 2015; Hussey & Arku, 2019; Maibach, Chadwick, McBride, et al., 2008; Majra & Acharya, 2009; McIver et al., 2016; Nigatu et al., 2014; Ock et al., 2018; Paterson et al., 2012; Polivka et al., 2012; Purcell & McGirr, 2014; Sarfaty et al., 2014, 2015, 2016; Sambath et al., 2022; Shrikhande et al., 2023; Syal et al., 2011; Tiitta et al., 2020; Tong et al., 2016; Tong et al., 2017; Wei et al., 2014; Xiao et al., 2016; Yang et al., 2020).

A large multinational survey of physicians and nurses conducted in 2020 found that nearly all survey participants understood that human-caused climate change is happening, that it is already harming human health in a variety of ways, and that these harms are likely to worsen in the future (Kotcher et al., 2021b). Further, more than 9 in 10 (91%) survey participants stated they were worried about the problem, and three out of four (75%) said the problem was personally important to them. Similarly, a separate multinational survey of physical and rehabilitation medicine professionals found that nearly all (96%) of the participants believed climate change was happening, and the majority believed that it was caused entirely (16%) or mostly (57%) due to human activities (Campbell et al., in press).

*Image credit: Climate Visuals*

A 2019 study of public health professionals from six African countries—Ghana, Nigeria, South Africa, Namibia, Ethiopia, and Kenya—found that nearly all said their countries had experienced climate change extensively (63%) or to some extent (32%), and that they had experienced the health impacts of climate change in their countries extensively (50%) or to some extent (38%; Opoku et al., 2021). More than three-quarters (76%) of survey participants stated that the magnitude and severity of diseases related to climate change would increase in the future if climate change was not addressed in public health programs (Opoku et al., 2021). A 2022 survey of South African health professionals, primarily doctors, also found that nearly all participants (97%) believed climate change was a reality, with three in four (75%) stating that it was mostly human-caused and more than nine in ten (93%) stating it will harm them, their communities, and their patients (Manga et al., 2022). A majority of public health professionals surveyed in China said that climate change would impact vector-borne diseases generally (66%–89%, depending on the specific province) and dengue fever specifically (65%–88%, depending on the province), with those from areas at higher risk for dengue fever more concerned (Tong et al., 2019). In Uganda, interviews with village health team members found general agreement that climate change is increasing vectors that transmit diseases, that new diseases are affecting humans and livestock, and that climate change is impacting food systems (Siya et al., 2021).

A 2021 qualitative study conducted in Canada found that health professionals viewed climate change as a major physical and mental health problem in their area and as a strain on the social determinants of health and a driver of health-related inequities (Sanderson & Galway, 2021). A study of health professionals in seven Caribbean countries found that 99% of participants believed in climate change, with 91% expressing concern for its impact on patients. Additionally, over 89% of participants strongly or somewhat agreed that health professionals bear a responsibility to raise awareness about the health consequences of climate change among both policymakers and the general public (De Freitas et al., 2023). A separate survey of health professionals specifically in the Camagüey municipality in Cuba found that 90% of respondents identified respiratory diseases as sensitive to climate change and 81% identified the elderly as the population most at risk (León-Ramentol et al., 2019).

In a study examining the perspectives of German anesthesiologists, nearly all (98%) participants understood that climate change is primarily caused by human activities, and a majority (83%) said that climate change was already affecting public health in Germany (Baumann et al., 2022). The research also highlighted a strong sense of responsibility among medical professionals, with 89% believing that they have an obligation to take action on climate change as part of their roles as doctors (Baumann et al., 2022). In another survey of German outpatient physicians, 83% of participants agreed that climate change is a serious and urgent problem, and a substantial majority (88%) expressed a sense of responsibility for taking climate-friendly actions in their practice (Mezger et al., 2021). Further, a significant proportion (84%) indicated willingness to provide advice to their patients on climate- and health-friendly lifestyle choices. However, barriers such as lack of information and support from colleagues were cited as obstacles to their efforts (Mezger et al., 2021). Similarly, a survey of mainly German pediatricians (96%) found that 80% of these health professionals recognized the effectiveness of strategies to address the health impacts of climate change (Edlinger et al., 2022). These strategies included providing relevant information to parents through means such as fliers and posters, and reaching out to young people through electronic platforms. However, the study also highlighted that 76% of pediatricians have not yet implemented these proactive measures (Edlinger et al., 2022).

However, not all studies of German health professionals suggest high levels of knowledge and engagement with climate-health connections. One study of interviews with German general practitioners found that while participants were generally aware of heat impacts on the elderly, they lacked a full understanding of the diversity of such risks and held varying levels of certainty about whether climate change leads to extreme heat (Herrmann & Sauerborn, 2018).

A 2019 survey of US pediatricians interested in environmental health found that nearly all (90%) expressed interest in learning more about climate change and health and what they can do to be more effective educators, advocates, and how to help their communities adapt (Kemper & Etzel, 2020). Another survey conducted in 2022 among health care professionals in Minnesota, USA, revealed that while a majority (75%) agreed that climate change is happening and it impacted the health of their patients (60%), only 21% felt adequately prepared to discuss climate change with their patients (Kircher et al., 2022).

A 2022 survey of Italian pediatric pulmonologists found that the overwhelming majority of participants were interested in the issue of climate change and health (96%) and more than three out of four agreed that it is the “greatest global health threat of the 21st century” (76%; Lauletta et al., 2022). Another recent study conducted among health professionals in Italy demonstrated that a significant majority (97%) acknowledged the potential impact of global warming on human health and recognized (93%) the capacity of health professionals to contribute towards reducing these impacts (Torre et al., 2023). A survey of a global

gastroenterology society's leadership found that most participants (86%) believed that climate change was human-caused, although many also believed there were more pressing issues for their societies to attend to (80%; Leddin et al., 2022).

A 2022 survey of the Indian health care workforce (i.e., doctors, community health workers, administrators) found high knowledge about links between climate change and direct impacts (such as vector-based diseases and extreme temperatures) but relatively low knowledge about indirect impacts (e.g., malnutrition) (Sambath et al., 2022). As with studies of health professionals' knowledge of the climate-health connection, research about students in medical professions shows an overall awareness, but incomplete knowledge and a desire for additional training. For instance, large majorities (i.e., 90% and above) of Chinese medical students (Liao et al., 2019) and Chinese medical, public health, and nursing students (Yang et al., 2018) in two surveys said they knew about the effects of climate change on air-quality and heat-related illness, but fewer (39% in each study) understood the risks to nutrition. In the 2019 survey, 80% said they required additional knowledge and information (Liao et al., 2019). Medical students in Canada (Létourneau et al., 2023) and Australian general practitioners and trainees (Purcell & McGirr, 2014) surveyed said they believed climate change would affect the health of their future patients.

