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Abstract

The impacts of climate change are having negative consequences on agricultural communities in the U.S. and other regions of the world. More specifically, these impacts are expected to increase in both scale and complexity and will continue to pose challenges both in terms of agricultural production and capacity. The purpose of this study was to understand ranchers' and farmers' perceptions of climate change's impact on their businesses and their mental well-being in a rural U.S. western state. Surveys were administered online and in-person to farmers and ranchers in fall of 2017. Descriptive statistics and correlational tests were conducted to evaluate if climate risk perception was related to levels of mental distress. Open-ended survey questions explored specifically how climate change is impacting mental well-being. The majority of respondents agree that climate change is having an impact on agricultural business and nearly three quarters of respondents are experiencing moderate levels of anxiety when thinking about climate change and its effects on agricultural business. A moderate correlation was observed between climate risk perception and climate-related anxiety. Qualitative data showed the impact of climate change on profitability was perceived as the main cause of distress. This study demonstrates that climate change is generating anxiety and distress for farmers and ranchers. To maximize public health preparedness efforts, interventions are warranted to provide climate adaptation education and therapeutic outreach specific to agricultural workers experiencing economic struggle in the context of climate change.

Significance: The negative impacts of climate change on agriculture are influencing the mental health of farmers and ranchers. Many farmers and ranchers have reported feeling anxious when thinking about the increasing threats of climate change, including impacts on the agricultural

economy and personal profitability. Because farmers and ranchers play a significant role in the nation's food security, public health preparedness efforts are warranted to provide mental health support and encourage the agricultural industry to adopt more sustainable farming practices.

Keywords: mental health, climate change, agriculture, rural health, depression, anxiety

Introduction

The current and projected impacts of climate change present challenges for agricultural productivity (Hatfield et al., 2014; Wuebbles et al., 2017), with potentially serious consequences for farmers' and ranchers' livelihoods (Ahmed & Stepp, 2016; Doherty & Clayton, 2011). Although many farmers and ranchers have adapted to weather patterns, climate change poses more extreme ecological stress and constraints to agriculture through increased inter-annual variability of temperatures and precipitation, more extreme weather conditions such as prolonged droughts and increased frequency and intensity of natural disasters (Hatfield et al., 2014; Wuebbles et al., 2017). Current climate trends are linked to declines in crop yields (D'Agostino & Schlenker, 2016), crop quality (Ahmed & Stepp, 2016), and livestock development, all of which present direct and indirect effects on food security through changes in food supply and market prices (Hatfield et al., 2014). In turn, these negative impacts can create occupational stressors for farmers and ranchers and may negatively influence their mental well-being (Bourque & Willox, 2014).

A growing body of literature is characterizing the implications of climate change on health (Trombley, Chalupka, & Anderko, 2017; Watts et al., 2018), yet limited empirical evidence describes how climate change may be specifically influencing mental well-being among rural agricultural populations in the U.S. The environmental impacts of climate change, and the resulting economic threat to agriculture may create distress, anxiety, and depression (Padhy, Sarkar, Panigrahi, & Paul, 2015). A qualitative study conducted in Australia identified three factors related to the psychological effects of farming in an arduous climate: uncontrollable events, financial hardship, and social pressure (Staniford, Dollard, & Guerin, 2009). In an analysis of general well-being in rural Australia, agricultural workers in drought-affected regions

reported significantly lower life satisfaction compared to non-agricultural workers in those regions (Hogan, Polidano, Russell, & Stakelum, 2006). In severe cases, farmers may resort to suicide (Padhy et al., 2015). Suicide rates are high within the agricultural industry (McIntosh et al., 2016). In particular, the occurrence of drought is associated with an increased frequency of farmer suicide across the globe (Hanigan, Butler, Kokic, & Hutchinson, 2012; Mishra, Gupta, & Bhabulkar, 2015).

This study addressed the aforementioned research gap regarding the limited evidence investigating if, and how, climate change influences mental health among rural agricultural populations in the U.S. through a case study in the state of Montana. Montana is a suitable study area to examine climate change and mental well-being among agricultural workers because it is an agricultural rural state (U. S. Census Bureau, 2010; United States Department of Agriculture, 2017) with existing mental health disparities, including high rates of depression (Centers for Disease Control and Prevention, 2017) and low access to mental health care (Kaiser Family Foundation, 2016). Furthermore, many of Montana's social and cultural values are centered around agriculture (Whitlock, Cross, Maxwell, Silverman, & Wade, 2017). Agriculture represents the largest economic sector in Montana, generating approximately $4.6 billion annually (United States Department of Agriculture, 2017). In 2014, agricultural land, including cropland and rangeland, accounted for approximately 65% of the total acreage of Montana and supported approximately 110,000 jobs and $3.3 billion in labor earnings (Power & Power, 2016). Furthermore, agricultural workers are a compelling group through which to examine the influence of climate change on mental well-being because of their crucial role in supporting overarching food systems and national food security.

