



HHS Public Access

Author manuscript

Health Aff (Millwood). Author manuscript; available in PMC 2021 December 01.

Published in final edited form as:

Health Aff (Millwood). 2020 December ; 39(12): 2182–2188.

Developing A Definition Of Climate and Health Literacy

Vijay S. Limaye¹ [climate and health scientist], Maggie L. Grabow² [primary care research fellow], Valerie J. Stull³ [postdoctoral research associate], Jonathan A. Patz⁴ [professor]

¹Natural Resources Defense Council, in New York, New York.

²Department of Family Medicine and Community Health at the University of Wisconsin–Madison School of Medicine and Public Health, in Madison, Wisconsin.

³Global Health Institute at the University of Wisconsin–Madison.

⁴Nelson Institute for Environmental Studies and the Department of Population Health Sciences and director of the Global Health Institute at the University of Wisconsin–Madison.

Abstract

A new generation of activists is calling for bold responses to the climate crisis. Although young people are motivated to act on climate issues, existing educational frameworks do not adequately prepare them by addressing the scope and complexity of the human health risks associated with climate change. In this article, we adapt the US government's climate literacy principles to propose a definition and corresponding set of elements for a concept we term climate and health literacy. We then conduct a scoping review to assess how the peer-reviewed literature addresses these elements. Our analysis reveals a focus on training health professionals, more international than domestic content, and limited information about data and models, fossil fuels, and equity. We propose developing a framework that builds on the climate and health literacy elements to support a broader educational agenda that prepares students and future leaders to recognize the complex health ramifications of a changing climate.

Climate change poses significant threats to human health by exacerbating risks from extreme heat, wildfires, coastal storms, ozone air pollution, and crop failures, among other hazards.¹ Although a growing volume of research highlights climate change impacts, research focused on corresponding health issues constitutes a small fraction of that work.² Despite research indicating that framing climate change as a health problem can motivate support for climate action, the lack of emphasis on this linkage persists.³

Against this backdrop, youth climate activists are voicing concerns about the habitability of the planet by declaring climate change a danger to their welfare. For example, prominent activist Greta Thunberg describes climate instability as a direct threat to human well-being.⁴ The Youth Climate Movement has also raised the profile of young people describing the climate crisis as a near-term, specific threat to health.⁵

Younger people are particularly vulnerable to the harmful effects of climate change, which can disrupt their development and contribute to long-term health challenges.⁶ These effects include threats to cognitive function⁷ and mental health.⁸ Air pollution from fossil fuel combustion limits recreational opportunities for youth⁹ and contributes to school absenteeism.¹⁰ Climate events also affect school operations, with some teachers suddenly fulfilling roles as disaster first responders.¹¹

To better prepare and protect people from climate harms, effective teaching strategies are key. Education systems offer a unique opportunity to harness the energy of motivated youth to inspire and train future leaders to acknowledge and understand the effects of climate change on human health. Strategies to reduce climate impacts on human health can include mitigation efforts (reducing carbon emissions) and preparing for unavoidable impacts through adaptation measures. However, undergraduate and professional students in the US are not adequately equipped as systems thinkers with interdisciplinary training to effectively navigate subject matter boundaries and develop integrated solutions to address the health impacts of climate change.¹²

Younger students, too, can be made aware of the links between climate change and health. No specific science standards for K–12 education link climate change and human health, and current curricula specifically focused on climate change and human health in the US are sparse. The Next Generation Science Standards offer a structure for K–12 science education, but do not provide clear guidance on teaching climate change and health in tandem.¹³ The term “climate change” is mentioned thirty-three times in the standards document, but never directly in conjunction with human health. The lack of teaching on climate change–related health effects persists at the undergraduate level, with only a few American universities offering elective courses, seminars, lectures, or certificate programs in this area.¹⁴

Although researchers, students, and other professionals have identified a need for improved climate and health education in professional training,¹⁵ there are currently limited efforts to standardize that content around a practical definition of the topic; shape it for primary, secondary, or undergraduate education; or ensure it is sufficiently robust. The sustainable healthcare education movement has advocated for education about the impact of climate change and ecosystem alterations on health, but strictly from a health care industry perspective.¹⁶ A more harmonized approach to this topic is needed to facilitate its dissemination to students.