Few studies have investigated the sources of information that health professionals use to learn more about climate change and health. However, a Chinese survey of health professionals in the city of Harbin found that the highest proportion of respondents learned about climate change and health from the internet (74%), followed by television or radio (61%), books and newspapers (46%), friends or co-workers (15%), training or conferences (1%), or by other means (12%; Gao et al., 2017).

The evidence base regarding health professionals' knowledge of the health relevance of climate change is relatively geographically diverse, with almost half (19 of 43) of included studies engaging Global South populations, as well as three large multi-continent, multinational surveys. Twelve studies occurred in Asian contexts (seven of those in China), five from Africa (including one multinational survey), and two from the Caribbean (with one multinational survey that included the South American nation of Guyana). The three large, multi-continent surveys as well as many other surveys sampled major medical societies or organizations, providing data from a range of professionals in terms of geography and medical specialty.

## Key takeaways:

- Overall, there is a relatively strong degree of evidence to indicate that health professionals worldwide possess a general understanding that climate change harms human health, but their knowledge varies. That is, while they recognize the threat of climate change, they also lack detailed knowledge about the subject, which limits their ability to act. Health professionals across many nations also believe climate change is already negatively impacting health in their communities. Numerous studies indicate that health professionals, including medical students, are eager to learn more about the connections between climate change and health. Ongoing education and training programs on this topic can help bridge this knowledge gap.
- Many health professionals around the world report feeling a strong sense of responsibility to address climate change by advocating for climate-friendly practices within their health care settings and participating in initiatives to mitigate climate change. To support these efforts, practitioners and policymakers should focus on providing relevant education and dedicated resources for health care professionals to engage in climate efforts.

# 10. Activating health professionals as trusted voices

## 10.1 Health professionals' willingness to engage in communication and advocacy

There is a growing call for health professionals to engage with the intersection of climate change and health (Kreslake et al., 2017; Maibach, Sarfaty, Mitchell, et al., 2019; Maibach, Miller, Armstrong, et al., 2021; Maibach, Frumkin, & Ahdoot, 2021; Wynes, 2022). In the 2020 multinational survey noted above, nearly seven out of ten (69%) participants reported that they were interested in receiving information about when and how to advocate with policymakers, and more than one in four (26%) expressed willingness to be a part of a global advocacy campaign to promote climate and health solutions (Kotcher et al., 2021b). Additionally, most said they believe health professionals have a responsibility to communicate the health impacts of climate change to both the public (86%) and policymakers (90%). A 2022 survey of primarily US dermatologists also found that the majority of participants felt they had a responsibility to educate patients (77%), other providers (85%), and policymakers (89%; Mieczkowska et al., 2022).

A series of earlier surveys conducted with three US medical societies—the American Thoracic Society, the National Medical Association, and the American Academy of Allergy Asthma and Immunology—also found that large majorities of physicians felt that health professionals should be educating the public about the health relevance of climate change, and that their professional societies should be advocating for climate and health solutions (Sarfaty et al., 2014, 2015, 2016).

*Image credit: Climate Visuals*

A 2018 survey of US medical, nursing, and physician assistant students found that most were highly engaged with the topic, with 90% feeling that they have a responsibility to both conserve resources and limit pollution in their practices (Ryan et al., 2020). Similarly, a majority of Turkish nursing students convened in a focus group said that public health nurses should help prevent global warming, conduct relevant research, and educate patients (Ergin et al., 2021). A 2019 survey of primarily US-based pediatricians interested in environmental health found that they consider candidates' climate stances when voting (76%), had contacted a government official about climate change (49%), and had participated in a march or demonstration in support of climate action and climate justice (29%; Kemper & Etzel, 2020). A 2022 survey of general practitioners and patients based out of French Polynesia found that 56% of general practitioners said that climate change is relevant to primary care, and 46% said that doctors should play an important role in addressing climate change with their patients (Walter et al., 2022). A large survey of Indian health professionals showed high support (73%) among respondents in learning more about the connection between climate change and infectious disease, and majorities reported participating in climate change (57%) and air pollution (57%) awareness campaigns, as well as in efforts to educate health facilities to adopt renewable energy (58%). The study also found that majorities were interested in learning more about implementing clean energy at their health care facilities (68%), and green hospital design and construction (57%; Sambath et al., 2022)

A secondary analysis of the 2020 multinational survey of physicians and nurses (Lee et al., 2021) found that agreement with the sentiment that "health professionals have a responsibility to bring the health effects of climate change to the attention of the public" (termed "professional responsibility" by the researchers) was a strong predictor of health professionals' willingness to "participate in a global advocacy campaign by health professionals to encourage world leaders to strengthen their commitments to achieving the goals of the Paris Climate Agreement." In turn, strong predictors of "professional responsibility" included understanding the extent of the consensus among climate scientists in the reality of human-caused climate change, being certain about the reality of human-caused climate change, and understanding that climate change is already causing a range of harms to human health in one's own country. This research suggests that efforts to educate health professionals about the nearly unanimous scientific consensus on human-caused climate change, as well as the many ways in which climate change is already harming people's health in their community or their country, will lead more health professionals to feel a sense of professional responsibility to engage with climate change.

On a smaller scale, qualitative interviews with hospital employees at one hospital system in the USA showed that health professionals are interested in receiving climate and health information and may be willing to advocate for hospital-wide climate and sustainability solutions (Hubbert et al., 2020). Similarly, qualitative interviews with health professionals from Northern Ontario, Canada found that participants felt that health professionals have an important role to play in promoting climate action but expressed a desire for more training and support to do this kind of work (Sanderson & Galway, 2021). A series of qualitative focus groups with clinical nurses based in Quebec, Canada, explored perceptions of their role in the promotion of sustainable diets. Findings suggest that the nurses were already addressing some aspects of sustainable eating in their clinical practice, but they were open to doing more with increased support from health organizations and with clearer guidelines and tools (Larente-Marcotte et al., 2022).

A qualitative study of US physicians investigated why and how they engage in climate-related conversations with patients and what resources are needed to facilitate such conversations further (den Boer et al., 2021). They found that most participants believed these conversations should be included in clinical encounters as a way to help patients understand how to protect their health. Despite this, they also found that physicians are wary of making patients feel fearful or powerless against climate change and did not want to harm their relationships with patients. Participants suggested that resources developed for both health professionals and patients, tailored for different specialties, would be helpful. These could include scripts with suggested phrases for patient counseling, and evidence-based handouts for patients with further information.

