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# The Relationship Between Climate Change Awareness and Mental Health Among Adults in the United States

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This is to certify that the doctoral dissertation by

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Abstract

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MPH, Rutgers University, 2015

MBBS, University of Ibadan, 2000

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

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Abstract

Understanding the connection between climate change awareness and overall well-being is crucial, particularly regarding its impact on the environment and mental health. However, there is a need for more research on this topic, especially within the American context. The mental health implications of climate change are not yet fully understood, and there is a gap in the literature. This gap was addressed by exploring climate change awareness effects on mental health among U.S. adults. The social ecological model provided a framework to examine the impact of climate change awareness on mental health, considering individual, interpersonal, community, and societal factors. This quantitative, cross-sectional study used the Health Information National Trend Survey-6 dataset. Regression analyses revealed that individuals with climate change awareness have an adjusted odds ratio of 1.392 (1.160–1.671) for depression or anxiety compared to those without awareness. The association between climate change awareness and depression or anxiety showed that gender was a statistically significant, albeit weak, predictor for females (AOR = 1.294, CI: 1.010-1.658), and not predictive for males (AOR = 1.036, CI: 0.764-1.405). Lastly, individuals with climate change awareness have an adjusted odds ratio of 1.677 (CI: 1.422-1.978) for worrying compared to those without awareness. These three manuscripts collectively highlighted a clear link between greater climate change awareness and increased psychological distress. Despite the mental health challenges posed by awareness of climate change, the potential for positive social change exists, as collective action and climate literacy can transform eco-anxiety into eco-action, fostering resilience and empowerment through community engagement.

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Part 1: Overview

## Introduction

The relationship between climate change awareness and mental health is an emerging public health concern, particularly in the United States. As climate change worsens, it is increasingly recognized as a significant driver of physical and psychological distress (Corvalan et al., 2022; Costello et al., 2009; Walinski et al., 2023; White et al., 2023). Climate-related events such as extreme weather, rising temperatures, and shifting seasons affect people worldwide, particularly vulnerable populations. While much attention has been given to the physical consequences of climate change, its psychological toll is only beginning to gain attention in the scholarly community (Clayton, 2021). Results based on a systematic review depicted that mental health issues exacerbated by climate change can range from chronic stress and anxiety to severe conditions such as posttraumatic stress disorder (PTSD) and depression (Cianconi et al., 2020). I aimed to explore the relationship between climate change awareness, sociodemographic attributes, and mental health, specifically focusing on depression, anxiety, and generalized anxiety disorder conditions characterized by worry (Ren et al., 2020) among adults in the United States.

Research has shown that climate change affects mental health both directly and indirectly (Chou et al., 2023; Cianconi et al., 2020; Clayton & Karazsia, 2020; Clayton et al., 2023; Closson et al., 2022; Corvalan et al., 2022; Daeninck et al., 2023; Dodds, 2021; Ediz & Yanik, 2023; El Khayat et al., 2022). Extreme weather events, such as hurricanes, wildfires, floods, and heat waves, have all been associated with an increase in mental

health disorders (Bundo et al., 2023). These events often cause immediate distress as people are forced to confront the loss of life, property, and community infrastructure. Furthermore, the long-term effects of climate change, such as prolonged droughts, food insecurity, and displacement, can result in chronic psychological distress (André et al., 2022; Goudet et al., 2024). The role of climate change towards food insecurity could be through both direct and indirect pathways, each contributing to the overall vulnerability of food systems. The direct impacts of climate change are primarily driven by environmental disruptions such as rising temperatures, altered precipitation patterns, and extreme weather events like droughts, floods, and storms, which directly influence agricultural productivity and can significantly reduce crop yields, especially in regions dependent on rain-fed agriculture (Mirzabaev et al., 2023). In contrast, the indirect impacts on food insecurity occur through social, economic, and policy-related channels that often amplify existing inequalities, which can trigger rural-to-urban migration, leading to pressure on local food systems and infrastructure (Baars et al., 2023). Additionally, according to a Swedish study, researchers also reported a significant rise in the prevalence of depression, anxiety, and PTSD in individuals exposed to these types of environmental stressors (Raza et al., 2024). These findings portray the emergent need for a deeper understanding of the role of climate change awareness towards mental health outcomes across different sociodemographic groups.

Beyond the direct impacts of climate change, awareness of its causes, consequences, and projected future effects can also contribute to mental health issues. Many individuals experience what has been termed *eco-anxiety*, a term used to describe

feelings of fear, helplessness, and distress about environmental degradation (Hickman et al., 2021). Epidemiological studies on eco-anxiety have shown that a significant portion of the population, especially younger generations, experience mental health challenges tied to environmental concerns. Notably, based on a national survey conducted by the American Psychological Association (APA, 2020) found that 68% of U.S. adults expressed some degree of concern about climate change, with 40% reporting that it significantly impacts their mental health. Eco-anxiety tends to be most intense among people under 30, who often felt heightened distress about the future and the sense that not enough was being done to tackle environmental problems. Further studies have quantified the prevalence of eco-anxiety in specific demographic groups. For instance, a study found that 51% of young people in the United States between 18 and 29 reported feeling anxious about climate change, with 29% expressing that they felt "very" or "extremely" anxious. The study also revealed that eco-anxiety was strongly associated with feelings of helplessness and the perception that climate change is beyond personal control (Clayton, 2021). Eco-anxiety is particularly prevalent among individuals who feel personally affected by climate change or those who perceive a lack of control over environmental destruction (Atta et al., 2024; Léger-Goodes et al., 2022; Maran & Begotti, 2021; Parry et al., 2022; Prencipe et al., 2023; Thomson & Roach, 2023). This emotional burden can be amplified by the constant media coverage of environmental disasters and the growing awareness of the severity of climate change, which may provoke feelings of anxiety and despair (Leonhardt et al., 2022). Studies have found that people who strongly believe in the reality of climate change are more likely to report elevated levels of distress, such as

worry, fear, and helplessness, as they anticipate the future consequences of environmental degradation (Ogunbode et al., 2022). As awareness grows, some individuals may experience heightened concern, which can manifest in symptoms of depression or anxiety (Abbasi, 2021; Atta et al., 2024; Bryman, 2016; Dodds, 2021; Fardell et al., 2023; Li et al., 2022; Reuben et al., 2022; Schwaab et al., 2022; Sciberras & Fernando, 2022). This highlights the need to examine the role of climate change awareness as a psychosocial factor, playing a critical role in mental health outcomes, especially as climate change continues to pose an existential threat. A study highlighted that more than 45% of participants said their concerns about climate change negatively impacted their daily lives and overall functioning. Additionally, a large majority 75% expressed that they found the future to be "frightening."(Hickman et al., 2021)

Climate-related mental health impacts may differ depending on various demographic factors, such as age, gender, and socioeconomic status (Goudet et al., 2024). Considering the endemic environmental susceptibility, women, for example, tend to report higher levels of climate-related distress than men, likely due to their greater vulnerability in the face of environmental crises like cyclones (Goudet et al., 2024). Women are often more directly affected by climate change through caregiving roles, financial insecurity, and increased risk of gender-based violence during natural disasters (White et al., 2023). Additionally, individuals from lower socioeconomic backgrounds and marginalized communities may face disproportionate mental health challenges as they are often the first to be affected by climate-related disruptions and the last to access resources for recovery (Cianconi et al., 2020; Prencipe et al., 2023). These disparities

suggest that the probable relationship between climate change awareness and mental health is not uniform but somewhat shaped by social, economic, and environmental factors.

In the context of the United States, these disparities are particularly pronounced. Urban populations, for example, may experience different mental health outcomes than rural populations due to factors such as population density, exposure to environmental risks, and access to mental health care (Silveira et al., 2021; Wahid et al., 2023). Additionally, individuals in rural areas may be more directly impacted by changes to agricultural practices, water availability, and natural disasters, which can intensify feelings of uncertainty and distress (El Khayat et al., 2022). On the other hand, people living in cities might feel more anxious because of the perceived dangers of crowded areas, like the risk of flooding, wildfires, and heat waves (Cianconi et al., 2020). These geographic and social factors highlight the importance of climate change awareness, and its effects on mental health are felt differently across various regions and communities in the United States (Cianconi et al., 2020; Lawrance et al., 2022).