Here, we describe the three parts of this work. First, we analyze the climate change literacy teaching principles developed by the US Global Change Research Program¹⁷ to propose a definition and corresponding set of elements comprising a concept we term climate and health literacy. In developing this definition, we draw on climate and health research to characterize key elements of this topic. Second, to assess the degree to which existing peer-reviewed publications at the intersection of climate, health, and education engage with the complexity of the topic, we conduct a scoping review¹⁸ based on the candidate elements of the proposed definition. Third and finally, we review climate and health materials developed by the National Institute for Environmental Health Sciences¹⁹ to assess overlap with the proposed climate and health literacy elements. From our research, the National Institute of

Environmental Health Sciences lesson plans are the predominant publicly available climate and health curricula that could potentially be used at the K–12, undergraduate, and medical professional levels and expanded on through the development of additional, localized case studies using publicly available data.

Principles Of Climate Literacy

Climate literacy describes essential educational principles of climate science, supported by fundamental concepts similar to those underlying science literacy benchmarks. Specifically, it denotes an “understanding of your influence on climate and climate’s influence on you and society.”¹⁷ It requires that individuals appreciate basic principles of the Earth’s climate system, know how to assess scientifically credible information about climate, communicate about climate change in a meaningful way, and make informed and responsible decisions with regard to actions that may affect the climate.

The Need For Climate And Health Literacy

The US Global Change Research Program defined seven principles of climate literacy to support educators in their efforts to include climate science in their curricula.¹⁷ These principles help to standardize material on a broad level. For example, the Climate Literacy and Energy Awareness Network has reviewed materials for quality and alignment with the Next Generation Science Standards and climate literacy frameworks.²⁰ The first six climate literacy elements describe the causes and consequences of climate change. The seventh element focuses on the ramifications of the climate crisis for the earth system and human lives; yet within this broad category, just one of six subelements specifically highlights human health implications. The incomplete characterization of health impacts excludes important dimensions of the problem, including how mitigation and adaptation can reduce physical and mental health harms,^{21,22} how societal dependence on fossil fuels worsens health,²³ and how costly climate-related damages to health can be.²⁴

Analogous to the principles of climate literacy, we posit that a set of key elements can support enhanced training on the relationship between climate and human health. Although the tenets of climate and health literacy have not previously been defined, they can build on the existing climate literacy definition to capture the depth and range of health-related knowledge in this field. For example, educational content can explain how government policies, industry actions, and individual behaviors affect climate change—and therefore health. Furthermore, case studies can describe the utility of policy action to actively promote or harm human health via mitigation of or adaptation to climate change.

Existing deficits in climate education resources demonstrate the need for broader training in this area.²⁵ For example, in a review of medical school curricula content linking health to climate change on the Association of American Medical Colleges curriculum inventory database, no explicit inclusion of climate change education was found.²⁶ An analysis of international health professions school curricula revealed large variation in content; a more standardized approach to material development could improve the focus of those efforts,²⁷

but before new curricula can be developed, greater consensus on the definition of climate and health literacy is needed.

Defining and enhancing climate and health literacy has the potential to indirectly improve health and well-being by strengthening climate policy and related health behaviors.²⁸ The positive impact of advancing health literacy on health outcomes is a good corollary for this potential effect. Health literacy has been described as a derivative concept and asset: People with health literacy have the skills needed to better engage in health-enhancing behavior and social actions for public health, which in turn has yielded improved health and more health opportunities.²⁹ We argue that the same will be true of climate and health literacy. Poor health literacy, in contrast, has been linked to costs associated with inappropriate or inadequate use of medication and is associated with low understanding of preventative care and access to preventive services.³⁰

Given the historic roles of young people in past political movements and their interest in the injustices of climate change, youth are potential agents of change.³¹ Empowering youth with climate and health literacy will enhance their ability to advocate for policy change using cogent arguments and evidence. In addition, improved climate and health literacy among professionals could drive health-based decision making related to energy and climate policy. Therefore, we propose clearly defining climate and health literacy with elements that can expand and deepen the application of this topic in educational curricula.

Study Data And Methods

Defining Climate And Health Literacy And Its Elements

The concept of climate and health literacy is not new.³² However, recognition of the need to expand teaching of this concept has focused primarily on training health professionals.²⁶ The Climate and Health Literacy Consortium, for example, works to educate the public about the health effects of climate change in health care settings.³² Climate change knowledge is essential for physicians and nurses to work effectively in a rapidly changing environment, and better training could prepare clinicians to address relevant climate-related challenges.