Relatedly, research in Thailand investigated predictors of whether physicians assessed the environmental history of their patients, discussed environmental impacts on health, and provided related health advice (Völker & Hunchangsith, 2018). They found four predictors for physicians' engagement with the issue: their attitude about their role in addressing the link between environment and health; the perceived attitude of the department head in addressing the link between environment and health; exchange of information with peers; and physicians' knowledge about environment-health links (Völker & Hunchangsith, 2018).

Some studies found that while health professionals are interested in addressing health impacts of climate change, there is less interest in advocacy in some cases. For instance, a small sample of Swedish nurses from several disciplines reported through interviews and focus groups an understanding of the health

of climate mitigation and a perceived responsibility to contribute to sustainability in health care, including decarbonizing workplace operations (Anåker et al., 2015). However, influencing global climate concerns was perceived to be beyond the scope of their work and even local efforts were deemed secondary to providing lifesaving care (Anåker et al., 2015).

Our understanding of health professionals' willingness to engage in climate communication and advocacy results from 17 studies, 10 of which were conducted in the USA or Canada. Of the remaining studies, two were multinational surveys, with one study each from French Polynesia (survey), India (survey), Sweden (focus group), Turkey (focus group), and Thailand (survey and follow-up interviews). While half of the six surveys conducted in the USA employed large samples, the remaining were smaller in scale. To better understand health professionals' willingness to engage in climate communication and advocacy, additional research with larger samples from more countries is needed.

## 10.2 Enabling health professional engagement in communication and advocacy

Although many health professionals are interested in engaging with climate change as a health issue, fewer actually do so. Research has shown that interested health professionals experience—or at least perceive—barriers to their ability to engage. These include a lack of knowledge, resources, time, perceived lack of patient interest, and a range of social challenges including issue polarization, fear of damaging professional relationships, and the perceived lack of peer support (den Boer et al., 2021; Campbell et al., in press; Kotcher et al., 2021b; Hubbert et al., 2020; Leddin et al., 2022; Luong et al., 2021; Ryan et al., 2020; Redvers et al., 2023; Sanderson & Galway, 2021; Sarfaty et al., 2015; Sarfaty et al., 2016; Sarfaty et al., 2014; Speck et al., 2023; and Tiitta et al., 2020). For instance, in a recent survey of mental health professionals in Minnesota, USA, about three out of four (72%) reported concern about the impact of climate change on their clients' mental health, and over half (55%) said that some clients had already expressed concerns about climate change. However, only about one-third (32%) said they felt adequately prepared to discuss the mental health implications of climate change with their clients (Hoppe et al., 2023).

A survey of patients in waiting rooms of health clinics found that more than four in ten (44%) believe climate change harms their community health. Still, only one in ten (10%) reported speaking to their physicians about an environmental issue and its health effects. In the same study, slightly less than two in ten (17%) physicians felt extremely or somewhat comfortable counseling patients on climate change and health (Boland & Temte, 2019).

Likewise, a study conducted with general physicians in Switzerland found that although more than three-fourths (80%) of respondents recognized that it was necessary to adapt their clinical practices to address the health impacts of climate change and their role in providing patients with corresponding information, more than half (50%) expressed discomfort in discussing climate change impacts on health. These findings indicate a challenge in engaging physicians to discuss the health consequences of climate change and highlight the need for targeted interventions to identify and address the causes of their discomfort (André et al., 2022). A survey conducted among health professionals working in acute care, rehabilitation clinics, and medical care centers in Germany found that a majority (80%) reported a strong sense of personal responsibility for contributing to climate change mitigation (Baltruksa et al., 2022). However, some of these professionals (20%) also expressed feelings of insufficient support from their colleagues in their efforts towards sustainability. Furthermore, the survey also revealed that these health professionals recognized the need for further education and training on the topic of climate change and its implications for health (Baltruksa et al., 2022).

Finally, results from what seems to be the only survey of US pharmacists about climate change and health reveal that while 55% deem climate change relevant to pharmacy practice, respondents were unwilling to discuss the topic with the public due to perceived lack of time (73%) or knowledge (49%), or believing it to be futile (46%) or too controversial (35%; Speck et al., 2023).

Removing or reducing the barriers to engagement is likely to help motivated health professionals participate more fully in addressing climate change as a health issue. Some potential approaches to reducing barriers include providing education and communication trainings; creating resources like patient education materials and policy briefs; giving actionable guidelines on how to achieve climate-friendly health workplaces; promoting workplace and professional policies and cultures that encourage and support advocacy; and showcasing effective advocacy outcomes (Kotcher et al., 2021b; Luong et al., 2021).

Working with two climate and health advocacy organizations (one US-based and one global), Campbell (2023) examined social normative appeals as a potential strategy to engage health professionals in advocacy for climate and health solutions. The study suggests that descriptive normative messages (i.e., those that demonstrate what peers are doing) were effective at increasing sign ons to a petition about limiting the use of fossil fuels. However, descriptive normative

appeals had mixed results in terms of getting people to invite their colleagues to sign the petition. These findings suggest that using normative appeals may be effective for easier, individual advocacy actions as well as those that do not evoke certain barriers health professionals face, such as concerns about peer support and colleagues' negative reactions.

A qualitative study of physicians in Canada investigated how health professionals may be both motivated and supported to advocate for health care system sustainability (Luo et al., 2023). Participants were motivated by their concern about climate-related health harms, their frustration with the waste associated with the health sector, and their recognition of their role and influence as physicians (Luo et al., 2023). Further, participants stated that support from health care system leadership, having interdisciplinary teams, and increased knowledge of and communication about the environmental impacts associated with health care delivery are necessary for them to be able to advance sustainability in health care (Luo et al., 2023). Therefore, providing physicians with these types of support may further enable their engagement with the issue.

A qualitative focus group study in South Korea examined health professionals' willingness to incorporate timely and tailored meteorological data (e.g., air temperature, precipitation amount, UV index, relative humidity) into patient guidance about how to prevent health harms from climate change (Ock et al., 2018). Although most participants acknowledged the existence of health effects related to climate change, many expressed a lack of interest in using meteorological information in the patient care process, because they felt it would be challenging to incorporate it into all of the other information they need to provide to patient.