Recent literature suggests that the awareness of climate change is associated with increased distress, particularly in those already suffering from mental health issues such as anxiety or depression (Gebhardt et al., 2023; Silveira et al., 2021). This finding is significant because it suggests that for some people, just being aware of climate change can add extra stress, potentially making existing mental health issues worse. Additionally, personal relevance toward climate change awareness predicts people's distress level. For example, people who have directly experienced climate-related disasters may be more

likely to struggle with eco-anxiety or depression due to the perceived threat to their lifestyle (Lawrance et al., 2022). However, even though climate change awareness is often seen as a significant factor influencing mental health, the specific ways this connection works are still poorly understood. More research is needed to explore whether knowledge of climate change and its impacts worsens or helps mental health problems.

The role of coping strategies in mitigating the mental health impacts of climate change is another area that requires further investigation. Evidence in the literature suggests that social support networks, resilience-building interventions, and engagement in climate action can help buffer against the mental health impacts of climate change (Latkin et al., 2022). For example, participation in climate change activism has provided individuals with a sense of empowerment and control over their environment, which can reduce feelings of helplessness and improve psychological well-being (Lawrance et al., 2022). However, the effectiveness of these coping mechanisms can differ depending on individual factors such as age, gender, and socioeconomic status. Therefore, it is crucial to examine ways various coping strategies interact with awareness of climate change to affect mental health in order to create more focused interventions.

In addition to individual coping strategies, community-level interventions are also crucial for addressing the mental health concerns stemming from climate change awareness. Community-based efforts and resources that focus on disaster preparedness, mental health support, and adaptability training can play a vital role in reducing the public health burden of climate-related stressors (Schwaab et al., 2022). Moreover, understanding climate change awareness's relationship with community adaptability may

offer better insights into building adaptive systems that address the physical impacts of climate change and promote mental well-being.

Although research on the mental health effects of climate change is growing, there is still a significant gap in understanding how awareness of climate change directly affects mental health in the United States. Given the diverse geographical, social, and economic contexts within the United States, it is paramount to understand the intersection of climate change awareness and mental health in different American populations, particularly those most vulnerable to its effects. As the effects of climate change continue to intensify, the need for research into its mental health implications grows more urgent. The mental health toll of climate change awareness, particularly among vulnerable populations, presents a significant public health challenge. Studies showed that people who have personally experienced the effects of climate change often show stronger and more immediate emotional reactions than those who have simply learned about it through education or media (Ogunbode et al., 2022). In contrast, individuals who have not directly experienced the impact of climate change but have learned about it through media, education, or activism can also develop significant eco-anxiety, which is often based on a future-oriented fear rather than immediate trauma (Ogunbode et al., 2022). By examining the relationship between climate change awareness and mental health outcomes such as worrying, depression or anxiety, I sought to contribute to the growing body of literature on this topic. The findings may have important implications for public health policy, climate adaptation strategies, and mental health care services, offering

valuable insights into mitigating the mental health impacts of climate change and promoting resilience in the face of environmental change.

Understanding the link between climate change awareness and mental health is crucial for addressing the growing public health challenges attributable to environmental stressors. As climate-related mental health concerns increase and the concept of climate change awareness expands, it is vital to explore the relationship between them. This dissertation will help fill that gap by examining awareness of climate change and the relationship with worry, depression, or anxiety in adults in the United States to offer evidence-based recommendations for mental health interventions and public health strategies. Additionally, I explored the role of sociodemographic attributes in the relationship. Through this research, I aimed to provide a more comprehensive understanding of the mental health implications of climate change awareness to guide future efforts to mitigate these effects and promote well-being in an increasingly uncertain world.

## Background

Climate change has emerged as one of the most pressing global challenges of the 21st century, with far-reaching consequences that extend beyond environmental impacts to include significant mental health implications (Costello et al., 2009). As the world grapples with the accelerating pace of climate disruptions, it becomes increasingly evident that the mental health toll of climate change awareness is profound and growing. The mental health consequences of climate change awareness manifest in various forms, including anxiety, depression, PTSD, and eco-anxiety, all of which have been

exacerbated by the increasing frequency of extreme weather events, such as heatwaves, floods, and wildfires (Abbasi, 2021; Clayton, 2021). Furthermore, rising sea levels, habitat loss, and economic displacement from climate-related disasters have contributed to heightened stress, particularly for vulnerable populations, including those with lower socioeconomic status, children, and the elderly (André et al., 2022; Latkin et al., 2022). As awareness of climate change grows, so does the fear and hopelessness about the future, particularly among individuals who feel they have little control over the situation (Rothschild & Haase, 2023).

While the physical health consequences of climate change are increasingly well-documented, the mental health implications, particularly regarding the relationship between climate change awareness and mental health disorders like depression and anxiety, are less explored. Recent studies have indicated a significant correlation between increased climate awareness and rising levels of mental health distress, particularly among individuals who feel directly impacted by environmental changes (Gebhardt et al., 2023; Lawrance et al., 2022). This is particularly concerning in light of the ongoing and predicted intensification of climate-related phenomena, which will continue to stress individuals' mental and emotional resilience (Clayton et al., 2023). Climate-induced anxiety—often referred to as eco-anxiety—has been documented as a growing mental health issue, especially in populations who perceive themselves as powerless or disconnected from solutions (Hickman et al., 2021; Rothschild & Haase, 2023). The psychological burden is particularly severe for individuals in regions that have experienced significant climate-related events, such as extreme weather and

displacement, and is often linked to pre-existing mental health conditions (Monsour et al., 2022; Raza et al., 2024). Despite growing attention to these issues, research on how climate change awareness specifically affects mental health, and how various sociodemographic factors influence this relationship, remains limited and underexplored.

**Climate Change Awareness and Mental Health**

The relationship between climate change and mental health has become a critical area of research, as both the frequency and intensity of climate events, and the awareness surrounding these phenomena continue to rise. Increasing climate awareness—whether through media coverage, educational initiatives, or direct exposure to climate events—has been linked to heightened levels of anxiety, depression, and distress. Bundo et al. (2023) highlighted rising temperatures associated with climate change have a direct influence on mood disorders, especially among individuals with pre-existing mental health conditions (Bundo et al., 2023). They also highlighted the contribution of both extremes of temperatures (high and low) contribute to negative mood states, with implications for individuals suffering from conditions like bipolar disorder (Bundo et al., 2023). This highlights the mental health risks posed by climate change that are often overlooked in broader climate impact assessments.

The mental health risks associated with climate change are particularly concerning given that exposure to such stressors is likely to increase as global temperatures continue to rise and extreme weather events become more frequent and severe (Cianconi et al., 2020). Moreover, these risks are compounded by the often disproportionate exposure to climate change burdens faced by vulnerable populations,

particularly those in lower socioeconomic strata, who may also lack the resources to cope with the mental health burden of climate change (Temte et al., 2019).

Studies have also identified significant age-related differences in how climate change awareness affects mental health. Adolescents and young adults, who are particularly sensitive to the challenges posed by a changing climate, have been found to exhibit higher levels of climate-related anxiety compared to older adults (La Greca et al., 2023; Sciberras & Fernando, 2022). This phenomenon is often compounded by the uncertainty of the future, as young people worry about the long-term effects of climate change on their lives, their communities, and the global ecosystem.

High school students show a stronger connection between climate change worry and proenvironmental behaviors, suggesting that, as they age, young people may increasingly translate their anxiety into action (Martin et al., 2022; Qin et al., 2024). This age-related trend suggests that as young people gain a deeper understanding of the emergent nature of the climate crisis, their emotional reactions become stronger, potentially increasing feelings of helplessness and anxiety. Similarly, a Aylward et al. (2024) found that young individuals often turn to advocacy and community involvement for empowerment, showing that while climate change awareness can cause distress, it can also motivate action and foster hope (Aylward et al., 2024). This duality of emotional responses—distress coupled with empowerment—is an important consideration for future interventions aimed at mitigating the mental health impacts of climate change.

**Sociodemographic Disparities and Climate Change Awareness**

Research has consistently shown that socioeconomic factors play a crucial role in the relationship between climate change awareness and mental health outcomes. Vulnerable populations, particularly those with lower socioeconomic status, are disproportionately affected by climate-related shocks, such as extreme weather events and the displacement they often cause (Pardon et al., 2024). Temte et al. (2019) found that younger people from lower socioeconomic backgrounds were particularly more vulnerable to elevated levels of depression and anxiety due to climate change related events. These groups are often more exposed to the immediate effects of climate events, such as flooding, hurricanes, and wildfires, which can disrupt their livelihoods and exacerbate financial instability. Moreover, the added stress of coping with these impacts—combined with the social and economic vulnerabilities associated with lower socioeconomic status can significantly contribute to mental health issues (Mason et al., 2024; Prencipe et al., 2023). As such, climate change awareness in these populations may not only increase feelings of anxiety but also serve to intensify existing mental health challenges related to financial insecurity, housing instability, and access to health resources (Latkin et al., 2022; Pardon et al., 2024).

