

Climate and Health Concerns of Montana's Public and Environmental Health Professionals: a Cross-Sectional Study

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Abstract

Background: Rural health professionals stand at the forefront of community response to climate change, but few studies have assessed their perceptions of the threat. Further, no previous study has compared the opinions of environmental to public health professionals or extensively analyzed the factors related to these experts' climate beliefs, risk perceptions, and injunctive norms.

Methods: In conjunction with the Montana Climate Assessment's 2021 *Special Report on Climate Change and Human Health*, the 479 members of the Montana Public Health Association and Montana Environmental Health Association were surveyed during September-October 2019, with 39% completing the survey. We summarized descriptive data about their perceptions of local climate-related changes, and their levels of belief that global warming is happening, is mostly human-caused, is a risk to human health, and that their offices and others should take action. We also evaluated which sociodemographic and risk perception factors related to these climate beliefs, risk perceptions, and injunctive norms.

Results: Health professionals in Montana, a politically conservative state, demonstrated high levels of awareness that global warming is happening, human-caused, and a threat to human health, well above reported rates of public concern. Eighty-eight percent said that global warming is occurring and 69% that it is mostly anthropogenic. Sixty-nine percent said that their own health was already affected by climate, and 86% said they were already seeing at least one climate change-related event in their communities. Seventy-two percent said that their departments should be preparing to deal with climate change's health effects, but just 30% said that it is currently happening. We found no statistically significant differences between Montana environmental health and public health professionals in regression models predicting climate beliefs, risk perception, and injunctive norms. As in studies of the public, political ideology and the observation of local climate-related changes were the strongest factors.

Conclusions: Montana environmental and public health officials said that departmental action was needed on climate change, indicating the readiness of rural health professionals to take action. Further studies of health professionals in rural regions are warranted.

Background

Anthropogenic climate change contributes to a wide array of increased human physical and mental health risks that manifest differently across communities due to varying hazards and vulnerabilities (1, 2). While urbanization represents one of four global mega-trends tracked by the United Nations (3), much of the world's population remains rural: 45% as of 2018 (4). In the United States, rural areas constitute 97% of land area and 19% of the population (5). These areas have distinct characteristics with implications for climate adaptation and health. Their economies are often closely tied to natural resources and agriculture with limited community capacity to adapt due to poverty and other social vulnerabilities (6, 7). In the United States, rural communities are also less likely to be concerned about climate than those in urban areas (8). Most of Montana's population is rural (65%) (9). In 2019, estimates

placed 50 of the state's 56 counties as less likely on average to say global warming is happening than the national average (67%) (8, 10).

Environmental and public health professionals recognize that environmental conditions affect human health (11, 12) and have called for action on climate change (13). The Lancet Commission described tackling climate change as the greatest public health opportunity of the 21st century (14). Because health is something that most people care about (15), communicating about the health effects of climate change can potentially help governments connect with wide publics on the issue (16, 17). Moreover, health care professionals themselves, particularly nurses, are “trusted messengers”; indeed, nurses have been the most trusted profession for the past 17 years in the Gallup Polls (18).

In this study we surveyed Montana environmental and public health professionals regarding their perceptions of climate change, its effect on human health, and the need for their offices and others to take action. Further, we analyzed how these perceptions relate to various factors, including sociodemographic and professional characteristics. To our knowledge, the climate risk perceptions of environmental and public health professionals have never been compared, nor have the climate change risk perceptions of health professionals in a frontier region of the United States like Montana been studied. Due to the importance of these professions for successful rural climate adaptation in their roles as content experts and trusted messengers (19), this study thus contributes a novel dimension to a growing literature on the role of health professionals in addressing climate change.

Montana's changing climate

Montanans are already experiencing impacts of climate change, such as fewer snow days and longer fire seasons (20). We conducted this study of health professionals in association with Montana's 2021 climate and health report: *Climate Change and Human Health in Montana: a Special Report of the Montana Climate Assessment, 2021* (19). Released in December 2020, the report details current and projected health-related impacts of climate change in Montana based on increased temperatures, changes in precipitation patterns, altered ranges for infectious disease vectors, increased wildfires, and increased stress on crops (which can affect food supply, nutritional content, and cost of foods).

Montana also serves as home to a number of vulnerable populations who may be particularly affected by climate change (21): rural residents, laborers in outdoor occupations, and indigenous communities. Montana is relatively sparsely populated with 6.8 people per square mile (22) compared to 92.9 persons per square mile nationally (23). Outdoor occupations such as farming, fishing, forestry, construction, and extraction represent 65 out of every 1,000 state jobs (24). Indigenous residents—who like other racial and ethnic groups may be more socially vulnerable with fewer resources to adapt—comprise 6.6 % of Montana's population (22) versus 1.3 % nationally (25).

Climate change beliefs and risk perception

Climate change is frequently viewed by the lay public as abstract and distant in time and effect (26, 27). People construe climate change as most likely happening elsewhere, to other people, or in the future. These characteristics of public risk perception can help explain why people choose not to engage in activities that might reduce the threat. Studies of risk perception suggest that perceived threat susceptibility and severity are important determinants of people's behavioral responses (28, 29). Hence it is notable that only 34% of Montanans in 2019 were likely to say that climate will harm them personally in the future, based on downscaled national survey estimates (10), compared to 42% nationally. (In 2020, Montana and U.S. percentages have increased, but the discrepancy remains; since this survey was conducted in 2019, 2019 data from Yale is used.)

Public opinion data demonstrates consistently lower climate concern in Montana than nationally, typically by between 5–10 percentage points. The 2019 Yale Climate Opinion Maps estimate that 60% of Montana residents say that global warming is happening (67% nationally), while 45% say it is mostly human-caused (53% nationally), and 54% of Montanans are worried about it (60% nationally)(10). Climate change perceptions have been well-documented as correlating with political affiliation, ideology, and worldviews (30). Indeed, Montana is ranked as a “highly conservative” state according to 2018 Gallup data (31).