To enhance the integration of climate and health perspectives into practice, a highly effective strategy may be to incorporate climate and health training into medical curricula. Despite increasing interest in climate-focused health training, the integration of such programs remains limited within medical education. Notably, a recent survey conducted among emergency medicine program directors in the USA highlighted this issue, indicating a remarkably low percentage of programs that include climate change in their curriculum. Only 10% of the surveyed programs reported incorporating climate change education (Moretti et al., 2023). A global study of medical students from 2,817 medical schools in 112 countries found that only 15% of medical schools had climate change and health in the curriculum (Omrani et al., 2020). A majority (85%) of Canadian medical students in a survey of all Canadian medical schools said that teaching about other health topics was more prevalent than climate and health (Létourneau et al., 2023). Yet research points to high interest in climate change and health education among several types of health professional students in several countries, such as US medical, nursing, and physician assistant students (Ryan et al., 2020), medical students in Canada (Létourneau et al., 2023) and China (Liao et al., 2019), nursing students in Finland (Tiitta et al., 2020) in the UK, Germany, Spain, Australia, and Sweden (Álvarez-Nieto et al., 2022), and Turkey (Ergin et al., 2021), and Australian general practitioners trainees (Wild et al., 2023).

Initial findings about the benefits of climate change medical education are promising. For instance, the inclusion of a standardized patient case in the curriculum of medical students proved to be helpful in raising awareness about the health impacts of climate change and recognizing the importance of being climate-aware providers (Ramkumar et al., 2021). Evaluation of Stanford University medical students who took an elective on climate change and health found an increase in knowledge, beliefs, and attitudes about climate-health impacts and perceived necessity of treating climate-health impacts as clinicians (Gomez et al., 2021). Tools to evaluate the extent to which medical school curricula adequately address climate change and health can help identify needs and promote dialogue between students and administrators about how best to strengthen medical training in this area (Hampshire et al., 2022).

Similarly, there are encouraging examples of successful training programs aimed at equipping health professionals with the skills to effectively communicate and engage with climate and health issues. An evaluation of a 2020/2021 online workshop series designed by Braver Angels (a nonprofit organization working to reduce political polarization in the USA) and offered in the USA to help train health professionals and others in climate change communication found that the workshops increased participants' confidence in their abilities to communicate on the topic (Malow et al., 2022). Health care professionals at two primary care clinics for veterans in Texas, US, who received a toolkit on climate change and renal health, reported increased knowledge of climate and health (89%) and confidence in discussing climate and health with patients (90%) (Torres & Dixon, 2023).

Virtual training for health professionals from 37 countries representing diverse health-related fields on climate-related health risks demonstrated a notable positive impact. A substantial majority of participants (94%) reported that the knowledge and skills acquired through the training significantly influenced their professional practice. Compared with the beginning of the course, participants reported an increase in the frequency of incorporating climate change and health knowledge into their work and in the frequency of discussing climate and health with their patients, community members, and colleagues (Sorenson et al., 2023).

An evaluation of a Climate for Health Ambassador program conducted in 2021/2022 also found promising results (Speiser & Hill, 2022). The program trained more than 1,200 US health professionals, 575 of whom agreed to give three talks and take two advocacy actions per year, and thereby earned the designation "ambassador" and were listed publicly on the Climate for Health program's website (Speiser & Hill, 2022). Although the ambassadors self-report their progress on the actions—and therefore, these agreements are in no way binding—their growing community suggests promise in these types of programs and strategies for encouraging organic engagement (Speiser & Hill, 2022). Training workshops likely have a key role to play in advancing health professional involvement in climate and health.

Of the 32 studies that address barriers faced by health professionals, strategies to address them, health professionals' interest in receiving educational resources, and early evidence of the effectiveness of such education, there are distinct categories. Four include multinational, large-scale surveys of health professionals. Another multinational study focuses on evaluating the effectiveness of a health and climate curriculum led by medical students. In addition, one study examines the perspectives of gastroenterology society leaders on climate and health, and another was a systematic review of physicians' views on discussing the co-benefits of health and climate solutions. Of the remaining studies, fifteen were conducted in the United States, three in Canada, and one each in Germany, Australia, Finland, China, South Korea, Switzerland, and Turkey.

## Key takeaways:

- Health professionals across many countries express interest in engaging in a variety of efforts to address climate change, including educating members of the public,policymakers, and their patients about the relevance of climate change to health. Many health professionals also express interest in doing more to reduce greenhouse gas emissions from the health care sector and adopt more sustainable practices. However, many health professionals face barriers due to limited issue-specific knowledge, resources, time constraints, and concerns about damaging professional relationships or credibility.
- Some health professionals interested in counseling their patients about climate change are concerned about harming the patient-provider relationship or making their patients feel excessively worried and powerless. Health organizations and institutions should develop and distribute locally relevant, easy-to-use guidelines and toolkits for health professionals who wish to integrate climate discussion in their practice. Resources should complement existing patient-provider routines rather than create additional time burdens.
- Although systematic evidence is still emerging, initial studies suggest that workshops, online training, and specific educational programs have demonstrated some success in enhancing health care professionals' confidence and knowledge in addressing climate and health issues. More such initiatives can play a key role in activating and advancing the role of health care professionals in climate and health efforts.
- To facilitate health professionals' communication and advocacy, health professionals should receive education and training on the intersection of climate change and health, including specific training and guidance for different medical specialties. Such training should specifically include information on the ways in which climate change affects health in their community or region. Improved education can lead to a greater sense of confidence, responsibility, and readiness to engage with climate change.
- Programming is also needed to help educate and support health professionals interested in promoting more sustainable practices in the workplace and the health care sector more broadly. Many facilities will likely require tailored assessments of the barriers to implementing more sustainable operations and targeted efforts to remove those barriers. Sustained collaborations between the health professionals, politicians and public officials, and the patient community should be encouraged to advance health-informed climate action.

# 11. Understanding of and engagement with climate change and health among public officials

Existing evidence suggests that public officials around the world vary in their awareness of and response to the intersection of climate change and public health, as illustrated by research conducted in different regions; however, to date, the scope of this research has been fairly limited. Most of the current research focuses on officials in executive branches of government, as opposed to those working in a legislative capacity, and tends to concentrate on officials working at subnational levels of government as opposed to the national level (e.g., local health department directors). Further, much of this research only assesses current understanding and engagement among public officials and does not test strategies to increase their understanding and engagement or influence policy.