Additionally, gender and geographic disparities further complicate the relationship between climate change awareness and mental health outcomes. For example, women, particularly those in rural or low-income areas, report higher levels of climate-related anxiety compared to men (Closson et al., 2022; Raza et al., 2024). This evidence may be attributed to the unique roles played by women in terms of caregiving

and household management, which can be significantly disrupted during climate-related crises. Notably, women's perceived vulnerability to climate stressors, coupled with gender inequalities in decision-making and resource access, makes them particularly susceptible to mental health challenges (Goudet et al., 2024). Furthermore, geographic disparities in climate vulnerability—such as those between urban and rural populations—play a role in mental health outcomes as well. Rural populations, who often face more direct exposure to environmental changes such as crop failure, drought, and wildfires, report higher levels of mental distress compared to their urban counterparts, who may have greater access to mental health services and economic resources (Wahid et al., 2023). These findings highlight the need for targeted public health interventions that consider the specific challenges and vulnerabilities faced by different demographic groups.

**The Need for Targeted Mental Health Interventions**

Given the growing awareness of climate change and its profound effects on mental health, there is a critical need for targeted mental health understanding and interventions that address the public health burdens of climate change. These interventions should not only aim to reduce worry, anxiety and distress, but also provide coping mechanisms for individuals and communities facing the direct consequences of climate change. As highlighted by studies, individuals who experience a direct impact from climate change whether through extreme weather events or economic displacement are at greater risk for developing mental health disorders, particularly when they lack the resources or support systems to cope (Gebhardt et al., 2023; Hepp et al., 2023). These

findings suggest that personalized mental health strategies, tailored to the specific experiences and needs of affected populations, are essential for mitigating the public health burden of climate change. Furthermore, encouraging resilience through community involvement and climate action can help protect against the mental health effects of climate change (Aylward et al., 2024; Dodds, 2021).

Understanding the mental health implications of climate change awareness, particularly in relation to sociodemographic factors, is essential for formulating effective strategies to support affected populations. While existing literature has begun to explore the relationship between climate change awareness and mental health (Clayton, 2021; Demir et al., 2024; Gianfredi et al., 2024; Schwaab et al., 2022; Thomson & Roach, 2023), significant gaps remain, particularly with regard to demographic variables such as gender influence this relationship. Addressing these gaps is critical for ensuring that mental health interventions are inclusive and responsive to the diverse needs of individuals and communities affected by climate change. As climate change continues to escalate, the need for comprehensive mental health strategies that address both the direct and indirect impacts of climate change has never been more urgent.

## Overview of the Manuscripts

### Manuscript 1: The Relationship Between Climate Change Awareness and Depression or Anxiety Among the U.S. Population

**Specific problem:** Current research has important gaps in understanding how awareness of climate change directly impacts mental health, especially concerning conditions like depression and anxiety. While some studies present the broader mental health effects of

climate-related stress, there's limited focus on how specifically knowing about climate change contributes to emotional distress, and how these effects differ across various demographic groups. Additionally, there's a lack of research involving the American population. This gap is particularly clear when considering how factors like age, socioeconomic status, and other demographic characteristics relate with climate awareness to influence mental health. I aimed to fill these gaps by examining the connection between climate change awareness and mental health outcomes, particularly depression or anxiety, among adults in the United States, while accounting for variables like age, gender, race, marital status, and socioeconomic status.

**Research question:** Is there an association between climate change awareness and depression or anxiety among adults in America controlling for age, gender, race, marital status and socioeconomic status?

**Nature of study and design:** I used a cross-sectional design to focus on capturing insights into various aspects of health behavior, including mental health attributes among young adults and older adults in America. I incorporated responses from participants regarding their mental health experiences, such as depression or anxiety, and overall psychological well-being, providing valuable insights into the intersection of climate change awareness and mental health.

**Sources of Data:** I used the National Cancer Institute Health Information National Health Trends Survey (HINTS) dataset for the study. The HINTS-6 2022 dataset used validated instruments such as standardized questionnaires and scales to collect information on mental health issues. These instruments were designed to assess different

dimensions of mental health, allowing researchers to gather detailed and reliable data on the psychological impact of all American adults

**Manuscript 2: Biological Sex Differences for The Relationship Between Climate Change Awareness and Depression or Anxiety Among the U.S. Population**

**Specific problem:** The mental health effects of climate change are not experienced the same way across genders. Men often cope by internalizing their stress, which can lead to issues like aggression or substance abuse rather than direct depression. On the other hand, women are more likely to express their emotions and seek help, which often results in higher reported rates of depression. To fully understand these gender differences, it's important to look at them from a cross-cultural perspective. Despite this, there is limited research on the relationship between attitudes toward climate change and depression, especially in the United States.

**Research question:** What is the moderating effect of gender on the association between climate change awareness and depression or anxiety among adults in America controlling for age, race, marital status and socioeconomic status?

**Nature of study and design:** I used a cross-sectional design focusing on mental health attributes among young adults and older adults in America. I incorporated responses biological sex differences from participants regarding their mental health experiences, such as depression or anxiety, and overall psychological well-being, providing valuable insights into the intersection of climate change awareness and mental health.

**Sources of Data:** I used the National Cancer Institute Health Information National Health Trends Survey (HINTS) dataset for the study. The HINTS-6 2022 dataset used

validated instruments such as standardized questionnaires and scales to collect information on mental health issues. These instruments were designed to assess different dimensions of mental health, allowing researchers to gather detailed and reliable data on the psychological impact of all American adults.

**Manuscript 3: The Relationship Between Climate Change Awareness and Worrying Among the U.S. Population**

**Specific problem:** Evidence in the literature pointed out that worry about climate change can actually contribute to mental health symptoms, adding complexity to the idea of adaptive versus maladaptive responses to climate awareness. Similarly, studies suggest that people with high levels of climate change worry were more likely to experience issues like sleep disturbances and trouble functioning in daily life. Other research suggested that, paradoxically, worry could drive political activism, showcasing the complex, dual nature of climate anxiety. However, despite these findings, there is still limited research supporting this relationship. Therefore, the goal of my study is to investigate how climate change awareness influences worry levels among adults in the United States, taking into account factors like age, gender, race, marital status, and socioeconomic status.

**Research question:** How does climate awareness influence the level of worrying among adults in the United States controlling for age, gender, race, marital status and socioeconomic status?

**Nature of study and design**: I used a cross-sectional design and focused on capturing insights into various aspects of health behavior, including mental health attributes among

young adults and older adults in America. I incorporated responses from participants regarding their mental health experiences, such as worry, and overall psychological well-being, providing valuable insights into the intersection of climate change awareness and mental health.

**Sources of Data:** I used the National Cancer Institute Health Information National Health Trends Survey (HINTS) dataset for the study. The HINTS-6 2022 dataset used validated instruments such as standardized questionnaires and scales to collect information on mental health issues. These instruments were designed to assess different dimensions of mental health, allowing researchers to gather detailed and reliable data on the psychological impact of all American adults.

## Significance

The increasing awareness of climate change and its broader impacts on human well-being has become a critical social issue. The situation that prompted this study is the growing recognition that awareness of environmental degradation, extreme weather events, and the social consequences of climate change can contribute to negative psychological outcomes, such as worry, anxiety, depression, and climate-related distress. While there is substantial evidence linking climate change to adverse mental health outcomes, there is a lack of in-depth understanding regarding the mechanisms that drive these relationships, and awareness of this climate changes particularly in the context of the United States. This gap in the literature underscores the need for more research on how climate change awareness impacts mental health and the ways in which individuals and communities cope with climate-induced psychological distress.

The implications of climate change on mental health are still poorly understood, despite climate change being universally acknowledged as a significant global issue with wide-reaching consequences. Many individuals are already experiencing heightened psychological discomfort as they worry about the long-term effects of climate change, including environmental degradation, extreme weather events, and the broader societal impacts (Ballew et al., 2024; Cianconi et al., 2020). Additionally, psychological distress is often driven by concerns about how climate change may affect the future, society, and the environment, with some individuals experiencing feelings of helplessness, anxiety, and despair (White et al., 2023). Moreover, individuals who are highly aware of climate change, often through media and social platforms, frequently reporting mental health discomfort due to ongoing environmental concerns, extreme weather, and societal implications.