To develop an overarching “definition” and elements comprising climate and health literacy, we analyzed the US Global Change Research Program climate literacy principles and sought to identify corresponding elements focused on describing the complexity of climate effects on human health. To do so, we summarized the seven climate literacy principles into broad descriptive categories (root cause, mechanism, determinants, implications, interventions, evidence, and complexity), conducted a qualitative thematic review of climate and health research based on those categories, and—based on that review—generated corresponding climate and health literacy elements (see online appendix exhibit A1).³³

Scoping Review Of Existing Research And Educational Content

After identifying candidate climate and health literacy elements, we explored whether growing knowledge about the health risks of the climate crisis is reflected in peer-reviewed literature at the intersection of climate change, education, and health.

The aim of this scoping review was to assess peer-reviewed research studies and commentaries for their engagement with the complexity of this topic, as identified through our climate and health literacy elements. Evaluating the discourse within the literature against a set of broad definitional elements informs recommendations for further implementation of educational content on climate change and health. In this review, we restrict our analysis to work published in academic journals because there is currently no systematic way to access current educational content across the K–12 and undergraduate curricula in the US.

The scoping review process was guided by the PRISMA extension for scoping reviews guidelines and is summarized in appendix exhibit A2.³³ Our search strategy was developed in consultation with a health sciences academic librarian and included three “AND” categories: climate change AND health AND education with no date constraints. We searched six electronic research databases: PubMed, the Education Resource Information Center, the Agricultural & Environmental Science Database, Academic Search Premier, and Web of Science. We excluded the research database Scopus because the focus of this article is US education and Scopus is global in scope. Next, the consulting librarian removed duplicates from the database search. Three reviewers screened thirty titles and abstracts from the overall sample of 1,346 articles to confirm 93 percent concordance. To prevent any disagreements in classification, reviewers followed a standardized screening rubric. The remaining 1,316 abstracts were divided among the three reviewers for screening. Inclusion criteria were as follows: articles must be published in English in a peer-reviewed academic journal and include mention of climate change or global warming, human health, and education or training. Reviewers assessed the remaining 206 full-text articles for eligibility on the basis of specificity to educational curriculum and training. Last, reviewers read the remaining seventy-two articles to evaluate whether each included any mention or discussion of the seven climate and health literacy elements. Reviewers also determined target student audiences and locations represented (US or international) in the articles.

Evaluation Of Current Climate And Health Lesson Plans

To complement the scoping analysis of the peer-reviewed literature, we reviewed all the National Institute of Environmental Health Sciences climate and health lesson plans to determine whether curricula, objectives, and keywords overlapped with the proposed climate and health literacy elements. These lesson plans are targeted toward US and international high school and secondary school courses and university undergraduates, and the National Institute of Environmental Health Sciences has developed additional materials specific to students in medical schools (both US and international) and public health graduate programs (US only). The National Institute of Environmental Health Sciences lesson plans were chosen for this analysis because they appear to be the only publicly available climate and health curriculum in the US.

Limitations

Several factors limit the analytical rigor and utility of this study. Although courses in climate change and health are minimally available at the university level, a thorough evaluation of existing curricula on climate and health was not feasible because of the lack of a centralized

resource capturing this content. Our proposed literacy elements are not all-encompassing: they do not indicate whether published research adequately captures the available science accurately or is age-appropriate, current, or has been evaluated for effectiveness. Our scoping review could only assess literature that discussed specific curricula and trainings via a secondary analysis; we were unable to view and evaluate the original education materials. Moreover, this review prioritized assessment of broad thematic content rather than targeting an analysis to determine the presence of specific terms (for example, health “co-benefits” of climate change mitigation).

Study Results

Based on our thematic analysis, we define climate and health literacy as the degree to which an individual understands the complex relationship between climate change and human health; a climate health–literate individual can recognize direct and indirect linkages between climate change and health, communicate risks, assess data, comprehend uncertainty, and make informed and responsible personal decisions or advocate for broader policies that protect health. In exhibit 1 and appendix exhibit A1, we identify potential climate and health literacy categories and seven elements based on the established US Global Change Research Program climate literacy principles.³³

Exhibit 1 summarizes results from our scoping review of the peer-reviewed literature in the context of the seven climate and health literacy candidate elements identified.