Studies conducted in Canada, the USA, and Australia indicate that public officials face numerous barriers to addressing the health impacts of climate change. In the USA, a study focusing on local health department directors revealed a shift in perceptions of the health threats posed by climate change. Between 2008 and 2012, there was a marked polarization in their views. By 2012, the proportion of local health department directors who strongly agreed that climate change had occurred in their jurisdiction doubled from 9% in 2008 to 18%, suggesting a growing recognition of climate change impacts. However, during the same period, those who strongly disagreed also increased from 1% to 12%. The authors posit that this may be indicative of the broader increase in polarization around climate change in the USA that occurred over the same time period, as shown by other nationally representative time period, as shown by other nationally representative surveys; however, the differences may also be due to

*Image credit: Climate Visuals*

changes in the local health department directors who responded, as this study used two separate cross-sectional surveys and was not a panel study of the same respondents at different points in time. In addition, the study found that perceived expertise in climate change adaptation and the availability of related services and programs offered by health departments declined between 2008 and 2012, likely due to funding cuts associated with the recession (Roser-Renouf et al., 2016).

Another study of public health officials from both governmental and non-governmental organizations in the USA found that participants did not know much about climate change and health, did not see it as an urgent priority, and felt that they lacked adequate expertise on the connection between climate change and health (Gould & Rudolph, 2015). They also reported that adding climate change to the current public health priorities is challenging, especially without the support of legal mandates to actively engage in climate-health efforts, strong leadership, intersectoral collaboration, resources, and workforce capacity (Gould & Rudolph, 2015). In Michigan, USA, public health officials acknowledged the presence of climate-related health issues in their regions, such as heatwaves and air quality concerns. Nevertheless, only a minority considered climate change to be a top priority in their policymaking (Carter et al., 2021). Similarly, a 2012 survey of local health department officials in New York, USA, found that only about four out of ten (39%) participants believed climate change will be a public health concern in the next 20 years, and only one-quarter (25%) believed it was a priority for their department (Carr et al., 2012). Another study conducted in New York, USA, between 2011 and 2012 surveyed and interviewed state and local health department officials and other stakeholders from environment, government, health, community, policy, academic, and business organizations (Eidson et al., 2016). Nearly half (46.5%) of state health officials reported having enough information about climate change and health impacts, with fewer local health department officials (17.1%) and other stakeholders from environment, government, health, community, policy, academic, and business organizations (40.9%) reporting the same (Eidson et al., 2016). Additionally, local health department officials primarily reported lack of funding, staff, and education/training as barriers to addressing climate and health impacts in their localities, whereas other stakeholders reported public awareness, lack of funding, and mixed messages and poor communication as barriers (Eidson et al., 2016).

A qualitative study of occupational safety and health workers in the Northwest region of the United States found that they perceive themselves as already facing climate-related hazards, such as wildfires and droughts. Participants conveyed that their readiness for climate-related hazards is contingent on socioeconomic factors and the extent of their training. They emphasized the need for more ongoing training and opportunities to enhance their climate literacy and risk assessment skills to respond to climate-related hazards (Pedersen et al., 2021).

Qualitative interviews with local authorities in South West England revealed that they face a number of barriers in developing local adaptation actions in their areas, including: financial constraints, lack of leadership, and limited public awareness of the health impacts of climate change. Participants identified the need for additional resources, collaboration, and leadership to effectively address the health impacts of climate change through adaptation measures (Woodhall et al., 2019).

A study of public health and non-public health professionals involved in decision-making about climate change policy and action in Ontario, Canada, found that professional participation was limited by factors such as a lack of cross-sector collaboration and communication about how to integrate health into climate change policy (Sanderson & Galway, 2021). However, the authors found that partnerships that have occurred within and across public health and non-public health sectors on climate change policy have had positive outcomes, such as shared access to funding, expertise, relationships for future engagement, and knowledge sharing and creation.

In perhaps the only study to look at legislators as an audience, a field experiment assessed the impact of an email campaign to get Canadian Members of Parliament to post about climate change more often on Twitter (Wynes et al., 2021). They found that the number of constituent emails received was positively associated with an increased amount of pro-climate tweeting by Members of Parliament. Follow up interviews with staff working in the Canadian Parliament suggest that phone calls and face-to-face contact may be more effective modes of engagement in some cases (Wynes et al., 2021). Interviewees also mentioned that they rarely hear about climate change from their constituents, suggesting that increased contact could be consequential.

A focus group study conducted with public health specialists in government, industry, and non-governmental organizations in Australia showed that participants were well aware of the threat climate change poses to health (Strand et al., 2010). However, participants suggested that the general public in Australia may not be as well informed about the health impacts of climate change, and highlighted the importance of identifying a number of factors that influence vulnerability to its effects. Raising public awareness of the health risks of climate change may help build public support for related policies, which in turn may have

positive implications for policymakers who may be interested in championing climate policies. A study conducted with urban planners in Australia found that, while they were aware of the impacts of climate change on infrastructure, they were less aware of the potential health impacts (Burton et al., 2015). The authors suggest that a lack of understanding of the ways in which climate change affects human health means that Australian cities may not specifically plan for the health impacts of climate change. Strengthening links between policymakers, planners, and public health professionals will increase awareness and understanding of each sector's role in addressing some of the health impacts of climate change (Burton et al., 2015).

Outside of urban areas, more than 90% of health service managers working in rural remote areas in Australia said that climate change would impact the health of the areas they serve (Purcell & McGirr, 2018). Participants suggested that the state and federal government should educate communities about the public health threat of climate change, and that local health districts should educate health professionals about the health impacts of climate change (Purcell & McGirr, 2018).

One study explored experiences and perspectives of 16 urban and public health planners from coastal cities in both Europe and Asia: Porto, Portugal; Söderhamn, Sweden; and Navotas, the Philippines. While interviewees from all cities mentioned the need for intersectoral approaches that include the public health perspective to develop local climate adaptation plans, public health officials were included in the planning process in Porto and Navotas only (Macassa et al., 2022). Other barriers to intersectoral planning included lack of localized health impact information, less than ideal collaboration across all sectors, financial strain, and low awareness among politicians and residents about the need to plan for climate-related health effects.

Research on the views of public officials on climate and health in Asia and Africa is more sparse. In the Chinese province of Guangdong, 81% of Centers for Disease Control (CDC) staff felt that climate change would negatively impact health, including through vector-borne diseases (95%) and specifically dengue fever (96%), yet less than one-third (27%) reported having a good understanding of climate change (Tong et al., 2016). Similarly, large majorities (more than 80%) of Chinese CDC staff surveyed in Liaoning and Anhui provinces believed that climate change would harm human health, but fewer (less than 60%) believed that climate change would affect rodent-borne diseases such as hantavirus (Tong et al., 2017). In South Korea, a study compared the perspectives of government officials, experts, and the general public in Hongseong County (Koo et al., 2021). They found no significant differences in the perceived severity of certain climate change impacts on health outcomes among the three groups, highlighting the need for increased education and communication efforts to improve policymakers' understanding of climate change and its associated health risks.