Views of environmental and public health professionals on climate change

Public and environmental health professionals both play an important role in climate adaptation (32) but typically have different organizational roles, expertise, and responsibilities for climate-related issues. For example, the Montana Public Health Association represents nurses, nutritionists, researchers, health educators, physicians and other licensed health practitioners (personal communication), while the Montana Environmental Health Association's members include largely sanitarians, food inspectors, and disaster management personnel (personal communication). But few studies have assessed the climate change risk perceptions of these officials. One of the earliest such studies was a national survey of health department directors conducted in 2007–2008 in collaboration with the National Association of County and City Health Officials (NACCHO) (33). The researchers found that while most of the officials said that their jurisdiction had already experienced climate change in the last 20 years (69%) and would experience climate change in the next 20 years (78%), including one or more serious public health effects (59%), few of them strongly agreed that climate change was an important priority for the department (12%). Another 39% agreed climate change was a departmental priority, but not strongly. Results of a follow-up study in 2011–2012 by Roser-Renouf, Maibach, and Li found public health departments' prioritization of preparing for climate change impacts declined significantly between 2008 and 2012 (34). Moreover, departments reported lower levels of perceived departmental climate risk assessment expertise and ability to develop adaptation plans.

Subsequent studies in the last decade and a half of health professionals have further explored health professionals' climate change beliefs and risk perceptions. Because researchers typically employ

somewhat differently phrased survey questions and sampling strategies, comparisons are difficult, but surveys since 2008 demonstrate high rates of agreement among health professionals that climate change is happening with less certainty that it is mostly human caused (35–37).

Previous climate and health studies have surveyed environmental health as well as public health professionals, though no study to our knowledge has directly compared the two groups. In Syal and colleagues' survey of environmental health directors in 2011 (40), only 46 % said that the health effects of climate change in their jurisdiction would be serious. In a series of three consecutive yearly surveys conducted with National Environmental Health Association members in 2016, 2017, 2018, respondents were most concerned (34%) about the effects of increased asthma, allergies, and cardiorespiratory disease from higher rates of air pollution under climate change (38). Only 49% said they would personally be harmed in the future, but 72% said that actions to mitigate climate change would positively benefit their health (38). In a 2012 Association of State and Territorial Health Officers (ASTHO) survey, 75% of environmental health directors said that their state or territory would experience one or more serious health harms in the future (39) .

Research on climate change public opinion demonstrates national surveys can obscure large regional differences (8). A 2012 study of New York State local health department officials (38) (public and environmental health) found lower levels of concern and expertise than the national NACCHO survey reported above (33). Less than a third (32%) reported local effects from climate change already occurring in their jurisdiction and just 39% said that climate change posed a threat to public health in the next 20 years. Only one quarter of the respondents perceived climate change as an important priority for their local health department. (40). In a 2009 study of local public health officers in California, Bedsworth (41) found much higher rates of concern and activity than in New York. A vast majority (94%) said that climate was a very or somewhat serious threat to public health; and majorities of the health departments reported programs in climate-related areas such as extreme heat, air pollution, and infectious disease. In a 2009 Oregon study, 88% of local health officers said that climate change will increasingly impact public health in the next 20 years and 38% of departments were making some changes related to climate action (42).

Among the climate and health survey studies, only two to our knowledge have analyzed survey findings to establish the relationship between sociodemographic and professional characteristics, or other variables, on health professionals' climate change perspectives. About half the professionals in Polivka's public health nurses' study in 2010 (35) said that their nursing division has a responsibility to address health-related effects of climate change, but most also said that they were not prepared to do so. A majority identified 4 out of 12 health effects as increased due to climate change with only subgroup differences by political ideology. However, there were differences on other measures by education, age, and political ideology. Less educated respondents were more likely to say that climate change is uncontrollable by humans than those with more years of college; younger respondents were more likely to say that nursing could lessen the health effects of climate change than those who were older; and liberals were more likely to say that climate change was anthropogenic and would have negative impacts than conservatives.

A 2011 study (43) assessed the relationship between environmental health directors' environmental attitudes, political views, gender, and risk perception on implementation of climate adaptation programs in the department. The authors found that environmental attitudes and political views contributed to the risk perception of the directors; gender did not. Forty-nine percent said they felt a responsibility for their department to address the health effects of climate change. Moreover, environmental health directors' climate and health risk perceptions accounted for 27% of the variance in the number of climate change impacts being addressed.

Sociodemographic and other factors related to climate change beliefs have been better studied with the public. In a meta-analysis of the determinants of climate change beliefs using studies of members of the public from across 56 nations, sociodemographic factors—gender, age, income, education and race—were found to have little effect compared to political affiliation, values, trust in scientists and understanding of the climate science consensus, and experience of local weather change (30). Van der Linden found similar relationships—though lesser effects from local experiences—in a study of determinants of climate risk perceptions (44).

The climate change beliefs, perceptions, and injunctive norms of health professionals in a rural, conservative state are likely to be affected by its political culture. At the same time, these experts have scientific training, actively engage with colleagues in medical and other scientific communities, and have direct experiences of changes in their community's health that could also potentially influence their levels of issue concern. In order to further explore the risk perceptions of public and environmental health professionals, we pose the following research questions:

RQ1: What are the climate change local observations, beliefs, risk perceptions, and injunctive norms of public and environmental health professionals in Montana, a rural and conservative state?

RQ2: (a) What is the relationship between the professional and sociodemographic characteristics of rural health professionals and their climate change belief and risk perceptions? (b) What is the relationship between the professional and sociodemographic characteristics and climate risk perception of rural health professionals on their injunctive norms for prioritization of climate change within their department?

Methods

We surveyed members of the Montana Public Health Association and Montana Environmental Health Association (MPHA/MEHA) between September 26, 2019 and October 30, 2019. MPHA has 379 members while MEHA is a smaller organization with just 100 members. The organizations' members are widely geographically distributed across the state. At least one member of both MPHA and MEHA works in each of Montana's 52 counties.