Despite the growing awareness and anxiety surrounding climate change, there remains a significant gap in our understanding of how this awareness translates into mental health outcomes, particularly long-term effects. Furthermore, a systematic review highlighted a strong relationship between climate change awareness and psychological distress, but the review also called for further research to assess the frequency and intensity of these psychological concerns, particularly with respect to long-term mental health (Gianfredi et al., 2024). Current literature is predominantly focused on immediate psychological effects, such as anxiety and depression, but does not adequately address the long-term trajectories of mental health outcomes in individuals who live with persistent climate change awareness. According to Li et al. (2020), more longitudinal studies are

needed to assess the long-term impacts of climate change awareness on mental health and to identify those populations most vulnerable to such impacts.

Further research is needed to evaluate the potential policy interventions that could mitigate the mental health effects of climate change. While some studies have suggested that proactive coping strategies and community resilience initiatives may help alleviate some of these concerns, there is limited empirical evidence to support this especially in relation to climate change awareness. As White et al. (2023) noted, current research lacks a consensus on the best interventions to address the mental health effects of climate change awareness, making it crucial to conduct more longitudinal and observational studies that can assess the impact of such interventions on mental health outcomes. Identifying which coping strategies are most effective in enhancing mental health resilience in the face of climate-related distress will be vital for crafting evidence-based policies to address mental health in the climate crisis context.

The intersectionality of climate change awareness and mental health also brings up critical issues of environmental justice, particularly for vulnerable populations. Low-income communities and racial minorities are disproportionately affected by both the physical impacts of climate change and the psychological distress associated with it (Barberian et al., 2022). Studies have shown that marginalized groups, such as ethnic minorities and low-income individuals, are more likely to experience environmental degradation, which exacerbates their mental health challenges (Berberian et al., 2022). For instance, cancer survivors, who already face heightened risks for poor mental health, may experience increased anxiety and depression when confronted with climate change

awareness. These vulnerable individuals may be especially susceptible to climate-related mental health issues, pointing to the need for targeted interventions for those facing compounded health challenges (Fardell et al., 2023; Walinski et al., 2023; White et al., 2023).

Environmental public health programs also play a crucial role in mitigating the mental health impacts of climate change. The 10 Essential Public Health Services as described by the Public Health National Center for Innovations (PHNCI) emphasized addressing systemic barriers and improving community conditions to ensure equitable health for all individuals, particularly those most at risk of climate-related health impacts (PHNCI, 2020). Public health initiatives that target mental health resilience through community mobilization, policy development, and community engagement are vital for reducing the mental health toll of climate change awareness. These programs are particularly important in communities that are already disadvantaged, as they can help mitigate the compounding risks posed by environmental degradation and limited access to mental health resources.

One of the significant challenges in addressing climate change-related mental health is understanding how sociodemographic factors intersect with climate awareness to shape mental health outcomes. Different age groups and socioeconomic attributes may respond to climate change awareness in distinct ways, with some groups being more vulnerable to mental health issues than others. Understanding these demographic variations is essential for developing targeted interventions and policies that effectively address the mental health impacts of climate change. For example, younger adults may be

more future-oriented and anxious about the long-term impacts of climate change, while older adults may be more concerned with immediate threats to their health and well-being (Schein et al., 2021). Furthermore, the mental health implication of climate change awareness differs based on direct exposure to natural disasters (Ogunbode et al., 2022). Contrary to eco-anxiety, for those who have experienced or observed climate-related disasters, the psychological consequences tend to be immediate and more severe. Evidence in the literature shows that these individuals often develop heightened anxiety, PTSD, and depression due to the traumatic nature of the events (Schein et al., 2021). The emotional distress stems from personal losses, property damage, and daily life disruption. This kind of anxiety is often rooted in the traumatic memories of the disaster and the ongoing fear of future occurrences, making it more immediate and acute than anxiety caused by mere awareness of climate change (Walinski et al., 2023). Both groups experience significant mental health impacts, but the source and intensity of their anxiety differ, with those who have witnessed natural disasters often facing more immediate and tangible emotional challenges (Hickman et al., 2021). Moreover, socioeconomic status plays a significant role in shaping individuals' ability to cope with climate change-related psychological distress. Lower-income individuals may have limited access to mental health services, adaptive coping strategies, or resources that can buffer the impacts of climate change (Pearson et al., 2023). Racial disparities also play a critical role in shaping vulnerability, as marginalized communities often face systemic barriers to accessing healthcare and mental health services. These factors make it essential to investigate how social determinants of health (SDoH) interact with climate awareness to exacerbate

mental health challenges in vulnerable populations (Berberian et al., 2022; Pearson et al., 2023).

To fill these gaps, I explored the relationship between climate change awareness and mental health outcomes among adults in America, with a specific focus on worry, depression and anxiety. I used quantitative methods to identify patterns and trends in the relationship between climate change awareness and mental health. By employing statistical analyses, I sought to uncover the mechanisms that underlie these associations, focusing on factors such as sociodemographic characteristics, and social determinants of health. In conclusion, the study's findings could foster positive social change by promoting a healthier community through improved health outcomes for individuals with mental health challenges, particularly those impacted by climate change awareness, while also considering the influence of sociodemographic factors.

## Theoretical Framework

The social ecological model (SEM) provided a useful framework for understanding the complex relationship between climate change awareness and mental health outcomes. According to SEM, individual behaviors and health outcomes are shaped by multiple levels of influence, including individual, interpersonal, community, and societal factors (Hennein et al., 2021). In the context of climate change awareness, factors such as socioeconomic status, access to healthcare, and racial disparities can influence individuals' vulnerability to mental health challenges. For example, individuals with limited access to healthcare may have fewer resources to cope with the mental health effects of climate change, while marginalized communities may experience

compounded mental health risks due to systemic inequalities (Hennein et al., 2021). By examining these levels of influence, SEM can be used to identify pathways through which climate change awareness affects mental health and inform policy interventions aimed at enhancing resilience.

Understanding how these factors intersect is critical for developing effective interventions and policies that promote mental health resilience in the face of climate change. By focusing on the unique vulnerabilities of different populations and identifying the underlying mechanisms that drive climate change-related mental health challenges, I will contribute to the development of evidence-based strategies for addressing climate change awareness mental health impacts. These strategies will be vital in promoting adaptive coping mechanisms, enhancing community resilience, and mitigating the negative mental health outcomes associated with climate change awareness, ultimately fostering a more resilient society capable of navigating the challenges posed by climate change.

## Summary

In Part 1, I introduced the study, describing the background, research problem, significance, and gap in the literature. Climate change and awareness of it are increasingly recognized as a global challenge beyond environmental concerns, profoundly affecting mental health (Ogunbode et al., 2022). Thus, the public health burden of the problem is increased. As climate-related disasters like wildfires, floods, and heatwaves become more frequent, awareness of these events has led to profound, widespread mental health distress. People are experiencing eco-anxiety, depression,

PTSD, and heightened levels of anxiety, particularly those living in regions directly impacted by climate change (Aylward et al., 2024; Clayton, 2021). Certain groups, including children, the elderly, and those from lower-income communities, are particularly vulnerable to the mental health impacts of climate change awareness. As awareness grows about the worsening state of the world, it often deepens feelings of hopelessness and helplessness, with many people feeling that they have little control over the situation or ability to make a real difference. Younger generation experience these distresses more than the older population, as they grow more informed about the long-term implications of climate change, often experience heightened anxiety and worry (Clayton, 2021). Sociodemographic factors may play a significant role in shaping mental health due to climate change awareness. People in low-income and rural areas are hit hardest by the physical impacts of climate change, as well as the mental health challenges that come with it (Ogunbode et al., 2022). These communities often lack the awareness and resources to cope with climate-related stressors, leading to an exacerbation of mental health concerns. Moreover, gender disparities also exist, with women—particularly in low-income and rural areas—reporting higher levels of climate-induced anxiety (Fox et al., 2019; Qiu & Qiu, 2024).

The purpose of the different manuscripts was clearly stated in the form of an overview, all the individual variables for the quantitative analysis were clearly defined and included, the methodology was highlighted individually for each manuscript, and the research questions were highlighted. The conceptual framework in the SEM was highlighted for use in the study.

In Part 2, I highlight a manuscript-styled introduction, research questions, and the methods for all three manuscripts individually (i.e. climate change awareness relationship with depression or anxiety, the mediating role of gender, and relationship with worry). The sectionis ended with an extensive provision of the study results and a discussion of the findings.

Part 2: Manuscripts

# Manuscript 1: The Relationship Between Climate Change Awareness and Depression or Anxiety Among the U.S. Population

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## Outlet for Manuscript

A suitable target journal for a manuscript exploring the relationship between climate change and mental health is **Global Environmental Change**. This journal can be accessed online at Global Environmental Change and follows the APA (American Psychological Association) formatting style.