A state-wide analysis derived from dispersed meteorological stations indicates that temperatures in Montana are increasing at a rate that is approximately two times greater than the average global temperature shift associated with climate change (Pederson, Graumlich, Fagre, Kipfer, & Muhlfeld, 2010). Whitlock and colleagues (2017) showed that increasing temperatures, coupled with a decrease in precipitation, can challenge irrigation capacity, limit full crop development, and increase the amount of crop pests in Montana. Increasing temperatures also induce substantial heat stress for livestock, reduce forage quantity on livestock rangeland, and increase the risk of wildfires (Whitlock et al., 2017). Due to these changes, one report predicts a 25% net decrease in crop production and 20% net decrease in livestock production by 2050 (Power & Power, 2016). This prediction would surmount to a loss of approximately 25,000 jobs and $736 million in state-wide labor earnings by 2050 (Power & Power, 2016), potentially impacting farmer livelihoods and mental well-being.

The primary aim of this study was to examine the association between climate change risk perception and mental well-being among farmers and ranchers in Montana. Using a qualitative approach, the secondary aim of this was to examine how climate change may be affecting the mental well-being of farmers and ranchers in the state. Study findings have the potential to inform future evidence-based programs to mitigate the risk of climate-change driven psychiatric distress in agricultural workers in the United States who support the nation's food system and food security of its people. We hypothesized that perceptions of climate change's greater impact will positively correlate with greater mental distress.

Methods

Procedures

We used a cross-sectional study design, administering paper surveys at two annual agriculture conferences in Montana and online surveys to three agricultural organization's email list servers. Surveys were distributed to multiple types of agricultural organizations in order to elicit responses from a broad range of types of producers whom are representative of the agricultural population in Montana. Individuals were eligible to participate if they identified as a current farmer or rancher in Montana and were over 18 years- old. All respondents received a $15 gift card for completing the survey, and the total sample consisted of 125 individuals.

The survey was reviewed for face validity by content experts with expertise in agriculture, climate change, rural communities, and mental health. Revisions were made based on feedback from experts. The survey was then further tested for validity with key informants and was modified based on feedback before being administered. Approval of human subjects was obtained by the Institutional Review Board (IRB) at Montana State University. Informed consent was retrieved from all study participants following IRB guidelines prior to taking the survey.

Survey Measures

The survey consisted of a total of 15 questions including three scales focused on assessing perceptions of climate change and mental well-being. The first scale of the survey instrument assessed climate risk perception, included a total of 3 questions, and was adapted from a previously validated climate change perceptions survey, Climate Change in the American Mind (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Rosenthal, 2015). The scale range is 1 to 5. The Cronbach's alpha = 0.762, indicating moderately good reliability.

An additional four questions asked how much climate change will harm (Climate Harm Scale): yourself, your family, people in your community, and other farmers in the U.S.

Respondents answered on a 4-point scale ("not at all"; "only a little"; a moderate amount"; "a great deal"). The Cronbach's alpha = 0.895, indicating high reliability.

We use a modified scale of the Generalized Anxiety Disorder Scale-7 (GADS-7) (Löwe et al., 2008) to evaluate climate change-related anxiety in order to measure depression symptoms. Specifically, the modified GADS-7 measures how strongly persons feel symptoms of anxiety when they think about climate change and its effects on business, with a 4-point response scale from "not at all" to "very." This scale was also highly reliable (Chronbach's alpha = 0.864).

We also used the Patient Health Questionnaire-9 (PHQ-9) to assess present depressive symptom severity (Kroenke, Spitzer, & Williams, 2001). The PHQ-9 measures how often individuals are bothered by depressive symptoms, with a 4-point response scale from "not at all" to "nearly every day". The PHQ-9 scale was followed by a question to ask the degree to which climate change impacts a person's level of distress. An open-ended question was used to ask respondents indicating distress to elaborate on why they felt that climate change was contributing to their levels of distress. The scale range is 1 – 4. This scale was found to be very reliable (Chronbach's alpha = 0.916). The last section of the survey comprised of six questions to gather occupational and socio-demographic characteristics.