The 21-question survey was fielded both on paper and online. On average it took respondents just under 5 minutes to complete. At a joint MPHA/MEHA meeting in September 2019, members were given the option

of completing the survey on paper versus waiting for an upcoming online survey link to be released the following week. The presidents of both organizations sent a link to the survey to their entire membership requesting their participation and notifying them that participants would be entered into a raffle for three \$100 Amazon gift cards.

Regression analyses were completed in SPSS Statistics 27. Of 271 respondents, 47 were students and 39 did not complete two or more demographic questions, such as professional affiliation. Dropping these respondents from the dataset left a final sample of 185. Researchers have demonstrated that extreme weather events can influence climate change concern (45). Of note, during 2019, there was a severe early snowstorm in September in Montana, but no severe wildfires in Montana (46, 47).

The survey received Johns Hopkins University IRB approval (Study #HIRB00009679).

Survey measures

The questionnaire employed measures adapted from previous studies of health professionals and the public on climate change (see Table 1). The complete survey—including each measure’s wording—can be found in the Additional File #1. The questions address: 1) local climate change observations and assessments of current and future impacts; 2) climate change beliefs; 3) risk perception; and 4) prioritization of climate action by their offices and others. Demographics assessed in the survey included occupation, age, gender, geographic region, community size, political ideology, race, and ethnicity (See Table 1, Additional File #1.) Political ideology was measured on a 1–9 scale with 9 being most conservative.

Local climate change observations and assessments of current and future impacts. Because of the politicization of climate change, the first set of measures did not employ either the term “climate change” or “global warming,” but instead asked whether respondents had observed changes in frequency of extreme heat days, late summer drought, flooding, forest fires, and extreme precipitation events in their community. The 2017 Montana Climate Assessment identified these as events that are occurring now and will increase over time in Montana (20). For the purposes of the regression analyses, the number of reported changes that the professionals reported observing was summed. Respondents were also asked about current and future harm to their health and that of their patients from these impacts.

Climate change beliefs. In order to compare the results of the climate change public opinion questions to national- and state-level data from the Yale Project on Climate Change Communication (10), we asked whether *global warming* is happening (yes, no, don’t know) and its predominant cause (mostly human activity, mostly natural causes, it isn’t happening).

Risk perception. Respondents answered questions that asked them to judge whether climate change harms, benefits, or has no effect on human health at different temporal and social scales: 1) whether now or in the future; and 2) whether for yourself, your patients, in Montana, in the United States, or in other countries.

Prioritization in addressing climate change. A final set of questions asked the health professionals to relate how much of a prioritization climate change is—and should be—in their work and that of other professionals. Respondents provided their level of agreement, or disagreement, that the public health and environmental health effects of climate change should be a priority at their workplace (strongly agree—strongly disagree). They indicated whether at their workplace there has been any discussion or work around climate change, and suggested who should be addressing the causes and potential effects of climate change in Montana (businesses, elected officials, city/county governments, Montana state government, federal government, tribal governments, health care providers, public health officials, environmental health officials, individual citizens, non-profits).

Results

After individuals with two or more missing demographic variables were dropped, the study response rate was 37% (MPHA) and 44% (MEHA). The professionals were mostly female (82%), white (94%), liberal (50%), with at least some college education (Table 1, Additional File #1). Respondents were geographically well-distributed across the state (Fig. 1, Additional File #1). Half of the professionals serve in communities of 2,000–50,000; another 40% work in communities of 50,000 or greater; 10% were in communities under 2,500.

Climate change local observations, beliefs, risk perceptions, and prioritizations of public and environmental health professionals in Montana [RQ1]

Local observations. According to the 2017 Montana Climate Assessment (20), climate change is expected to increase extreme heat days, late summer drought, flooding, forest fire severity, and extreme precipitation events. The majority of respondents (86%) said that at least one of these phenomena are already occurring in their community. As shown in Fig. 1, about half of respondents (45 to 62%) said these events are already occurring, over half (57 to 74%) think their community's health is currently being harmed by each of these events, and an even higher number said their community's health will be harmed more in the future (68 to 80%).

Beliefs. The vast majority of respondents (88%) said that global warming was happening, with 69% saying that it is mostly human caused.

Risk perceptions. Regarding perceived risk, 69% said that climate change was harming their personal health already, and 79% said that it would harm their personal health in the future.

Prioritization. While almost three out of four health professionals said that climate change should be a priority at their workplace (73%, somewhat agree or strongly agree), less than a third said there had been any discussion or work on the topic (30%). Almost all respondents (93%) said action is needed to address climate change; only 7% said no action is needed. Regarding who should take action on climate, 73% percent said that all of the entities listed should act on climate and 26% chose one or more: federal government (16%); environmental health officials (15%); Montana state government (14%); elected

officials (11%); city/county governments (11%); tribal governments (9%); public health officials (8%); and individual citizens (8%); businesses (5%); non-profits (4%); and health care providers (2%), with the percentages showing the total for each individual entity.

The relationship between professional and sociodemographic characteristics and climate change beliefs and risk perception [RQ2a]

Logistic regression models predicting survey participant selection of the responses that “global warming is happening” and that it is “mostly caused by humans” were both statistically significant (respectively, $\chi^2(9) = 41.470, p < .001$; $\chi^2(9) = 31.345, p < .001$) (Tables 1 and 2). The models correctly classified 89.1% and 74.6% of cases (0.415, 0.234, Nagelkerke R^2). Of seven predictor variables only two were statistically significant in both the models: political ideology and community size (Tables 2–3). In both cases, increased conservatism was related to decreased likelihood of saying that global warming is happening and health experts serving communities between 2,500 and 50,000 people—e.g., more rural areas—were less likely to say that global warming is happening. Occupation was not a significant predictor in either model.