Other scholars have categorized health literacy in terms of levels.³⁴ Similarly, for climate and health literacy, we propose three distinct levels or scaffolding (functional, intermediate, and advanced) to sequentially indicate increased awareness of climate change and health-related decision-making on personal, family, and public levels, as well as increased depth of understanding of the complex interactions between climate and human health. We anticipate that proficiency in climate and health literacy can be developed over time, with younger students obtaining functional levels during K–12 education and older, college and professional students reaching advanced levels. For example, K–12 students should understand the root causes of climate change and its basic links to health and make appropriate decisions in a disaster context (for example, following guidance on evacuation orders during wildfires or extreme weather events). Professionals may be able to articulate how climate models predict health impacts over wide temporal and geographic scales.

Our findings demonstrate the extent to which peer-reviewed articles from the scoping review included discussion of the elements of climate and health literacy. These articles spanned the education of a wide range of age groups, from preschool students to those engaging in professional training. However, the predominant audience was health care professionals, representing nearly half of the articles (47 percent) included in the assessment. Notably, articles focusing on the importance of teaching nurses elements of climate and health literacy comprised nearly 20 percent of the final articles. All articles mentioned the basic mechanism between climate change and health (element 2), and 60 percent linked environmental conditions to physical and mental health (element 3). Linkages between fossil fuels and health (element 1) were identified in 35 percent of articles. About half of the

reviewed articles described both how mitigation and adaptation actions can improve health outcomes (element 5, 56 percent) and the complexity of climate impacts on health (element 7, 57 percent). Importantly, the inequitable implications of climate change on the health of marginalized groups (element 4) were identified in only 39 percent of the articles. Relatively few articles explained the data and models on which climate and health research findings are based (element 6, 24 percent). Overall, we found a high degree of international content even though we specifically omitted international databases in our search (50 percent). Appendix exhibit A3 describes these data in greater detail.³³

Our evaluation of six existing climate change and health-related lesson plans indicates that these materials include consideration of most of the climate and health literacy elements (see appendix exhibit A4).³³ The learning goals for all lesson plans and course materials are the same, and we found that all these materials explained five of the seven proposed elements. We note that most (four of six) of the lesson plans did not engage with element 4, which focuses on the inequitable health burden of climate-related risks. These materials link to modules based on material presented in the National Climate Assessment³⁵ and, as such, do not include a wide array of case studies tailored to specific localities.

Discussion

Real-world application of the climate and health literacy definition and elements will require development of a strong educational framework, pedagogical models, and curricula appropriate for various age groups. Such advancements should be developed through an iterative process that engages climate, health, and education experts.

Health professionals are on the front lines of this challenge, but students across all age groups can benefit from the conceptualization of climate change as a health issue. Improved student understanding of climate change and its impacts on health is needed to ensure that future scientists, business leaders, and decision makers—including politicians and advocates—have appropriate knowledge to make informed decisions regarding climate change adaptation, mitigation, and policy. Specifically, a definition of climate and health literacy is useful to inform medical education and wider audiences. Application of this definition should ultimately include learning objectives, modules, and assessment tasks to integrate into existing curricula. Lessons can be learned from the emerging efforts to integrate climate change and health in public health graduate programs. For example, the Global Consortium on Climate and Health Education recently proposed a core set of Climate and Health Competencies for students receiving training in health professions.³⁶ These competencies also stress the climate-health mechanism, the complexity of effects, and the role of mitigation and adaptation interventions to improve health.

By adopting a definition of climate and health literacy and further applying it through a framework and curricula in the future, there is an opportunity to boost climate and health literacy such that impactful shifts in health and policy may result. Professionals and students who reach advanced levels of climate and health literacy will be better equipped to advocate for climate-smart and health-driven policies as constituents, voters, business leaders, and decision makers. Evidence demonstrates that quantifying climate change impacts in terms

of economics and health outcomes can be a more effective climate advocacy strategy than discussing the environment alone.³⁷ Climate and health literate citizens will have the vocabulary and understanding to better prepare and respond to climate-related health risks.