Data Analysis

Study questions were examined using descriptive statistics, such as means, standard deviations, and proportions. Correlational analyses assessed relationships between quantitative scales. ANOVA examined differences between means of climate-related anxiety scores across sample characteristics including age, years working in agriculture, generation on operation, best described affiliation, largest part of operation, and contribution of farming to the total household

income. Tukey-Kramer HSD pos-hoc analyses were used for each ANOVA model. Content analyses based on coding methodology (Saldaña, 2015) was used to identify themes for the open-ended qualitative questions regarding how climate change was contributing to participants' levels of distress. After the first author conducted the initial coding, the second author did another separate review. The Cohen's kappa agreement score was very good (k = 0.97).

Results

Quantitative Results

Descriptive sample characteristics. Table 1 presents participant characteristics and frequencies of respondents. Of the 125 respondents, the majority were 35-54 years old and approximately half of the sample identified as being the 3rd or 4th generation on their farming or ranching operation. Although, we did not specifically track race and gender, overwhelmingly most respondents were White males. One third of respondents indicated having an organic operation and the other two thirds indicated having a conventional operation. Approximately three fourths of total respondents reported that farming contributes to at least 40% of total household income.

[Table 1 here]

Descriptive perceptions of climate change. Overall, 69.3% of respondents are either somewhat sure or extremely sure that climate change is happening and 72.0% of respondents expressed that they personally have experienced the effects of climate change on their agricultural business. 74.0% of respondents feel either moderately anxious or very anxious when regarding the effects of climate change on their agricultural business and 43.3% feel moderately afraid or very afraid to the same effect. Finally, 39.4% of respondents agree or strongly agree that climate change is contributing to their levels of indicated distress, in reference to the PHQ-9.

Scale Means and standard deviations. On the 5-point scale of climate risk perception (low risk – high risk), the mean score was 3.76 (SD = 1.26). One the 4-point scale of perceived climate harm ("not at all" to "a great deal") the mean score was 2.72 (SD = 0.98). On the 4-point scale of the modified GADS-7 for climate-related anxiety (low anxiety – high anxiety), the mean score was 2.27 (SD = 0.67). Lastly, on the 4-point PHQ-9 scale for general depression (no symptoms – frequent symptoms), the mean score was 1.61 (SD = 0.66).

Scale correlations. Table 2 presents correlations among key measures. A moderate positive correlation was found between climate risk perception and climate-related anxiety symptoms $r(119) = 0.46$, $p<.001$. A moderate positive correlation was also found between climate risk perception and climate-related distress $r(120) = 0.33$, $p<.001$. A strong positive correlation was found between perceived climate harm and climate-related anxiety $r(114) = 0.61$, $p<.001$. A moderate positive correlation was also found between perceived climate harm and climate-related distress $r(115) = 0.43$, $p<.001$. Respondents who perceive more overall climate harm (to themselves, their family, people in their community, and other farmers in the U.S.) also indicate higher levels of climate-related anxiety and climate-related distress.

[Table 2 here]

Climate-related anxiety score differences by sample characteristics. There was a significant effect of affiliation (organic or conventional farmer) on climate-related anxiety $F(2,115) = 5.33$, $p<.05$, with organic farmers indicating higher anxiety compared to conventional farmers (M = 2.53 vs. 2.12). Largest part of operation categories (grain/legume, fruit/vegetable, rancher) were found to be significantly different $F(3,114) = 4.76$, $p<.001$ with fruit/vegetable farmers indicating higher anxiety than grain/legume farmers and ranchers (M = 2.48 vs. 2.01 and 2.38, respectively). Farming contribution to income ranges (<10%, 10 – 40%, 40 – 70%, 70 –

100%) were also found to be significantly different $F(3,115) = 4.26$, $p<.001$ with the 10 – 70% ranges indicating higher anxiety compared to the 70 – 100% range (M = 2.43 vs. 2.04). No significant mean differences in climate-related anxiety were found by age, generation, or years working in agriculture (results not shown).

Qualitative Results

Table 3 depicts three main themes that emerged from the coding analysis of how specifically climate change is contributing to farmer and rancher mental distress: financial concern, operational planning, and resilience. Financial concern refers to the stress related to climate change and its effects on prospective profitability of business. Operational planning refers to the apprehension of harsh weather and variable seasonal changes when planning for planting or harvesting. Resilience refers to select participant's perceptions of adapting or mitigating the negative impacts of climate change on their agricultural business.