A study examining people's knowledge, attitudes, and practices regarding climate change and dengue in Laos and Thailand surveyed 10 government officials from each country. It found that only 30% in Laos and 20% in Thailand reported an understanding and awareness of the link between climate change and dengue fever. This lack of awareness was attributed to factors such as a lack of local policy, regulatory authority, trained public health staff, funding, scientific information, and political support (Rahman et al., 2021). In Mukuru, Nairobi, Kenya, a qualitative study conducted in 2021 found that local community leaders, health workers, volunteers, policymakers, and academics in the area recognized a range of climate-related health impacts, including lung disease, heat stroke, and hypertension (Andersen et al., 2021). In particular, they highlighted the significant negative impacts of climate change on mental health, underscoring the need for comprehensive policies that address both physical and mental well-being.

Only 18 studies have examined public officials' engagement with climate change and health, and this evidence is concentrated primarily in Canada, Australia, and the USA, with fewer studies from Asia, Europe, and Africa, and none from South America.

## Key takeaways:

- Most of the current evidence focuses on public officials working at subnational levels in executive branches of government, primarily those working in public health. Current evidence is based primarily on interviews and cross-sectional surveys, and few studies have systematically tested strategies to increase engagement among public officials and influence policy.
- Awareness of the intersection between climate change and public health among public officials varies significantly across regions. Some officials recognize the diverse health impacts of climate change, while others have relatively low awareness due to factors such as insufficient resources, training, and political support. Practitioners, therefore, can play a pivotal role in bridging the awareness gap and enhancing understanding of climate change and its health risks among public officials, as informed policymaking is essential to mitigate the potential health risks posed by climate change.
- Raising public awareness of the health risks of climate change may help build public support for related policies, which in turn may have positive implications for policymakers who may be interested in championing climate policies. Creating and strengthening avenues for members of the public to express their concerns about climate change and health to public officials will help to signal the importance of this issue and may encourage these officials to take more ambitious actions.
- Public officials in regions like the USA face various barriers when addressing climate-related health impacts. Public health officials may not prioritize climate change without legal mandates, leadership inspiration, collaboration, adequate resources, and dedication.
- Growing cross-sector collaborations between public health officials and non-public health sectors may encourage a greater consideration of health impacts in other areas of climate policymaking.

# 12. Evidence for action: research agenda for climate-health engagement

After reviewing the current state of research on the understanding of the health impacts of climate change among different audiences and the effectiveness of communication strategies, it is evident that significant progress has been made in scholarship. While certain recommendations and takeaways can be drawn from the existing body of research, it is important to underscore that the current knowledge base, while valuable, remains incomplete. Therefore, a more comprehensive and robust research effort is needed to fill the remaining gaps and provide a more nuanced understanding of the best practices in building and sustaining engagement with climate and health among the public, health professionals, and public officials.

To propel the field forward, we propose a research agenda that highlights these gaps and offers preliminary directions for addressing them. By designing future research to address these gaps, continued investigation can provide valuable insights that will help us achieve a healthier and safer future for all.

## 12.1 Expand Assessment of Public Understanding of the Health Relevance of Climate Change

Most studies on public perceptions of climate change and health, with a few exceptions, have been conducted in the USA, Canada, and the UK. This leaves a significant knowledge gap in understanding peoples' perceptions of climate change and health outside of these regions. To address this gap, it is crucial to conduct comprehensive research that assesses public understanding of climate change and health in diverse global populations. Such research should explore how cultural, social, and contextual factors shape the

*Image credit: Climate Visuals*

reception and comprehension of climate and health messages in different regions. Insights from this research can help in developing advocacy and communication strategies that increase climate and health literacy, personal and political engagement with the issue, and increase participation in activities that enhance both personal and community (including national and global) protection from climate change. Insights from this research can help in developing advocacy and communication strategies that increase climate and health literacy, personal and political engagement with the issue, and increase participation in activities that enhance both personal and community (including national and global) protection from climate change.

While current research has established that health professionals are highly trusted messengers on this issue, there may be other important messengers with latent potential that can credibly convey information about climate change and health. Therefore, researchers must make it a priority to identify additional trusted climate and health voices so that efforts can be made to help them realize their potential.

Furthermore, it is crucial to focus efforts on building capacity and communities of practice in a broader set of geographies so that locally based researchers have the resources available to lead and conduct high-quality research on this topic.

## 12.2 Develop and Test Communication Interventions

To communicate the health impacts of climate change effectively, it is essential to develop and test communication interventions. Although current scholarship on the topic provides meaningful insights, more research is needed to identify and harness effective communication strategies.

### 12.2.1 Increase comparative research across geographic contexts

Comparative analyses are needed to examine audience responses to information about short-term versus long-term health harms associated with climate change across different national contexts and within communities. Such research can help explore the influence of varying temporal dimensions of health impacts and inform the design of targeted messaging campaigns. In a similar vein, there is a lack of research on communicating the localized health impacts of climate change to people living in affected regions. By testing the effectiveness of interventions that use a public health frame to discuss the local impacts of climate change, researchers can provide evidence-based recommendations on how to communicate with and engage local communities in climate action.

### 12.2.2 Strengthen research on communication about climate and health solutions

Given that current evidence suggests that informing people about solutions and co-benefits is effective, it would be crucial to enhance the evidence base on communication efforts centered around solutions and co-benefits. A preliminary study found that informing people about the health care costs linked to climate change increased their risk perception (Limaye & Toff, 2023). Expanding upon this study, it would be useful to further investigate the effect of communicating health care costs as well as the impact of communicating the health-related economic benefits of climate action. Such research would provide additional insight into whether communicating health-related economic benefits would be more or less effective than communicating solely the health benefits of climate action.

Another crucial aspect that necessitates further attention is whether the personal health benefits of climate solutions, such as promoting active transportation like cycling, or the collective health benefits, such as improved air quality resulting from increased biking, would be more effective in communication efforts. Conducting research in this area can inform the development of targeted communication strategies around climate solutions that resonate with diverse audiences.

### 12.2.3 Incorporate more precise measures of public support for climate policies

It is worth noting that a considerable number of studies in this field utilize support for climate policies generally as the primary outcome measure. While this approach offers valuable insights, there is a need to better understand how communication efforts may differentially influence support for specific climate and health policies. By doing so, we can enhance our understanding and effectively work towards outcomes in a more targeted manner.