Table 1
Descriptive statistics for the sample

	<i>n</i>	Min	Max	<i>M</i>	<i>SD</i>
Age (18–44; 45–64; 65+)	185	1	3	1.62	0.64
Male	184	0	1	0.17	0.38
White/ Caucasian	185	0	1	0.94	0.24
Education	180	1	5	3.30	0.84
Political ideology	182	1	9	4.29	1.86
Environ health professional	185	0	1	0.24	0.43
Community size (< 2,500; 2,500 – 50,000; >50,000)	184	1	3	2.30	0.64
Number of local observed climatic changes	179	0	5	2.63	1.65
Harm to patients	180	0	1	0.63	0.48
GW happening	185	0	1	0.88	0.32
GW human-caused	182	0	1	0.69	0.47
Harm to me	184	0	1	0.69	0.46
Priority for department	183	1	5	3.96	1.09

Table 2
 Logistic regression model predicting the response “global warming is happening”

	<i>B</i>	<i>SE</i>	Wald χ^2	<i>df</i>	<i>p</i>	Odds ratio	95% C.I. for odds ratio	
							Lower	Upper
Age: 18–44 years*	-0.74	1.52	0.24	1	0.626	0.48	0.02	9.42
Age: 45–64 years*	-0.98	1.46	0.45	1	0.504	0.38	0.02	6.59
Male (Dichotomous)	1.28	1.16	1.21	1	0.270	3.58	0.37	34.68
Race: White/Caucasian (1); other (0)	0.12	1.20	0.01	1	0.919	1.13	0.11	11.91
Education (1–5)	-0.38	0.43	0.78	1	0.378	0.68	0.29	1.60
Political ideology (Conservatism ranked high, 1– 9)	-0.93	0.26	12.51	1	0.000	0.40	0.24	0.66
Occupation: Environmental health (1); public health (0)	-0.72	1.00	0.52	1	0.471	0.49	0.07	3.46
Community size: Under 2,500 people**	-0.11	1.29	0.01	1	0.933	0.90	0.07	11.18
Community size: 2,500 – 50,00 people**	-1.95	0.97	4.09	1	0.043	0.14	0.02	0.94
Number of local observed climatic changes (0–5)	0.95	0.29	10.75	1	0.001	2.59	1.47	4.56
<i>Constant</i>	8.48	3.31	6.58	1	0.010	4839.60		
<i>n</i> = 170; *Contrast category 65 + years; **Contrast category over 50,000 people								

Table 3

Logistic regression model predicting the response "global warming is caused mostly by human activity"

	<i>B</i>	<i>SE</i>	Wald χ^2	<i>df</i>	<i>p</i>	Odds ratio	95% C.I. for odds ratio	
							Lower	Upper
Age: 18–44 years*	-0.37	0.90	0.17	1	0.680	0.69	0.12	4.01
Age: 45–64 years*	-0.66	0.87	0.56	1	0.454	0.52	0.09	2.88
Male (Dichotomous)	0.47	0.62	0.57	1	0.449	1.59	0.48	5.32
Race: White/Caucasian (1); other (0)	0.05	0.78	0.00	1	0.947	1.05	0.23	4.84
Education (1–5)	-0.09	0.27	0.10	1	0.749	0.92	0.54	1.56
Political ideology (Conservatism ranked high, 1–9)	-0.46	0.13	13.36	1	0.000	0.63	0.49	0.81
Occupation: Environmental health (1); public health (0)	-0.22	0.53	0.17	1	0.679	0.80	0.29	2.26
Community size: Under 2,500 people**	-0.76	0.75	1.03	1	0.310	0.47	0.11	2.03
Community size: 2,500 – 50,00 people**	-0.82	0.45	3.22	1	0.073	0.44	0.18	1.08
Number of local observed climatic changes (0–5)	0.35	0.13	6.71	1	0.010	1.41	1.09	1.84
<i>Constant</i>	3.32	1.77	3.52	1	0.061	27.72		
<i>n</i> = 168; *Contrast category 65 + years; **Contrast category over 50,000 people								

The model predicting whether respondents say that climate change harms them now was also significant, $\chi^2(10) = 55.364$, $p < .001$. The model correctly classified 77.1% of cases (0.388, Nagelkerke R^2). Of the eight predictor variables only three were statistically significant: education, political ideology, and number of observed local climate changes (Table 4). Higher education was related to an increased likelihood of saying that climate change harms them and the number of observed local climatic changes, while increased conservatism was associated with decreased likelihood of saying they were currently being harmed. Again, occupation was not a statistically significant predictor.

Table 4

Logistic regression model predicting the response “global warming harms ... human health now for the people below [yourself]”

	<i>B</i>	SE	Wald χ^2	<i>df</i>	<i>p</i>	Odds ratio	95% C.I. for odds ratio	
							Lower	Upper
Age: 18–44 years*	0.46	0.79	0.34	1	0.562	1.58	0.33	7.50
Age: 45–64 years*	0.10	0.78	0.02	1	0.896	1.11	0.24	5.13
Male (Dichotomous)	0.60	0.63	0.91	1	0.341	1.82	0.53	6.22
Race: White/Caucasian (1); other (0)	0.40	0.76	0.28	1	0.596	1.50	0.34	6.69
Education (1–5)	0.72	0.29	6.18	1	0.013	2.06	1.17	3.64
Political ideology (Conservatism ranked high, 1–9)	-0.34	0.12	7.42	1	0.006	0.71	0.56	0.91
Occupation: Environmental health (1); public health (0)	0.16	0.56	0.08	1	0.774	1.17	0.39	3.50
Community size: Under 2,500 people**	0.71	0.77	0.86	1	0.355	2.04	0.45	9.17
Community size: 2,500 – 50,00 people**	-0.23	0.46	0.25	1	0.616	0.80	0.32	1.95
Number of local observed climatic changes (0–5)	0.60	0.15	17.10	1	0.000	1.83	1.37	2.43
<i>Constant</i>	-2.14	1.73	1.53	1	0.216	0.12		
<i>n</i> = 170, *Contrast category 65 + years; **Contrast category over 50,000 people								

The relationship between professional and sociodemographic characteristics and risk perception on injunctive norms for office prioritization [RQ2b]

A linear regression model predicting respondents' level of agreement that environmental and public health organizations should prioritize addressing the effects of climate change (Table 5) was significant $F(11, 154) = 13.199, p < .001$, accounting for 48.52% of the variation in the respondents' agreement across the five-point measure ($R^2, 0.485$). Of the nine predictors, four were significant. Men were more likely than women and other gender identifications to say that climate change should be a priority. So, too, were those who observed higher rates of local climate changes and those who said that their patients have been harmed from climate change. Conservatives were less likely to say that climate change should be a priority for their organizations.