This analysis draws on established climate literacy principles to identify a corresponding definition and elements within a health context and evaluates existing literature for its representation of those elements. Findings from our scoping review illustrate that climate change and health curricula could be improved by further educating students to better grapple with the breadth of health inequities involved with a changing climate and to better understand the wide range of data and models necessary to inform climate impacts on health. Our results also indicate that efforts are needed to broaden climate and health training beyond nurses, doctors, and public health professionals to K–12 and undergraduate students, as well as the broader public, and the existing National Institute of Environmental Health Sciences lesson plans are a suitable starting point for achieving, at the very least, functional climate and health literacy. Such efforts could empower people of all ages to harness knowledge of the health implications of climate change in support of advocacy and policy change.

Students who are not trained to confront the complex health ramifications of climate change will be limited in their ability to address these threats in their professional lives. A climate and health literacy definition informed by a tested set of climate literacy principles can enable more engagement with this topic within education systems, considering the enormity of global climate crisis as it relates to public health. A health-focused approach to teaching about climate change could help make the climate crisis more personal and tangible to all students and more relevant to learners of younger ages.³⁸ This approach can complement more advanced competency frameworks targeting health professional students.³⁶

Barriers may limit the application of the climate and health literacy definition into school curricula. Incorporating this health-focused content into K–12 and undergraduate curricula may be arduous in addition to the challenge of teaching basic climate literacy principles.³⁹ Content developed within each component element should be responsive to the changing needs of students, educators, and the broader public to respond to the health threats of climate change. For example, youth perspectives and actions can be incorporated, as can representation of regions expected to experience disproportionate health harms from climate change.⁴⁰ Furthermore, development of educational content that engages with these seven elements tailored to local contexts would require significant new efforts. As exhibit 1 shows, specific elements merit more attention because they have been underemphasized within the existing research literature.

Conclusion

By conceptualizing climate change as fundamentally a human health issue, a climate and health literacy approach can help empower and stimulate young people to address this existential threat from a health-protective standpoint. Before we can apply climate and health literacy approaches to education, however, we must agree on how it should be defined. Here, we have provided a definition and outlined seven elements of climate

and health literacy, drawing from the well-established climate literacy literature. Further, we outline gaps in current peer-reviewed literature related to these primary categories. Interdisciplinary effort is needed to shape and apply an appropriate climate and health literacy framework for education.

Although the climate crisis presents significant risks to human health, existing frameworks for teaching about climate change do not adequately describe these risks, and teaching of these topics to K–12 and undergraduates is limited. Existing literature exploring education, climate change, and human health reveals gaps in key content areas, such as equity and models, and a large focus on nurses and medical professionals. Enhancing climate and health literacy among K–12 and undergraduate students and people of all ages can help augment preparedness to deal with the complex health ramifications of the climate crisis.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgment

Maggie L. Grabow was supported by both the Health Resources and Services Administration (T32HP10010) and the US National Center for Complementary and Integrative Health of the National Institute of Health training award (T32AT006956). The authors thank both Mary Hitchcock and Colleen Henegan for their support and expertise.

NOTES

1. [Globalchange.gov](https://health2016.globalchange.gov/downloads). The impacts of climate change on human health in the United States: a scientific assessment [Internet]. Washington (DC): US Global Change Research Program; 2016[cited2020 Oct 9]. Available from: <https://health2016.globalchange.gov/downloads>
2. Watts N, Amann M, Arnell N, Ayeb-Karlsson S, Belesova K, Berry H, et al. The 2018 report of the Lancet Countdown on health and climate change: shaping the health of nations for centuries to come. *Lancet*. 2018;392(10163):2479–514. [PubMed: 30503045]
3. Weathers MR, Kendall BE. Developments in the framing of climate change as a public health issue in US newspapers. *Environmental Communication*. 2016;10(5):593–611.
4. Murray S Framing a climate crisis: a descriptive framing analysis of how Greta Thunberg inspired the masses to take to the streets [Internet]. Uppsala (Sweden): Uppsala University; 2020[cited2020 Oct 9]. Available from: <http://uu.diva-portal.org/smash/record.jsf?pid=diva2%3A1386491&dsid=undefined>
5. Fisher SR. Life trajectories of youth committing to climate activism. *Environ Educ Res*. 2016;22(2):229–47.
6. Salas RN, Knappenberger P, Hess JJ. 2019 Lancet countdown on health and climate change policy brief for the U.S. *Lancet Countdown* [serial on the Internet]201911[cited2020 Oct 9]. Available for download from: <https://www.lancetcountdownus.org/2019-lancet-countdown-us-brief>
7. Cedeño Laurent JG, Williams A, Oulhote Y, Zanobetti A, Allen JG, Spengler JD. Reduced cognitive function during a heat wave among residents of non-air-conditioned buildings: An observational study of young adults in the summer of 2016. *PLoS Med*. 2018;15(7):e1002605. [PubMed: 29990359]
8. Majeed H, Lee J. The impact of climate change on youth depression and mental health. *Lancet Planet Health*. 2017;1(3):e94–5. [PubMed: 29851616]
9. Ramírez A, Sarmiento OL, Duperly J, Wai Wong T, Rojas N, Arango CM, et al. Should they play outside? Cardiorespiratory fitness and air pollution among schoolchildren in Bogotá. *Rev Salud Publica (Bogota)*. 2012;14(4):570–83. [PubMed: 23912511]