Global Environmental Change emphasizes the human dimensions of environmental change and its associated impacts, making it an ideal venue for discussing the intersection of climate change and mental health. The journal promotes interdisciplinary research, which is crucial for tackling the complex issues surrounding how climate change influences mental well-being. Additionally, the articles published in this journal frequently examine policy implications, social impacts, and behavioral responses, aligning seamlessly with discussions about mental health in the context of climate-related stressors.

## Abstract

Exploring the connection between climate change awareness and overall well-being is crucial, particularly in how it impacts both the environment and mental health. However, there is a pressing need for more research, especially within the United States, to better understand these effects. The mental health consequences of climate change have not been thoroughly examined. In this study, the relationship between awareness of climate change and feelings of worry among U.S. adults was explored. The social ecological model was the framework for analyzing this relationship through various individual, interpersonal, community, and societal factors. Based on the HINTS-6 dataset, a nationally representative, cross-sectional survey conducted by the National Cancer Institute, a variety of statistical methods, including regression models, to examine these relationships were used. The findings showed that individuals who are aware of climate change have a higher adjusted odds ratio of 1.392 (1.160–1.671) for experiencing depression or anxiety compared to those who are unaware. Additionally, nonheterosexual individuals displayed a significantly higher adjusted odds ratio of 2.691 (CI: 2.125–3.407) for depression or anxiety, underscoring the strong connection between mental health and climate change awareness. This study highlights a notable link between heightened awareness of climate change and mental health challenges among the U.S. population. Despite the documented mental health struggles tied to this awareness, there is also the potential for positive social change, as collective action and climate education can help transform eco-anxiety into meaningful eco-action, empowering individuals and building resilience through community-driven efforts.

## Introduction

Climate change has been characterized as "potentially the greatest global health threat of the 21st century," with projected adverse effects on both mental and physical health (Costello et al., 2009). Thus far, these predictions have been fulfilled. The impact of climate change on mental health is direct, as individuals are affected by extreme weather events such as intense heat, floods, wildfires, cyclones, and hurricanes (Bundo et al., 2023). A study looked at the mental health impacts of flooding in two areas of India, Chennai and Cuddalore, involving 223 individuals directly affected by the floods (Bandla et al., 2019). The results revealed that approximately 45% of the participants experienced some form of psychiatric distress. Specifically, 101 of the participants (45.29%) were dealing with depression, 60 people (26.9%) showed symptoms of PTSD, and 48 (27.4%) experienced anxiety. Additionally, 11 individuals (4.9%) reported an increase in substance use following the disaster (Bandla et al., 2019). Climate change increases the risks of prolonged droughts, food insecurity, habitat loss, land inundation, and salinization due to rising sea levels, deforestation, and resultant forced migration (Almulhim et al., 2024; André et al., 2022; Kumar et al., 2022). These factors may contribute to an increased incidence of various mental health disorders like depression and anxiety (Abbasi, 2021; André et al., 2022; Gebhardt et al., 2023; Latkin et al., 2022; Wright et al., 2024). For example, Monsour et al. (2022) focused on the impact of climate change-induced sea level rise (SLR) and tropical cyclone exposure on mental illness symptom prevalence, noted that a significant number of people in South Florida were projected to develop anxiety, major depressive disorder, or PTSD symptoms

following tropical cyclone exposure due to climate change (Monsour et al., 2022). Another study found that higher levels of daylight exposure following climate change were associated with improved sleep quality (Raza et al., 2024). Hence, it highlights the role of increased natural daylight in winter as a potential way to reduce the likelihood of experiencing depression symptoms.

Climate change significantly affects various aspects of human life, particularly physical and mental health (Cianconi et al., 2020; Pardon et al., 2024; Schwaab et al., 2022). Growing evidence in the literature indicates that behavioral and mental health disorders such as major depressive disorder and bipolar disorder are influenced by environmental and climatic conditions (Cianconi et al., 2020). In a similar vein, extreme weather events like heat waves, coastal erosion, and floods can throw agricultural practices into disarray(El Khayat et al., 2022). This situation creates job insecurity for farmers and workers globally while also deepening mental health struggles, which raises serious public health issues. For example, Abbasi (2021) discovered that more cloud cover in spring and less sunlight in winter can worsen depressive symptoms and that rising temperatures are linked to greater dissatisfaction among people with bipolar disorder (Abbasi, 2021). Additionally, Prencipe et al. (2023) found that a significant proportion of the population study reported experiencing climate distress, with approximately 70% indicating feelings of anxiety, depression, and worry related to climate change. Hence, climate change seems to be an essential factor leading to a decrease or increase in stress and a shift in humanṡ behavior.

Evidence in the literature has increasingly described heat exposure as a critical climate-related factor impacting mental health stability (Bundo et al., 2023). As a public health concern, the increasing temperature of heat exposure concerns following climate change is notably reported to lead to psychiatric morbidity in the form of suicides and severe mental health disorders (Abbasi, 2021; Bundo et al., 2023). Despite the growing interest in this area, research on how awareness of climate change and different sociodemographic factors affect mental health is still quite limited. For instance, Bundo et al. (2023) examined how ambient temperatures influence daily mood changes, finding that extreme temperatures result in negative mood states. Their findings indicated that both unusually high and low temperatures adversely affected mood, particularly in individuals with baseline pre-existing mood disorders. For example, the probability of having a bad mood for the entire day decreased by 7.0% for each 5 °C increase in maximum temperature (Bundo et al., 2023). Thus, further research on the relationship between climate change-related studies and mental health is needed.

Regarding sociodemographics, studies have suggested that children and adolescents are particularly vulnerable to the psychological impacts of climate change (La Greca et al., 2023; Leonhardt et al., 2022; Pardon et al., 2024; Raza et al., 2024). For example, La Greca et al. (2023) reported significant physical complaints among children exposed to extreme weather events linked to stress from evacuation and displacement. Research has also indicated that social influences and emotional responses are vital in climate change activism (Latkin et al., 2022; Lawrance et al., 2022). Similarly, evidence suggests a diminished sense of perceived control among the youths following a

pandemic-related event, which was associated with increased mental health symptoms (Lawrance et al., 2022). However, the mechanism of the relationship remains understudied. Other findings in the literature suggest that women are disproportionately affected by climate change due to their caregiving roles, which exacerbates psychological distress, particularly during resource scarcity or threats to their children's safety- PTSD, anxiety, and depression (Leonhardt et al., 2022). Notably, financial instability and inadequate access to mental health resources have been described as a mediator of the public health burden (Pardon et al., 2024; Prencipe et al., 2023). Additionally, Prencipe et al. (2023) supported this literature as lower socioeconomic backgrounds reported more significant climate distress, evidenced by more adversely affected mental health.

Evidence in the literature showed significant concerns about climate change, coupled with anxiety about the future, leading to emotions like fear, anger, and sadness, collectively known as climate anxiety, which may increase substance abuse and suicidal behavior (Lykins et al., 2023). For example, a study of Norwegian adults found that while many expressed worry about climate change, especially women and those with higher education, the overall concern was lower compared to adults in European countries like the UK, Spain, and Italy (Leonhardt et al., 2022; Pardon et al., 2024; Raza et al., 2024). Research also indicates that anxiety about climate change is more prevalent among adolescents and young adults (La Greca et al., 2023; Leonhardt et al., 2022; Lykins et al., 2023; Sciberras & Fernando, 2022). The growing awareness of the negative impact of climate change on mental health, especially among children and adolescents (Leonhardt et al., 2022; Pardon et al., 2024; Raza et al., 2024), has not only been in focus in research

but also the media. Other notable demographic attributes were adults living in urban areas expressed more worry about climate change than those living in rural areas. Despite these worries about climate change, Norwegian adults were less worried about climate change than adults in other European countries (Leonhardt et al., 2022). Leonhardt et al. (2022) also reported that almost 40% of Norwegian adolescents were worried about climate change and that girls, pupils with at least one parent with higher education, and pupils from urban areas were more inclined to worry about the climate. Leonhardt et al. further noted that adolescents who were worried about climate change had more symptoms of depression than those who were not so concerned. Similarly, Lykin et al. (2023) showed that exposure to bushfires resulted in higher climate change-related distress and concern. Hence, there is higher perceived personal vulnerability to the effects of climate change in those with direct exposure to bushfires. Finally, the Raza et al. (2024) showed that the impact of daylight exposure on mental health outcomes varied across individuals, as living with children younger than 12 years of age had lower odds of reporting symptoms of depression when exposed to daylight one or more hours per day. Hence, it suggests the possible role of awareness. So far, these findings have not been replicated in the literature and among the American population.