Table 5

Regression model predicting agreement with “At my workplace, preparing to deal with the public health and environmental health effects of climate change should be a priority”

	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
<i>(Constant)</i>	4.32	0.59		7.33	0.000
Age: 18–44 years*	0.26	0.26	0.12	1.00	0.318
Age: 45–64 years*	0.04	0.26	0.02	0.15	0.881
Male (Dichotomous)	0.40	0.19	0.13	2.04	0.043
Race (White/Caucasian)	-0.05	0.28	-0.01	-0.17	0.865
Education (1–5)	-0.08	0.09	-0.06	-0.88	0.380
Political ideology (Conservatism ranked high, 1–9)	-0.21	0.04	-0.35	-5.10	0.000
Occupation: Environmental health (1); public health (0)	-0.13	0.18	-0.05	-0.72	0.475
Community size: Under 2,500 people**	-0.19	0.25	-0.05	-0.78	0.435
Community size: 2,500 – 50,00 people**	-0.27	0.14	-0.12	-1.90	0.060
Number of local observed climatic changes (0–5)	0.16	0.04	0.24	3.62	0.000
Climate change harms my patients (Dichotomous)	0.59	0.15	0.26	3.80	0.000
<i>n</i> = 166; *Contrast category 65 + years; **Contrast category over 50,000 people					

Discussion

Public and environmental health professionals in a rural and conservative state demonstrate high levels of understanding that global warming is happening, human-caused, and has immediate health risks. Moreover, they say that their offices should prioritize this issue. However, few say that their offices are addressing the issue (30%). Like members of the public, factors such as political ideology and experiences of local change in their communities relate the most strongly to the experts' responses.

Comparison to other studies of health care professionals

In contrast to public concerns about climate change in Montana that typically rank lower than U.S. averages, health care professionals in Montana demonstrated similar or higher climate change concerns and perceived need for action compared to national studies of their colleagues. Most Montana health professionals said that global warming was happening (88%), mostly human caused (69%), and should be a priority at their workplace (73%). By way of comparison, one of the highest rates of climate concern and prioritization by health professionals was recorded in a 2014 survey of African American physicians in the National Medical Association (NMA) (35). Almost all (97%) said that climate change was happening; 62% that it is caused mostly by human activity; and 75% that physicians had a responsibility

to address climate change with their patients. The relatively high rates of issue awareness and concern found in this study of Montana health professionals—roughly comparable to the 2014 NMA study—may be due in part to population-wide shifts in climate change beliefs during the decade and a half since these studies started (48).

Differences between health professionals and the public

Other health provider studies have shown that while health professionals can have very different views on climate change compared to the general public (35), they can also be subject to some of the same politically polarizing influences (34). The present study illustrates both higher concern levels than the public and the influence of political ideology. In 2019, the Yale Climate Opinion Maps estimated that 60% of people in Montana were likely to say that global warming is happening (8, 10), as opposed this study's finding of 88% of state public health professionals saying the same that year.

Public health professionals spend their careers addressing threats to the wellbeing of the people within their communities (49), so it might be inferred that they would be more informed about climate change and its health implications than the general public. But public and environmental health professionals, even in Montana, are distinctly different in political ideology and sociodemographic characteristics than state residents in general. As of 2018, 39% of Montanans said they were conservative, 38% moderate and 18% liberal (50). In contrast, this sample of Montana health professionals was 23% conservative, 27% moderate, and 50% liberal. Additionally, 80% of the respondents were female (51).

Factors related to professionals' climate change beliefs, risk perceptions, and injunctive norms

Political ideology and local experiences of climate-related changes consistently significantly predicted responses that global warming is happening and mostly human-caused; both of these variables are also strongly correlated with public beliefs about climate change (30). While local experiences of climate change may be motivated by either physical conditions or previously held beliefs (52), health experts might be expected to be more attuned to changes in conditions, especially as relates to community health. Interestingly, neither education nor expert status (environmental vs. public health) were consistently significant predictors, demonstrating little or no difference between environmental and public health experts, or differences between health professionals with some college experience versus those with advanced degrees. (Education was only a significant predictor of respondents who said that climate change was harming their health now.)

Perceived need for climate action

In 2018, at least half of registered U.S. voters – including Democrats, Independents, and liberal/moderate Republicans, but not conservative Republicans – said that citizens, the U.S. Congress, President Trump, their own member of Congress, and/or their local government officials should do more to address climate (53). Most (73%) of the respondents in this study of Montana health professionals said that action on climate was needed by all of the above. For those who did not list “all”, federal government,

environmental health, and state government officials ranked at the top of those the professionals said should be taking action, while health care providers fell at the bottom. The assumption that health care providers do not have a responsibility to address climate change is one that many in health care are attempting to address since providers are trusted and respected messengers in our society (18) and healthcare is a topic of concern for most people (54).

Study limitations

This study found no significant difference in the beliefs and attitudes of environmental and public health professionals, a topic that had not been previously studied. But the number of these health professionals in Montana is relatively small: a larger U.S. study of public and environmental health professionals in other rural areas would be valuable. Although the survey response rate was relatively high with 39% fully completing the survey, we do not have demographic information for the two member organizations to fully assess the representativeness of the sample. The online survey was advertised by the MEHA and MPHA leadership with no mention climate or global warming, but the 17% of respondents who participated in a paper version of the study at MPHA's annual meeting met the lead author and may have been aware that the study was about climate change, leading to response bias.