10. Park H, Lee B, Ha E-H, Lee J-T, Kim H, Hong Y-C. Association of air pollution with school absenteeism due to illness. *Arch Pediatr Adolesc Med.* 2002;156(12):1235–9. [PubMed: 12444836]
11. Costa R, Cross Hansel T, Moore M, Many M, Osofsky J, Osofsky H. Teachers and school personnel as first responders following disasters: survivors and supporters. *J Trauma Stress Disord Treat.* 2015;4(4).
12. Shaman J, Solomon S, Colwell RR, Field CB. Fostering advances in interdisciplinary climate science. *Proc Natl Acad Sci U S A.* 2013;110 Suppl(Suppl 1):3653–6. [PubMed: 23440191]
13. Next Generation Science Standards. Next Generation Science Standards [Homepage on the Internet]. San Francisco (CA): WestEd; 2013[cited2020 Oct 8]. Available from: <https://www.nextgenscience.org/>
14. Lavey WG. Teaching the health impacts of climate change in many American higher education programs. *Int J Sustainability Higher Educ.* 2019;20(1):39–56.
15. Shaman J, Knowlton K. The need for climate and health education. *Am J Public Health.* 2018;108(S2):S66–7. [PubMed: 29072939]
16. Teherani A, Nishimura H, Apatira L, Newman T, Ryan S. Identification of core objectives for teaching sustainable healthcare education. *Med Educ Online.* 2017;22(1):1386042. [PubMed: 29025363]
17. US Global Change Research Program. Climate literacy: the essential principles of climate science. Washington (DC): US Global Change Research Program; 2009.
18. Lawrence C, Mhlaba T, Stewart KA, Moletsane R, Gaede B, Moshabela M. The hidden curricula of medical education: a scoping review. *Acad Med.* 2018;93(4):648–56. [PubMed: 29116981]
19. National Institute of Environmental Health Sciences. Climate change and human health lesson plans [Internet]. Durham (NC): NIEHS; 2020[cited2020 Oct 9]. Available from: <https://www.niehs.nih.gov/health/scied/teachers/cchh/index.cfm>
20. Climate Literacy and Energy Awareness Network. About the CLEAN Project [Internet]. CLEAN; 2020[cited2020 Oct 9]. Available from: https://cleanet.org/clean/about_project/index.html
21. Patz JA, Stull VJ, Limaye VS. A low-carbon future could improve global health and achieve economic benefits. *JAMA.* 2020;323(13):1247–8. [PubMed: 32108863]
22. American Public Health Association. Addressing the impacts of climate change on mental health and well-being [Internet]. Washington (DC): APHA; 2019115[cited2020 Oct 9]. (Policy No. 20196). Available from: <https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2020/01/13/addressing-the-impacts-of-climate-change-on-mental-health-and-well-being>
23. Grabow ML, Spak SN, Holloway T, Stone B, Mednick AC, Patz JA. Air quality and exercise-related health benefits from reduced car travel in the midwestern United States. *Environ Health Perspect.* 2012;120(1):68–76. [PubMed: 22049372]
24. Limaye VS, Max W, Constible J, Knowlton K. Estimating the health-related costs of 10 climate-sensitive U.S. events during 2012. *Geohealth.* 2019;3(9):245–65. [PubMed: 32159045]
25. Schreiner C, Henriksen EK, Kirkeby Hansen PJ. Climate education: empowering today's youth to meet tomorrow's challenges. *Stud Sci Educ.* 2005;41(1):3–49.
26. Wellbery C, Sheffield P, Timmireddy K, Sarfaty M, Teherani A, Fallar R. It's time for medical schools to introduce climate change into their curricula. *Acad Med.* 2018;93(12):1774–7. [PubMed: 30024475]
27. Shea B, Knowlton K, Shaman J. Assessment of climate-health curricula at international health professions schools. *JAMA Netw Open.* 2020;3(5):e206609. [PubMed: 32463471]
28. Mancuso JM. Health literacy: a concept/dimensional analysis. *Nurs Health Sci.* 2008;10(3):248–55. [PubMed: 18786068]
29. Nutbeam D The evolving concept of health literacy. *Soc Sci Med.* 2008;67(12):2072–8. [PubMed: 18952344]
30. Sanders LM, Shaw JS, Guez G, Baur C, Rudd R. Health literacy and child health promotion: implications for research, clinical care, and public policy. *Pediatrics.* 2009;124(Suppl 3):S306–14. [PubMed: 19861485]