The concept of eco-anxiety was described by the American Psychological Association in 2017 as a "persistent fear of environmental catastrophe," which can vary from mild stress to more severe conditions like depression, anxiety, PTSD, and suicidal thoughts, which may also lead to harmful coping behaviors, including intimate partner violence and substance use (Hickman et al., 2021). In response, researchers and mental

health professionals have been working to find ways to measure the psychological effects of these climate change. The emergence of eco-anxiety necessitated the development of assessment tools to measure climate-related mental health impacts. These tools will help clinicians and researchers identify and better understand symptoms of eco-anxiety, enabling them to provide more focused care and support for those affected. Notably, Hepp et al. (2023) introduced the Climate Change Distress and Impairment Scale (CCDIS), which captures emotional distress and functional impairment linked to climate change. The instrument includes items designed to evaluate both emotional distress (e.g., anxiety, sadness) and functional impairment (e.g., disruptions in daily activities and work performance) related to climate change. Despite this tool demonstrating strong reliability and sensitivity about its targeted measure, there remains to be a gap in the literature for its use. Thus, highlighting the lack of studies and information on psychological distress associated with climate change.

Gebhardt et al. (2023) focused on the relationship between climate change awareness and mental health among individuals with pre-existing psychiatric conditions. They revealed that increased awareness of climate change was associated with higher psychological distress, particularly among those with anxiety and depression. They also noted the moderating role of perceived personal relevance in the relationship, as individuals directly affected by climate change reported more significant distress (Gebhardt et al., 2023; Lawrance et al., 2022). Hence, it suggests the possible amplification of feelings of anxiety based on the concept and understanding of climate change. Additionally, access to social support and possessing the ability towards coping

strategies were documented as mitigating factors to this relationship, as those who experienced a direct impact on their own lives or communities reported more significant distress compared to those who trivialized it (Gebhardt et al., 2023; Lawrance et al., 2022; Pardon et al., 2024; Schwaab et al., 2022). Depressive symptoms could motivate individuals to engage in activism or contribute to feelings of helplessness (Latkin et al., 2022). The usual predictors of climate change activism were environmental attitudes, perceived efficacy, and personal values. Additionally, social norms increased influence of the relationship between climate-related distress and activism, necessitating further research. Furthermore, higher levels of depressive symptoms were associated with less likelihood of engaging in climate activism, indicating that awareness might not be influential in making a change (Latkin et al., 2022). Other studies have also reported that activism engagement and social support protect against pandemic-related situations and climate change stressors (Lawrance et al., 2022).

Prencipe et al. (2023), who used a population in Tanzania, East Africa, identified higher education, frequent religious participation, being female, being younger, and being unmarried as being linked to increased awareness of climate change. Hence, when controlling for climate change awareness, a substantial predictor of distress and other demographic characteristics, regional differences and levels of religiosity emerged as crucial factors contributing to climate change distress (Prencipe et al., 2023). Significantly higher levels of climate change awareness and engagement among medical students were associated with increased anxiety and stress symptoms (Schwaab et al., 2022). Hence, this suggests that awareness can lead to heightened concern without

adequate coping strategies. Other studies have also suggested that climate change-related worry among adolescents increased over 8 years (Sciberras & Fernando, 2022). As young people mature, their awareness of climate change issues and their potential impacts intensifies. Additionally, evidence in the literature relates that females had higher levels of climate-related worry compared to males, and adolescents from lower socioeconomic backgrounds tended to experience more significant anxiety about climate change (Sciberras & Fernando, 2022). Thus far, these findings have not been replicated or refuted these findings following a review of the literature. Hence, there is a need for further study to understand the relationship between climate change awareness and mental health disorders.

Given the compounded impact of the COVID-19 pandemic on mental health, particularly among young people, Lawrence et al. (2022) identified that concurrent exposure to climate change concerns, heightened awareness of environmental issues, and stressors associated with the COVID-19 pandemic significantly contributed to increased levels of anxiety, depression, and stress in youth. Additionally, the pandemic exacerbated existing worry about climate change, leading to perceived increased overall psychological distress. Similarly, an additive synergistic effect has been reported regarding climate change impacting a pandemic-related condition, and vice versa, as high levels of distress from both crises were associated with more severe mental health (Lawrance et al., 2022). Hence, the study highlights the possible comorbid association between climate change, mental health, and sociodemographic characteristics. The role of geographic disparities in mental health outcomes following climate change awareness has

been documented in the literature, as there were higher adverse mental health effects among the population in rural/suburban settings compared to their urban counterparts (Wahid et al., 2023). Studies have indicated that individuals living in rural and suburban areas experience more significant adverse mental health effects compared to those residing in urban environments. These disparities are multifaceted and can be attributed to several contextual factors, including differences in access to mental health care, social support, and vulnerability to climate-related stressors. Rural populations often face limited access to healthcare services, including mental health professionals, which can hinder their ability to receive timely and adequate treatment (Howard et al., 2020).

Vulnerable populations, particularly those with lower socioeconomic status, are disproportionately affected by climate-related shocks (Temte et al., 2019). Younger populations and lower socioeconomic backgrounds have been associated with higher levels of depression about climate stressors (Temte et al., 2019). Hence, these studies highlight the prevalence of depression and anxiety linked to climate impacts, emphasizing the urgent need for targeted mental health interventions and further research into climate change awareness and its effects on mental health. Understanding the mental health implications of escalating climate change is essential for formulating effective strategies to support affected populations. Current literature highlights significant gaps that must be addressed, particularly regarding how climate change awareness influences mental health in the form of depression or anxiety and the specific challenges different demographic groups encounter. The current literature reveals important gaps in understanding how climate change awareness directly influences mental health,

particularly in the context of depression or anxiety. While some studies have examined the broad mental health impacts of climate-related stressors, there is limited research on how awareness of climate change specifically contributes to emotional distress, and how these effects vary across different demographic groups. Additionally, there is limited studies conducted using American population. This research gap is particularly evident when considering how different factors such as age, socioeconomic status, and other sociodemographic attributes interact with climate awareness to shape mental health outcomes. Hence, my objective of this study is to address these gaps by assessing the relationship between climate change awareness and mental health outcomes, specifically depression or anxiety among Americans. I hypothesized that there is an association between climate change awareness and depression or anxiety among adults in America controlling for age, gender, race, marital status and socioeconomic status.

**Hypothesis Test**

Null Hypothesis ($H_0$): There is no significant association between climate change awareness and depression or anxiety among adults in America controlling for age, gender, marital status and socioeconomic status.

Alternative Hypothesis ($H_1$): There is a significant positive association between climate change awareness and depression or anxiety among adults in America controlling for age, gender, marital status and socioeconomic status.

# Methods

## Study Design

In this HINTS-6 study, I used a quantitative, cross-sectional design and relied on secondary data from the extensive dataset collected by the National Cancer Institute (NCI). The survey was carefully designed with strong statistical methods and reliable sampling techniques to ensure accuracy. In addition to assessing public access to health information, the HINTS-6 survey included questions focused on mental health, climate change concerns, and broader social factors affecting health. This makes the dataset especially useful for exploring how climate change awareness, mental health, and social conditions are connected, particularly in vulnerable populations. Along with assessing public access to health information, the HINTS 6 survey also included questions about mental health, concerns over climate change, and broader social factors that affect health. This makes the dataset especially valuable for exploring how climate change awareness, mental health, and social conditions are interconnected, particularly among vulnerable groups. The secondary nature of the data means that no new participants were recruited for this specific study, but rather, existing data were analyzed to answer research questions related to climate anxiety and its potential relationship with mental health.

## Study Population

The HINTS is a comprehensive, nationally representative survey administered by the NCI since 2003. HINTS gathers data from civilian, noninstitutionalized adults aged 18 or older living in the United States. The survey's primary aim is to assess the American public's access to and utilization of health information, with a specific focus on

cancer across the continuum of care prevention, early detection, diagnosis, treatment, and survivorship. The most recent round, HINTS-6, conducted from March 7, 2022, to November 8, 2022, included a goal of obtaining 7,000 completed questionnaires. The survey's focus areas are broad, ranging from health literacy and misinformation to social determinants of health and telehealth usage. The HINTS-6 study population was selected using a two-stage sampling design. For the first stage, a stratified sample of residential addresses across the United States was selected. This approach ensured diverse geographic and demographic representation, with an emphasis on capturing data from both urban and rural areas. The second stage involved the random selection of one adult per household using the Next Birthday Method, which is commonly used in household surveys to minimize bias. The sampling strategy for HINTS 6 also included oversampling of high minority populations, both in urban and rural areas, to ensure adequate representation of these groups, which have historically been underrepresented in health research. The inclusion of rural communities was a novel aspect of the 2022 administration, with the aim of increasing rural participation in health data collection and addressing health disparities that may exist between urban and rural populations.