Conclusion

This study finds that Montana's health professionals are already aware of climate change's risks and want to see their offices and others more actively engage on the issue. Because of the level of expertise and community knowledge held by these professionals, information about their concerns may be helpful for the public and policymakers, much as climate organizations have spotlighted faith groups as opinion leaders (55). The positions of trust that these experts hold in their communities potentially make them ideally situated to lead discussions on how to address climate change in rural areas. As health professionals become more aware that a large number of them— even in rural conservative states — are concerned, it may potentially open up spaces for wider conversations with their colleagues and patients.

Abbreviations

APHA – American Public Health Association

EH – environmental health

IRB – Institutional Review Board

MEHA – Montana Environmental Health Association

MPHA – Montana Public Health Association

NEHA – National Environmental Health Association

NMA – National Medical Association

PH – public health

US – United States

Declarations

Declarations

N/A

Ethics Approval and Consent to Participate

The survey received Johns Hopkins University IRB approval (**Study #:** HIRB00009679). Johns Hopkins follows the Common Rule (the Federal Policy for the Protection of Human Subjects), the ethical principles of the Belmont Report, and the Declaration of Helsinki. The first question of the survey tool established informed consent (Additional File #1, Survey Tool).

Consent for Publication

Not applicable

Availability of Data and Materials

The survey tool is located in Additional File #1. The dataset supporting the conclusions of this article is available in an SPSS file and has been uploaded to the journal's data repository.

Competing Interests

The authors, LGB and KLA, declare they have no actual or potential competing financial interests.

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Authors' Contributions

Both LGB and KLA developed the questionnaire and participated in all aspects of the research. Both authors contributed to the final draft of the paper and approved the submitted version. LGB had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Both authors read and approved the final manuscript.

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LGB practices hospital pediatrics and climate advocacy in rural Montana, after serving 27 years in Indian Health Service. She serves on the EPA's Children's Health Protection Advisory Committee and the American Academy of Pediatrics Executive Committee for the Council on Environmental Health. She sits on the leadership team for the Montana Climate Change and Human Health project. She earned a MS from Johns Hopkins in Energy Policy and Climate in 2020.

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References

1. Crimmins A, Balbus J, Gamble JL, Beard CB, Bell JE, Dodgen D, et al. The impacts of climate change on human health in the United States: A scientific assessment [Internet]. U.S. Global Change Research Program; 2016 [cited 2020 May 19]. Available from: <https://health2016.globalchange.gov/downloads>
2. Watts N, Adger WN, Ayeb-Karlsson S, Bai Y, Byass P, Campbell-Lendrum D, et al. The Lancet Countdown: tracking progress on health and climate change. *The Lancet*. 2017 Mar 18;389(10074):1151–64.
3. United Nations. World population prospects 2019: Highlights [Internet]. Population Division, Department of Economic and Social Affairs, United Nations; 2019. Report No.: ST/ESA/SER.A/423. Available from: https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf
4. United Nations. World urbanization prospects: the 2018 revision [Internet]. Department of Economic and Social Affairs, Population Division, United Nations; 2019. Available from: <https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf>
5. U.S. Census Bureau. New Census data show differences between urban and rural populations [Internet]. The United States Census Bureau. 2016 [cited 2020 May 19]. Available from: <https://www.census.gov/newsroom/press-releases/2016/cb16-210.html>
6. Dasgupta P, Morton J, Dodman D, Karapinar B, Meza F, Rivera-Ferre MG, et al. Rural areas. In: Field C, Barros V, editors. *Climate change 2014: Impacts, adaptation, and vulnerability* [Internet]. Cambridge and New York: Cambridge University Press; 2014 [cited 2020 May 19]. p. 613–57. Available from: <https://gala.gre.ac.uk/id/eprint/14369/>
7. Gowda PH, Steiner J, Olson C, Boggess M, Farrigan T, Grusak MA. Chapter 10: Agriculture and Rural Communities. In: *Impacts, risks, and adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, DR, CW Avery, DR Easterling, KE Kunkel, KLM Lewis, TK Maycock,

- and BC Stewart (eds)] [Internet]. U.S. Global Change Research Program; 2018 [cited 2020 May 19]. Available from: <https://nca2018.globalchange.gov/chapter/10/>
8. Howe PD, Mildener M, Marlon JR, Leiserowitz A. Geographic variation in opinions on climate change at state and local scales in the USA. *Nature Climate Change*. 2015 Jun;5(6):596–603.
 9. United States Department of Agriculture. State fact sheets: Montana [Internet]. United States Department of Agriculture, Economic Research Service. 2020 [cited 2020 May 19]. Available from: <https://data.ers.usda.gov/reports.aspx?StateFIPS=30&StateName=Montana&ID=17854>
 10. Yale Program on Climate Change Communication. Yale climate opinion maps 2019 [Internet]. Yale Program on Climate Change Communication. [cited 2020 May 19]. Available from: <https://climatecommunication.yale.edu/visualizations-data/ycom-us/>
 11. Definitions of Environmental Health [Internet]. National Environmental Health Association. [cited 2020 May 20]. Available from: <https://www.neha.org/about-neha/definitions-environmental-health>
 12. Environmental Health [Internet]. American Public Health Association. [cited 2020 May 20]. Available from: <https://www.apha.org/topics-and-issues/environmental-health>
 13. American Lung Association. A declaration on climate change and health: Climate change is a health emergency [Internet]. 2019. Available from: https://www.apha.org/-/media/files/pdf/topics/climate/190429_declaration_climate_health.ashx?la=en&hash=16B91AA9FFE92E5A021524490027D573FEAE080B
 14. Watts N, Amann M, Ayeb-Karlsson S, Belesova K, Bouley T, Boykoff M, et al. The Lancet Countdown on health and climate change: from 25 years of inaction to a global transformation for public health. *The Lancet*. 2018;391(10120):581–630.
 15. Myers T, Nisbet M, Maibach E, Leiserowitz A. A public health frame arouses hopeful emotions about climate change. *Climatic Change* [Internet]. 2012;113:1105-1112. Available from: <https://link.springer.com/article/10.1007/s10584-012-0513-6>
 16. Akerlof KL, Boules C, Ban Rohring E, Rohring B, Kappalman S. Governmental communication of climate change risk and efficacy: Moving audiences toward “danger control.” *Environmental Management*. 2020 May 1;65(5):678–88.
 17. Maibach EW, Nisbet M, Baldwin P, Akerlof K, Diao G. Reframing climate change as a public health issue: an exploratory study of public reactions. *BMC Public Health*. 2010 Jun 1;10(1):299.
 18. Brenan M. Nurses again outpace other professions for honesty, ethics. *Gallup Polls* [Internet]. 2018 [cited 2020 Oct 1]; Available from: <https://news.gallup.com/poll/245597/nurses-again-outpace-professions-honesty-ethics.aspx>
 19. Adams A, Byron R, Maxwell B, Byron L, Higgins S, Eggers M, et al. Climate change and human health in Montana :A special report of the Montana Climate Assessment. [Internet]. Bozeman, MT: Montana State University, Institute on Ecosystems, Center for American Indian and Rural Health Equity; 2020 [cited 2021 Jan 2]. Available from: <https://doi.org/10.15788/c2h22021>
 20. Whitlock C, Cross W, Maxwell B, Silverman N, Alisa A. 2017 Montana Climate Assessment [Internet]. 2017. Available from: <https://scholarworks.montana.edu/xmlui/handle/1/13584>