[Table 3 here]

Discussion

To our knowledge, this is the first study to empirically evaluate whether and how climate change impacts the mental well-being of farmers and ranchers in the rural western U.S. region. Overall, our results suggest that perceptions of climate risk and harm correlate positively with increased levels of both anxiety and distress in our sample. Qualitative data also support these findings by providing details on how farmers and ranchers are being negatively impacted. Concerns range from predicting weather patterns on the growing season, financial vulnerability, and what future climate trends may mean for the viability of the farm or ranch. The majority of respondents (72%) reported directly experiencing climate change's effects on their operation and 74% reported feeling anxious when thinking about those effects on business.

We also found varying levels of climate-related anxiety by sample characteristics. Organic farmers reported higher levels of anxiety compared to conventional farmers and fruit/vegetable farmers reported higher levels of anxiety compared to grain/legume farmers. This may be due, in part, to warmer weather providing optimal growth and extended seasons for grains and legumes. While we did expect to find significant differences in climate-related anxiety related to farming contribution to income, we were surprised to find that individuals who stated farming contributes 70-100% to total household income reported significantly less climate-related anxiety than individuals who stated that farming contributes <70% to total household income. This finding may reflect that those with higher percentages of income from the business may have greater resources to adapt to these changes, leading to some selected comments that speak to resilience. Hence, a greater percentage of income from the business may mitigate the impact of perceived climate risk and harm from mental distress and worry. Future research is warranted to examine the rationale behind some why some agricultural workers may feel a greater mental impact from climate's effects compared to others.

Qualitative results allowed us to further investigate how climate change is impacting farmer and rancher mental well-being. We identified three distinct themes representing climate change and its influence on farmer and rancher mental well-being: financial concern, operational planning, and resilience. Our results are consistent with literature that shows climate change mainly influences agricultural workers' mental well-being by creating anxiety and distress concerning business profitability (Doherty & Clayton, 2011; Staniford et al., 2009). Studies show that individuals who experience financial hardship over extended periods of time are at a greater risk of mental health issues than those who are financially secure (Kiely, Leach, Olesen, & Butterworth, 2015). The economic pressures of farming in a variable climate may be

exacerbating the existing poor state of mental health in rural regions of the United States (Carpenter-Song & Snell-Rood, 2016). Robust evidence demonstrates the variety of mental health disparities existing in rural communities compared to urban counterparts, with issues including availability of health services and a stigma against help-seeking behavior (Larson & Corrigan, 2010).

Despite the challenges of climate change for rural farmers, some respondents did not express distress, but instead suggested resilience by emphasizing the importance of proactive behavior, flexibility, and adaptability. The resilience responses are very interesting, as resilience can act as a powerful tool in maintaining good mental health (Marinucci, Luber, Uejio, Saha, & Hess, 2014). Nurturing resilient thoughts and behaviors may be a way to alleviate climate-related anxiety and distress by encouraging farmers and ranchers to adopt sustainable farming strategies (Tanner et al., 2014). If resilience is an impetus towards transitioning to sustainable methods, psychosocial interventions should be structured around a framework of resiliency and optimism (Marinucci et al., 2014).

This study had several limitations. With a cross-sectional design, we were not able to determine direct causality between climate change and mental well-being. A longitudinal study is warranted to address issues of causality. Self-reported mental well-being is also prone to bias (Rogler, Mroczek, Fellows, & Loftus, 2001). We did not collect data on other potential sources of stress that may impact mental health. Finally, the study sample was limited to members attending select Montana agricultural organizations, and therefore may not be generalizable to farmers and ranchers in other regions of the US. Future studies should examine perceptions of farmers and ranchers in different regions of the country.

Conclusions

While the physical and economic implications of climate change are studied widely (Environmental Protection Agency, 2016; Grotjahn, Patrick Holden, Izaurralde, Mader, & Marshall, 2014; Walthall et al., 2013), the mental health implications have largely been overlooked. Future research should examine levels of climate risk and harm perception and identify if and how this may be impacting mental well-being while concentrating on impacts specific to agricultural business in rural communities. Changes in both farming practices and policies geared toward supporting agricultural businesses at-risk are warranted to address the negative impacts that climate change may have on mental well-being.

To maximize public health preparedness efforts, increased mental health services are warranted in rural areas to provide therapeutic outreach specific to agricultural workers experiencing economic struggles (Fritze, Blashki, Burke, & Wiseman, 2008). As trusted agents of information, health practitioners and community health workers can further offer agricultural communities accessible adaptation and mitigation resources (Kreslake, Sarfaty, Roser-Renouf, Leiserowitz, & Maibach, 2017). Because climate change's influence on mental well-being is incremental and often invisible, a priority is to raise awareness and encourage public health advocates to more seriously consider the relationship between climate change and mental well-being among agricultural and rural communities.

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