**Sample Size & Statistical Power**

The sample size for the HINTS-6 is very critical towards ensuring the study's statistical power and generalizability. The HINTS-6 survey aimed to collect 7,000 completed questionnaires, targeting a diverse group of civilian, noninstitutionalized adults across the United States. Adequate representation sample of the population was achieved by using a two-staged stratified sampling survey design. This sample size is

considered large enough to detect meaningful differences and relationships in the data, particularly for exploring complex public health issues such as climate change anxiety and mental health. Considering the robust sample size, the HINTS-6 dataset provides a comprehensive insight to the relationship between climate change perceptions and mental health outcomes, offering statistical power to detect small to moderate effect sizes in the population. The large sample size for the dataset plays an essential role in detecting even small associations between different factors. In public health research, having enough statistical power is crucial for ensuring reliable and helpful findings. Thus, possible in helping to guide policy and intervention efforts (NCI, 2022). The HINT-6 broad sample ensures that the study can capture differences across various demographic groups, including gender or urban-rural populations distribution, as well as different racial and ethnic communities. This is particularly important for understanding health disparities and how social factors influence health outcomes. Power analysis for a sample of this size typically suggests a high probability of detecting statistically significant relationships, assuming the effect sizes are moderate or large. The stratified sampling design of HINTS 6 strengthens the study by oversampling certain groups, such as urban minorities and rural populations, which have often been underrepresented in health surveys. This approach is essential for gaining a deeper understanding of the unique health needs and mental health concerns of these communities, especially regarding climate change. As a result, the sample design not only boosts the study's statistical power but also ensures that the findings are more inclusive and reflective of the wider population.

**Data Collection**

The HINTS-6 used a mixed-mode data collection strategy, which offered respondents the option to complete the survey online or on paper. This flexibility was designed to increase participation across different populations, including those with limited access to the internet. To further boost response rates, particularly from hard-to-reach groups, HINTS 6 included additional mailings with increased incentives for non-respondents. The data collection period ran for several months, from March to November 2022, and participants were incentivized with a $2 prepaid monetary incentive, with additional bonuses for completing the survey online. This method of incentivization and increased outreach was aimed at maximizing the response rate and ensuring a diverse sample of respondents.

**Measures**

The dataset offers a rich variety of variables, with dependent variables related to mental health, including questions such as “Has a doctor or other health professional ever told you that you had depression or anxiety disorder?”. The response was “Yes” or “No.”

The independent variable of interest for this study is the perception of climate change, specifically, “how much individuals think climate change will harm their health?”. The responses were “A lot”, “Some”, “A little”, “Not at all”, “Don’t Know.” These responses will be recategorized as a dichotomous response (a) Yes for “A lot”, “Some”, “A little”; (b) No for “Not at all”

For demographic variables considered as covariates, age, sex, education, income, and marital status were used. Confounding variables include demographic factors such as

gender as “On your original birth certificate, were you listed as male or female?”, Sexual identity as “Do you see yourself as…?”, employment status as “Which of the following best describe your current occupational status?”, Marital status as “What is your marital status?”, educational attainment as “What is the highest grade or level of schooling you completed?”, income as “Thinking about members of your family living in this household, what is your combined annual income, meaning the total pre-tax income from all sources earned in the past year?” Education-level data was categorized into four groups: “<Post High School” versus “Some College” versus “College Graduate” versus “Postgraduate”. Sexuality was categorized as “Heterosexual” versus “Not Heterosexual”. Marital Status was categorized as “Married” versus “Not Married” versus “Others”. Income information was computed by the poverty income ratio (PIR), which is also an indicator of income relative to the economic needs of a household. This is a polytomous variable that was achieved by calculating annual fluctuations in household size and cost of living and monitoring the consumer price index concerning household income and federally established poverty limitations. PIR levels were defined as low income ($PIR < 1$), middle income ($1 \leq PIR < 4$), and high income ($PIR \geq 4$) and dichotomized for analysis with a cutoff point of 1. These variables are critical for understanding how social and economic factors may influence individuals’ concerns about climate change and its mental health impacts. Notably, by considering these confounding variables, the study aims to control for factors that could influence the relationships between climate change awareness and mental health outcomes.

**Data Analysis**

For the data analysis, I focused analyzing secondary data from the HINTS-6 to explore relationships between climate change perceptions and mental health outcomes. The study was based on a cross-sectional design, which is appropriate for examining correlations and associations at a specific point in time. Given the vast amount of data available in the HINTS-6 dataset, I aimed to extract meaningful insights regarding perceptions of climate change and its influence on mental health, particularly anxiety and depression. This quantitative approach involved the use of various statistical techniques to test the study's hypotheses and interpret the data within the context of the survey's scope. The first step in the analysis involved descriptive statistics to summarize the sample characteristics. This included measures such as frequencies, means, and standard deviations for the demographic variables (e.g., age, gender, income, education) and the primary study variables (e.g., perceived harm of climate change, depression/anxiety diagnoses, and worry). These descriptive analyses provided an overview of the sample's composition and the distribution of key variables, helping to identify patterns that may guide further statistical tests. Additionally, the use of visualizations such as histograms and bar charts will aid in understanding the data's distribution, while also highlighting any potential outliers or anomalies. To examine the relationships between the dependent and independent variables, I employed inferential statistical techniques, beginning with chi-square tests and independent samples *t* tests. The chi-square test wasused to analyze categorical variables, such as the relationship between mental health diagnoses (e.g., depression, anxiety) and sociodemographic factors like gender and race. This helped

identify any significant associations between categorical variables. For more complex relationships, complex samples logistic regression will be the primary statistical method used to assess the influence of multiple independent variables on binary outcomes such as whether a respondent has been diagnosed with depression or anxiety. This technique is particularly useful because it can handle multiple predictors simultaneously, including demographic factors (e.g., gender, income, education) and perceptions of climate change. Additionally, the technique is ideal because the probability of being selected for the sample is not equal for all participants. Logistic regression allowed for an estimation of odds ratios, which indicated the likelihood of a mental health diagnosis given different levels of climate change concern, while controlling for potential confounding variables. This analysis provided a clearer understanding of how climate change perceptions may contribute to mental health outcomes, accounting for other sociodemographic factors that could serve as confounders for the relationships. These include factors such as gender, race, marital status, and income, which could affect both mental health and climate change perceptions. By controlling for these variables in the regression models, the analysis provided a more accurate estimate of the relationship between climate change perceptions and mental health outcomes. Additionally, sensitivity analyses were conducted to check for the stability of the results across different subgroups (e.g., male vs female). The ultimate goal of this analysis was to offer actionable insights into how climate change may impact public health, particularly among vulnerable populations.

### Ethical Consideration

Ethical procedure is important for public health research. This study received institutional review board approval from Walden University with approval number 01-21-25-1188599.

## Results

### Demographic Attributes Overview

Table 1 presents the demographic characteristics of the HINT-6 study population. The average age of participants was 55.6 years, with a standard deviation of 17.4 years. Gender distribution showed that 39.52% were male and 60.48% were female. Employment status indicated that 50.86% were employed, while 49.14% were unemployed. Regarding marital status, 51.49% were married, 29.28% were not married, and 19.24% identified as divorced, widowed, or separated,. Educational attainment varied, with 32.11% having less than a high school education, 21.28% some college experience, 27.67% holding a college degree, and 18.94% having postgraduate education. In terms of sexual orientation, 92.22% identified as heterosexual. Annual income distribution revealed that 43.66% earned less than $50,000, 29.66% earned between $50,000 and $99,999, and 26.68% earned more than $100,000. Notably, 26.40% of participants reported experiencing depression or anxiety, while 78.28% indicated an understanding of climate change.