### 12.2.4 Broaden research on visual communication about climate and health

Research should also explore the effectiveness of visual communication techniques, as the literature lacks comprehensive research on best practices in climate visual communication, particularly in non-Western countries. To address this gap, research should focus on identifying and analyzing effective visual communication techniques. Such investigations will shed light on culturally sensitive and inclusive communication approaches that resonate with diverse audiences. Visual imagery may prove to be a powerful tool for conveying the health relevance of climate solutions.

### 12.2.5 Identify and test strategies for effective engagement with public officials

There is a notable gap in scholarship on understanding and identifying strategies for directly engaging policymakers and public officials on climate change and health issues. By assessing public officials' views on this topic and identifying effective engagement strategies, we can significantly strengthen the process of designing and implementing pro-climate policies for a safer and healthier world. One important step in this direction is to better understand what types of expertise and information public officials are interested in with regard to climate change and health. Furthermore, public officials should ensure the perspectives of public health professionals are prioritized through deliberative and organizational policymaking processes that reduce divides between the two camps (Awuor et al., 2020).

### 12.2.6 Test communication interventions for unintended consequences to mental health

Finally, it is crucial for researchers to recognize and address the growing climate-related mental distress experienced by people. Failing to effectively communicate can have negative consequences for people's mental health and capacity to engage in climate action. Any interventions and communication efforts should actively work towards alleviating such distress and take care to avoid inadvertently exacerbating it.

## 12.3 Center equity in climate and health research

Health harms linked to climate change disproportionately impact communities worldwide, highlighting the urgent need to prioritize equity in climate and health research. Therefore, researchers must actively examine how social, political, cultural, and economic barriers contribute to adverse climate-related health effects on disadvantaged groups, ultimately resulting in health disparities. This was highlighted by fellow researchers and public health experts during a stakeholder panel discussion at the European Public Health Conference 2021, where they emphasized the need to expand research efforts to communicate the links between climate change, health, and inequalities between and within countries (Jabakhanji et al., 2022).

From a communication perspective, there is a notable lack of research on whether highlighting health inequities exacerbated by climate change would increase or decrease public support for addressing such inequities. Research that identifies best practices for advancing equity in climate and health messaging is crucial to promote climate justice and action, but also to mitigate potential audience backlash (i.e., having the opposite of the intended message effect).

To avoid audience backlash, the research community should also identify the boundary conditions within which equity messaging would be effective. In that, they must identify the audiences, contexts, and target behaviors/attitudes in which equity messaging can have a positive versus a negative effect. For instance, they can investigate whether members of less vulnerable groups respond negatively to equity-driven climate and health messaging compared to members of vulnerable groups. In the same way, it would be valuable to assess how the public responds to messages that address specific climate and health-related vulnerabilities and compounding risks. This includes factors such as age, preexisting health conditions, racial inequities, and economic inequities, as well as the interactions among these risk factors. Understanding whether some of these messages are more polarizing than others and, if so, how to effectively communicate them is crucial. For example, research in other health contexts has found that messaging about racial inequities may be more polarizing among White audiences than others (Niederdeppe et al., 2023).

Sensitively extending this type of knowledge to messaging about differential group vulnerabilities to the health impacts of climate change would provide a foundation for researchers and practitioners to develop constructive ways to communicate about—and ultimately address—climate- and health-related inequities.

## 12.4 Strengthen research to support health professional engagement with climate change and health

To effectively activate health professionals who are willing to become climate messengers, it is important to understand and address barriers that may impede their engagement in climate and health solutions. Current research identifies several barriers, including limited awareness of the connections between climate change and health, competing priorities, time constraints, and organizational barriers within health care settings. More research is required to understand how best to reduce these barriers and support health professionals in their engagement efforts. The research community should also examine how people respond to the various actions that health professionals can undertake in service of climate and health solutions. This includes exploring and comparing the effectiveness of interventions such as advocating for policy changes, promoting sustainable health care practices, and integrating climate change considerations into patient care. Understanding how different stakeholders respond—including patients, colleagues, and policymakers—can inform efforts to maximize the positive impact of health professionals' engagement and reduce any unintended

consequences. Furthermore, research should work to identify effective strategies that increase health professionals' confidence in their ability to publicly discuss climate and health, in part by informing them of their trusted status.

To equip health professionals with the necessary knowledge and skills, practical education on the impacts of climate change in various health care fields is crucial. However, the existing body of research addressing the effectiveness of climate-related training for health care professionals is limited in scope. These studies, though informative, fall short of providing the strong and contextual evidence-based recommendations necessary for the development and widespread implementation of effective curricula globally. Therefore, further investigation is needed.

Effective curricula would enhance health professionals' knowledge on how climate change affects patient health and provide communication strategies for addressing the intersection of climate and health with their patients, colleagues, health care systems, and policymakers. By incorporating climate-related training into health care curricula and providing ongoing professional development opportunities, health professionals can be better prepared to discuss the health harms of climate change and the health benefits of climate solutions in their practice.

A recent scoping review found that literature on climate change and health professionals often focused only on the fields of medicine and nursing. There are few to no studies on effective training for various health professionals such as physician assistants, physical therapists, and respiratory therapists. Additionally, the review found that current research paid little attention to interprofessional collaboration and education among health professionals in several fields (Kinnon et al., 2022).

Researchers should actively seek to partner with health care systems in developing standardized metrics and evaluation tools to track the progress of climate-friendly initiatives and efforts to reduce emissions of heat-trapping pollution. By engaging health care systems in the development of a standardized measurement framework, the research community can ensure that it aligns with the realities and priorities of health care practice. Such collaboration would promote the integration of climate and health considerations into routine health care operations, making it easier to track progress and sustain long-term efforts.

## 12.5 Summary

This research agenda highlights key areas for investigation in climate change and health communication and advocacy. Expanding research to a broader, more diverse set of geographies and populations, developing and testing communication interventions, understanding best practices in visual communication, centering equity in research, and finding new ways to continue to engage public officials, policymakers, and health professionals can enhance the ability to communicate effectively about and advocate for climate and health solutions. Ultimately, this knowledge will contribute to informed decision-making, effective public engagement, and timely climate action that also protects human health and well-being.

*Image credit: Climate Visuals*

# Methods

The purpose of this global literature review was to compile and summarize all relevant research on perceptions of and engagement with climate and health, encompassing both English and key non-English languages, published between January 2000 and July 2023. The overarching goal was to draw on this existing body of work to identify actionable recommendations for effectively communicating the health risks associated with climate change and the health benefits of climate solutions.

In the process, we also identified potential areas of research for further exploration in this important field.

This section outlines the approach used to identify and evaluate the relevant English-language and non-English-language research included in this review for the purposes of this review.