31. Han H, Ahn SW. Youth mobilization to stop global climate change: narratives and impact. *Sustainability*. 2020;12(10):4127.
32. Health Care Without Harm. Climate and Health Literacy Consortium [Internet]. Reston (VA): Health Care Without Harm; 2013[cited2020 Oct 9]. Available from: <https://noharm-uscanada.org/issues/us-canada/climate-and-health-literacy-consortium>
33. To access the appendix, click on the Details tab of the article online.
34. Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promot Int*. 2000;15(3):259–67.
35. US Global Change Research Program. Fourth National Climate Assessment, volume II: impacts, risks, and adaptation in the United States [Internet]. Washington (DC): US Global Change Research Program; 2018[cited2020 Oct 9]. Available from: <https://nca2018.globalchange.gov/>
36. Global Consortium on Climate and Health Education (GCCHE). Core climate & health competencies for health professionals [Internet]. New York (NY): Columbia University; 2018[cited2020 Oct 9]. Available from: https://www.publichealth.columbia.edu/sites/default/files/pdf/gcche_competencies.pdf
37. Nemet GF, Holloway T, Meier P. Implications of incorporating air-quality co-benefits into climate change policymaking. *Environ Res Lett*. 2010;5(1):014007.
38. Chadborn N, Gavin NT, Springett J, Robinson JE. “Cycling – exercise or trying to stop pollution”: methods to explore children’s agency in health and climate change. *Local Environ*. 2013;18(3):271–88.
39. Veron D, Marbach-Ad G, Wolfson J, Ozbay G. Assessing climate literacy content in higher education science courses: distribution, challenges, and needs. *J Coll Sci Teach*. 2016;45(6):43–9.
40. Patz JA, Gibbs HK, Foley JA, Rogers JV, Smith KR. Climate change and global health: quantifying a growing ethical crisis. *EcoHealth*. 2007;4(4):397–405.

Exhibit 1:

Scoping review articles containing elements of climate and health literacy (CHL), by literacy level

Definitional categories and elements of CHL	Articles including CHL elements (%) (n=72)
Functional literacy level	
1. Root cause: The fossil fuels that shape our lives worsen the climate crisis and our health.	35
2. Mechanism: Climate change affects human health by altering global temperatures and the hydrologic cycle and driving sea level rise.	100
Intermediate literacy level	
3. Determinants: The environment and our health are intertwined. Quality of life and physical and mental health are strongly tied to our environment.	60
4. Implications: Climate change worsens existing health disparities.	39
5. Interventions: The adverse health impacts of climate change can be reduced through mitigation and adaptation.	56
Advanced literacy level	
6. Evidence: Our understanding of climate impacts on health relies on different types of data and models.	24
7. Complexity: The human health effects linked to climate change are complex and vary over space and time.	57

SOURCE Authors' analysis of 72 peer-reviewed articles on climate change, human health, and education or training.

^aArticles that discuss each of the seven elements of CHL as a percent of the overall total.