21. USGCRP. Fourth National Climate Assessment [Internet]. U.S. Global Change Research Program, Washington, DC; 2018 [cited 2020 May 19] p. 1–470. Available from:
<https://nca2018.globalchange.govhttps://nca2018.globalchange.gov/chapter/10>
22. Census Viewer: Population of Montana [Internet]. 2010 [cited 2020 May 20]. Available from:
<http://censusviewer.com/state/MT>
23. Duffin E. Population density of the United States from 1790 to 2019 in residents per square mile of land area [Internet]. 202AD [cited 2021 Jan 3]. Available from:
<https://www.statista.com/statistics/183475/united-states-population-density/>
24. U.S. Bureau of Labor Statistics. occupational employment statistics: May 2019 state occupational employment and wage estimates Montana [Internet]. [cited 2020 May 20]. Available from:
https://www.bls.gov/oes/current/oes_mt.htm
25. Montana area, size, and density [Internet]. States 101. 2014 [cited 2020 May 20]. Available from:
<https://www.states101.com/populations/montana>
26. Leiserowitz A. Climate Change Risk Perception and Policy Preferences: The Role of Affect, Imagery, and Values. *Climatic Change*. 2006 Jul 1;77(1–2):45–72.
27. Weber EU. What shapes perceptions of climate change? New research since 2010. *WIREs Climate Change*. 2016;7(1):125–34.
28. Witte K. Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs*. 1992;59(4):329–49.
29. Rogers RW. A protection motivation theory of fear appeals and attitude change. *The Journal of Psychology*. 1975 Sep 1;91(1):93–114.
30. Hornsey MJ, Harris EA, Bain PG, Fielding KS. Meta-analyses of the determinants and outcomes of belief in climate change. *Nature Climate Change*. 2016 Jun;6(6):622–6.
31. Jones J. Gallup Polls Social Series: Environment. American views on global warming, 2019. Gallup Polls [Internet]. 1 [cited 2019 Nov 25]; Available from:
https://news.gallup.com/poll/248030/americans-views-global-warming-2019-trends.aspx?g_source=link_newsv9&g_campaign=item_248027&g_medium=copy
32. Kreslake J, Sarfaty M, Roser-Renouf C, Leiserowitz A, Maibach E. The critical roles of health professionals in climate change prevention and preparedness. *American Journal of Public Health*. 2018 Apr 26;
33. Maibach EW, Chadwick A, McBride D, Chuk M, Ebi KL, Balbus J. Climate change and local public health in the United States: preparedness, programs and perceptions of local public health department directors. *PloS one*. 2008;3(7).
34. Roser-Renouf C, Maibach EW, Li J. Adapting to the changing climate: An assessment of local health department preparations for climate change-related health threats, 2008-2012. *PloS one*. 2016;11(3):e0151558.
35. Sarfaty M, Mitchell M, Bloodhart B, Maibach EW. A Survey of African American physicians on the health effects of climate change. *International Journal of Environmental Research and Public Health*.

- 2014;11(12):12473–85.
36. Sarfaty M, Bloodhart B, Ewart G, Thurston GD, Balmes JR, Guidotti TL, et al. American Thoracic Society member survey on climate change and health. *Annals of the American Thoracic Society*. 2015;12(2):274–8.
 37. Sarfaty M, Kreslake JM, Casale TB, Maibach EW. Views of AAAAI members on climate change and health. *The Journal of Allergy and Clinical Immunology: In Practice*. 2016;4(2):333-335.e26.
 38. McAdams J, Rehr R, Kobayashi N, DeArman V. Measuring National Environmental Health Association member attitudes, awareness, and behaviors on climate change: results from three consecutive annual surveys. *Journal of Environmental Health*. 2019;81(8):40–3.
 39. State and territorial health agency needs for a changing climate: A summary and analysis of ASTHO’s 2009 and 2012 climate health needs assessments [Internet]. 2012 [cited 2021 Feb 21]. Available from: <https://www.astho.org/Programs/Environmental-Health/Natural-Environment/Climate-Change/2012-Climate-and-Health-Survey-Report/>
 40. Carr JL, Sheffield PE, Kinney PL. Local preparedness for climate change among local health department officials in New York State: A comparison with national survey results. *Journal of Public Health Management and Practice*. 2012;18(2):E24–32.
 41. Bedsworth L. Preparing for climate change: A perspective from local public health officers in California. *Environ Health Perspect*. 2009 Apr;117(4):617–23.
 42. Vynne S, Doppelt B. Climate change health preparedness in Oregon: An assessment of awareness, preparation and resource needs for potential public health risks associated with climate change [Internet]. Eugene OR: The Climate Leadership Initiative with The Oregon Coalition of Local Health Officials, Environmental Health Committee; 2009 [cited 2021 Feb 2]. Available from: https://tools.niehs.nih.gov/cchhl/index.cfm/main/detail?reference_id=1142
 43. Syal, S, Wilson, R, Crawford, J.M, Lutz, J. Climate change and human health—what influences the adoption of adaptation programming in the United States public health system? *Mitigation and Adaptation Strategies for Global Change*. 2011;Volume 16, pages 911-924.
 44. van der Linden S. The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *Journal of Environmental Psychology*. 2015 Mar 1;41:112–24.
 45. Konisky DM, Hughes L, Kaylor CH. Extreme weather events and climate change concern. *Climatic Change*. 2016 Feb 1;134(4):533–47.
 46. Dolce C. Extreme fall start marked by unusual heat, snow and cold records in the United States. 2019 [cited 2020 Jun 10]; Available from: <https://weather.com/news/news/2019-10-02-fall-extreme-weather-snow-cold-northwest-east-heat-lorenzo>
 47. National Interagency Fire Center [Internet]. [cited 2020 Jun 10]. Available from: https://www.nifc.gov/fireInfo/fireInfo_statistics.html
 48. Leiserowitz A, Maibach E, Rosenthal S, Kotcher J, Bergquist P, Ballew MT, et al. Climate Change in the American mind: April 2020. Yale University and George Mason University [Internet]. New Haven, CT: Yale Program on Climate Change Communication; 2020. Available from:

<https://climatecommunication.yale.edu/wp-content/uploads/2020/05/climate-change-american-mind-april-2020b.pdf>

49. Polivka BJ, Chaudry RV, Crawford JM. Public health nurses' knowledge and attitudes regarding climate change. *Environmental Health Perspectives*. 2012;120(3):321–5.
50. Jones J. Conservatives greatly outnumber liberals in 19 U.S. states [Internet]. Gallup Polls. 2019 [cited 2020 Jun 10]. Available from: <https://news.gallup.com/poll/247016/conservatives-greatly-outnumber-liberals-states.aspx>
51. Montana gender ratios 2019 [Internet]. States 101. 2019 [cited 2020 Dec 1]. Available from: <https://www.states101.com/gender-ratios/montana>
52. Myers TA, Maibach EW, Roser-Renouf C, Akerlof K, Leiserowitz AA. The relationship between personal experience and belief in the reality of global warming. *Nature Clim Change*. 2013 Apr;3(4):343–7.
53. Leiserowitz A, Maibach E, Roser-Renouf C, Rosenthal S, Cutler M, Kotcher J. Politic and global warming, March 2018. [Internet]. Yale Center on Climate Change Communication. 2018 [cited 2020 Mar 1]. Available from: <https://climatecommunication.yale.edu/publications/politics-global-warming-march-2018/2/>
54. Norman J. Healthcare once again tops list of Americans' worries [Internet]. Gallup Polls. 2019. Available from: <https://news.gallup.com/poll/248159/healthcare-once-again-tops-list-americans-worries.aspx>
55. Janson J. The civic and community engagement of religiously active Americans [Internet]. Pew Research Center. 2011 [cited 2020 Jun 10]. Available from: <https://www.pewresearch.org/internet/2011/12/23/the-civic-and-community-engagement-of-religiously-active-americans/>

Figures

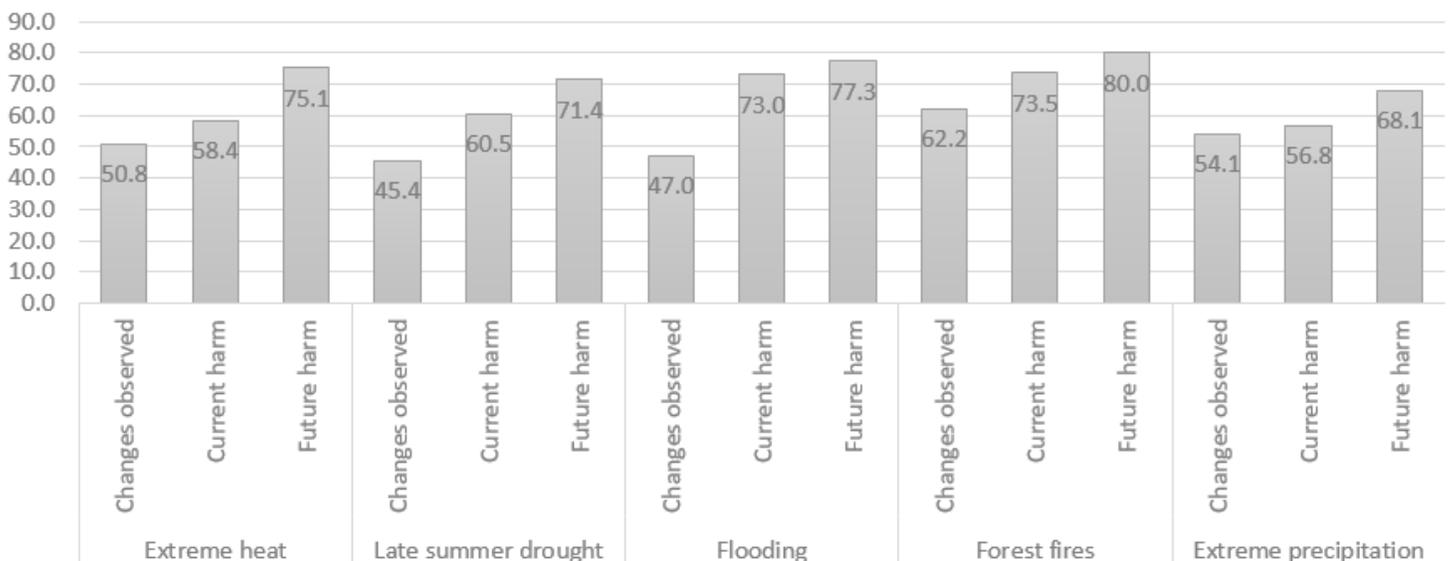


Figure 1

Montana health professionals' perceptions of climate change-related events in their communities.

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