## English-language studies

To find English-language research, we conducted an iterative search to identify relevant research articles. We did not impose a date range on the searches and therefore searched for any relevant research regardless of when it was published. We included all relevant research identified that was published as of July 2023 and initially used Google Scholar as the primary search engine. We used a set of keywords central to the intersection of climate change and public health, such as "Climate change," "Climatic change," "Health," "Public health," "Health professionals," "Perceptions," "Attitudes," and "Opinions." These keywords were designed to be agnostic with respect to the population studied. In other words, they were sensitive enough to detect studies relevant to each of our key audiences: public audiences, health professionals, and public officials/ policymakers.

As our review efforts progressed, we expanded the search scope to encompass additional databases, specifically ScienceDirect, PubMed, and Web of Science. The keywords employed for the search were "Climate Change" AND "Health" AND "Perception" OR "Understanding" OR "Awareness." After ordering the search results by relevance, we screened the first 15 web pages of results for each of these databases. Additionally, we found three articles via ancestry search techniques.

## Non-English language studies

To increase the generalizability of our findings, we worked in consultation with a research librarian to identify seven databases that specialize in international research published in non-English languages. These databases contained research in the following languages: Chinese, French, German, Italian, Japanese, Korean, Portuguese, and Spanish. Our aim was to use the broadest possible set of languages in our search based on available databases. In addition to the databases, we also used Google Scholar for its international coverage. For the Google Scholar search, we employed keywords central to the topic, such as "climate change," "public health," "health professionals," and "public attitudes" and screened the first 15 webpages of the search results.

We iteratively developed search strings to identify relevant research in consultation with a research librarian. We tailored the search strings to each database as some databases required more precise search terms than others in order to retrieve relevant articles. Each of the databases allowed search terms to be entered in English rather than requiring prior translation into the non-English language. Table 1 provides an overview of our eligibility criteria for inclusion according to study population, content, context, time period, article type, and language. Table 2 provides an overview of the search results for non-English language research in various databases. The "Initial Number of Articles Found" represents the number of articles retrieved during the initial search, while the "Final Number of Articles from Database" represents the number of relevant articles identified after screening for eligibility. The "Search String(s)" column details the specific search terms and phrases used in each database to extract relevant research papers.

The initial screening of search results in each database included examining the titles and abstracts and was conducted independently by a single author. In cases where titles and abstracts were unavailable in English, we utilized DeepL, an online translation service known for its high-quality translations. If an article was deemed relevant based on the title and abstract, a full-text screening was conducted by at least two authors with the aid of DeepL for translation purposes.

We also actively sought citations from partner organizations such as the Global Climate and Health Alliance, the Australian Climate and Health Alliance, Health Canada, the Canadian Medical Association, and the WHO Civil Society Working Group. This outreach took place during working group meetings and through solicitation via email listservs.

Overall, we found 182 English language studies and 13 non-English language studies on the views of the public, health professionals, and public officials regarding the health impacts of climate change, and evaluations of different strategies for communicating these impacts and future risks. Two studies, Koo et al. (2021) and Baltruksa et al. (2022), were found in Korean and German research databases, respectively. Both were available in English and are therefore included in the count of English language studies found. In addition, where relevant, 20 commentaries, short notes, and opinion pieces are included and referenced in the review.

Appendix 1 lists the articles reviewed, the language in which each study was published, and additional information about the populations that were sampled, including the type of participants (e.g., public, health professional, or policymaker) and geographic location of the population.

**Click or Scan the QR code to see Appendix 1.**

**Table 1**
**Inclusion and exclusion criteria based on the population, concept, time, article type, and language.**

| Criteria | Inclusion | Exclusion |
|---|---|---|
| Population | General Public, Health professionals and Public officials | Individuals from unrelated fields (e.g., journalists, business leaders) |
| Concept | Articles focusing on the views of public, health professionals and public officials (e.g., government employees, politicians and their staff) regarding of the health implications of climate change; articles evaluating different strategies for effectively communicating about current and future health risks of climate change and the health benefits of action to address climate change | Articles about aspects of climate change and health but are not specifically assessments of the views of the general public, health professionals, and public officials or assessments of effective strategies to communicate with these populations; articles addressing climate change or environmental issues broadly and not climate change and health specifically |
| Time | Published from January 2000 to July 2023 | Published before 2000 and after July 2023 |
| Article type | Primary research and grey literature | Commentaries, media pieces, blogs, newspaper articles and dissertations |
| Language | Chinese, English, French, German, Japanese, Korean, Portuguese, and Spanish | Languages not listed (excluding those specified) |

## Table 2
## Overview of search results for non-English language research in specific databases

| Database | Initial number of articles found | Final number of articles from the database after screening | Search string (s) |
|---|---|---|---|
| SciELO | 6 | 2 | (Climate change AND Health effects AND Public perceptions) (Climate change AND Health effects AND Public perception) |
| CnKi | 10 | 1 | (Climate change AND Health effects AND Public awareness) (Climate change AND Health effects AND Climate change communication OR Health communication) (Climate change AND Health impacts AND Public perception) (Climate change AND Public health AND Public perception) |
| Korean Citation Index | 14 | 2 | (Climate change AND Health effects AND Public awareness) (Climate change AND Health effects AND Climate change communication OR Health communication) (Climate change AND Health impacts AND Public perception) (Climate change AND Public health AND Public perception) |
| J-Stage | 724 | 1 | (Climate change OR Global warming AND Health effects OR Health consequences AND Public Perception OR Public beliefs) (Climate change OR Global warming AND Health impacts OR Health risks AND Public Perception OR Public beliefs) (Climate change OR Global warming AND Human health OR Planetary health OR public health AND Public attitudes OR Public understanding) (Climate change OR Global warming AND Health effects OR Health impacts OR Health risks AND climate change communication OR Health communication OR Health messaging) |

| Database | Initial number of articles found | Final number of articles from the database after screening | Search string (s) |
|---|---|---|---|
| Erudit | 100 | 2 | (Climate change OR Global warming AND Human health OR Planetary health OR public health AND Public perception OR Public attitudes OR Public understanding) |
| Cairn.info | 56 | 1 | (Climate change OR Global warming OR Health effects OR Health consequences) AND (Public Perception OR Public beliefs) (Climate change OR Global warming AND Health effects OR Health impacts OR Health risks AND climate change communication OR Health communication OR Health messaging) |
| Google Scholar | First 15 pages of search results | 4 | Keywords: Climate change, public health, public attitudes, and health professionals |
| Citations from partner organizations | 22 | 1 | |

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