**Table 1**

*Attributes of the HINTS-6 Population*

| Characteristics | **S**ample (*N*= 6154) | |
|---|---|---|
| | *N* | % |
| Age (Mean±*SD*) | | 55.60±17.43 |
| Gender | | |
| Male | 2293 | 39.52 |
| Female | 3509 | 60.48 |
| Employment | | |
| Yes | 2952 | 50.86 |
| No | 2852 | 49.14 |
| Marital status | | |
| Married | 2979 | 51.49 |
| Not married | 1694 | 29.28 |
| Divorced/widowed/separated | 1113 | 19.24 |
| Education | | |
| <Post high school | 1860 | 32.11 |
| Some college | 1233 | 21.28 |
| College graduate | 1603 | 27.67 |
| Postgraduate | 1097 | 18.94 |
| Sexual orientation | | |
| Heterosexual | 5212 | 92.22 |
| Not heterosexual | 440 | 7.78 |
| Annual income | | |
| <$49,999 | 2396 | 43.66 |
| $50,000- $99,999 | 1628 | 29.66 |
| >$100,000 | 1464 | 26.68 |
| Depression or anxiety | | |
| Yes | 1565 | 26.40 |
| No | 4364 | 73.60 |
| Climate awareness | | |
| Yes | 3924 | 78.28 |
| **No** | 1089 | 21.72 |

**Sociodemographic Factors and Mental Health Status**

Table 2 presents the association between socio-demographic factors and the disclosure of depression or anxiety.

**Table 2**

*Sociodemographic attributes of HINTS-6 based on Depression or Anxiety*

| Characteristics | Depression or anxiety | | |
|---|---|---|---|
| | Yes | No | P-value |
| | *N* (%) | *N* (%) | |
| Gender | | | <.0001 |
| Male | 436 (28.57) | 1842 (43.50) | |
| Female | 1090 (71.43) | 2392 (56.50) | |
| Employment | | | .0137 |
| Yes | 736 (48.20) | 2196 (51.88) | |
| No | 791 (51.80) | 2037 (48.12) | |
| Marital status | | | <.0001 |
| Married | 679 (44.55) | 2287 (41.19) | |
| Not married | 483 (31.69) | 1188 (28.15) | |
| Divorced/widowed/separated | 362 (23.75) | 745 (17.65) | |
| Education | | | ,4085 |
| <Post high school | 490 (32.17) | 1353 (32.02) | |
| Some college | 344 (22.59) | 880 (20.82) | |
| College graduate | 416 (27.31) | 1177 (27.85) | |
| Postgraduate | 273 (17.93) | 816 (19.31) | |
| Sexual orientation | | | <.0001 |
| Heterosexual | 1284 (85.71) | 3896 (94.63) | |
| Not heterosexual | 214 (14.29) | 221 (5.37) | |
| Annual income | | | <.0001 |
| <$49,999 | 732 (49.66) | 1643 (41.31) | |
| $50,000- $99,999 | 393 (26.66) | 1225 (30.80) | |
| >$100,000 | 349 (23.68) | 1109 (27.89) | |
| Climate awareness | | | <.0001 |
| Yes | 1130 (84.71) | 2766 (75.91) | |
| No | 204 (15.29) | 878 (24.09) | |

**Odds Ratio Estimates for Sociodemographic Attributes and Mental Health**

Table 3 details the odds ratio estimates for the association between socio-demographic attributes, climate change awareness, and the likelihood of experiencing depression or anxiety.

**Table 3**

*Univariate and Multivariate Analysis for Climate Change Awareness, Covariates and Depression or Anxiety*

| Dependent variable | Odds ratio | |
|---|---|---|
| | Crude (95% CI, *p*) | Adjusted (95% CI) |
| | Yes vs no | Yes vs no |
| Age | 0.981 (0.978- 0.984, <.0001) | 0.973 (0.968- 0.978, <.0001) |
| Gender | | |
| Male | Reference | Reference |
| Female | 1.925 (1.696- 2.185, <.0001) | 0.586 (0.505- 0.679, <.0001) |
| Employment | | |
| Yes | 1.159 (1.031- 1.303, 0.0137) | 0.598 (0.507- 0.704, <.0001) |
| No | Reference | Reference |
| Marital status | | |
| Married | Refence | Reference |
| Not married | 1.369 (1.195- 1.569, <.0001) | 1.582 (1.320- 1.895, <.0001) |
| Divorced/widowed/separated | 1.637 (1.406- 1.905, <.0001) | 1.111 (0.917- 1.345, 0.1914) |
| Education | | |
| <Post high school | 1.189 (0.985- 1.436, 0.2427) | 1.007 (0.810- 1.253, 0.8799) |
| Some college | 1.216 (0.992- 1.490, 0.1585) | 1.068 (0.853- 1.336, 0.4520) |
| College graduate | 1.925 (0.885- 1.294, 0.4539) | 0.993 (0.812- 1.214, 0.6930) |
| Postgraduate | Reference | Reference |
| Sexual orientation | | |
| Heterosexual | Reference | Reference |
| Not heterosexual | 3.335 (2.676- 4.155, <.0001) | 2.691 (2.125- 3.407, <.0001) |
| Annual income | | |
| <$49,999 | 1.517 (1.293- 1.781, <.0001) | 1.169 (0.951- 1.437, 0.0765) |
| $50,000- $99,999 | 0.983 (0.823- 1.174, 0.0828) | 0.884 (0.729- 1.072, 0.0780) |
| >$100,000 | Reference | Reference |
| Climate awareness | | |
| Yes | 1.758 (1.487- 2.079, <.0001) | 1.392 (1.160- 1.671, 0.0004) |
| No | Reference | Reference |

**Adjusted Odds Ratios for Mental Health Relationships**

In terms of adjusted odds ratios, the analysis indicates that age has an adjusted odds ratio of 0.973 (CI: 0.968-0.978), suggesting a continued decrease in the odds of mental health issues with age. For gender, females compared to males had an adjusted odds ratio of 0.586 (CI: 0.505-0.679), indicating a reduced likelihood of reporting depression or anxiety when controlling for other factors. Being employed compared to unemployment resulted in an adjusted odds ratio of 0.598 (0.507- 0.704), suggesting that unemployment significantly increases the odds of mental health challenges. For marital status, being single compared to being married resulted in an adjusted odds ratio of 1.582 (1.320- 1.895), while not being divorced compared to being married showed an adjusted odds ratio of 1.111 (0.917- 1.345). Educational comparisons revealed that those with less than posthigh school exposure versus postgraduate education had an adjusted odds ratio of 1.007 (CI: 0.810-1.253), while those with some college experience compared to postgraduate showed an adjusted odds ratio of 1.068 (CI: 0.853-1.336). For college graduates compared to postgraduate individuals, the adjusted odds ratio was 0.993 (CI: 0.812-1.214). For sexual orientation, non-heterosexual individuals had an adjusted odds ratio of 2.691 (CI: 2.125-3.407) compared to heterosexual individuals, indicating a strong association with mental health issues. Income analysis revealed that those earning less than $50,000 compared to more than $100,000 had an adjusted odds ratio of 1.169 (CI: 0.951-1.437), while earning between $50,000 and $100,000 compared to more than $100,000 had an adjusted odds ratio of 0.884 (CI: 0.729-1.072). Finally, individuals with knowledge about climate change compared to those without awareness had an adjusted

odds ratio of 1.392 (1.160- 1.671), further emphasizing the importance of climate awareness in mental health outcomes.

## Discussion

In recent years, the spotlight has been on the relationship between climate change awareness and depression, anxiety, and associated mental health issues. I conducted comprehensive investigation into the relationships between a variety of sociodemographics, climate change awareness, and a reported response of previous depression or anxiety. While previous research has established some correlation between these variables and health outcomes, its nuances regarding sociodemographic factors of interest are reported here, with significant results pertaining to age, gender, employment status, marital status, education, income, and sexual orientation. Moreover, awareness of climate change itself appears to drive mental health, which may imply that greater climate change awareness may reduce climate change-related anxiety and depression (Gebhardt et al., 2023). Thus, the context of sociodemographic attribute portrays the importance of this study findings.

### Sociodemographic Attributes of the Relationship

The sociodemographic profile of the HINT-6 study population appears to capture important trends relevant to mental health outcomes. Participants had a mean age of 55.6 years, which is a demographic that may have unique mental health needs or challenges (Mongelli et al., 2020) and consistently report on climate anxiety. Older adults are more vulnerable as they are more likely to be affected by the negative impacts caused by climate change such as health-related issues (e.g., anxiety and depression) and socio-

economic instability (Cianconi et al., 2020; White et al., 2023). The crude odd ratio of age showed that the likelihood of depression or anxiety was lower in older individuals, with an odds ratio of 0.981. This indicates that older individuals report mental health issues marginally less likely than younger individuals and correlates with prior literature suggesting resilience and adaptive mechanisms improve with age (Merchant et al., 2022; Tabudlo et al., 2022). However, this association between age and mental health could be dependent on several psychosocial factors, including life experience and social support networks. Similarly, the adjusted estimates for age (AOR= 0.973) further supports the idea that older individuals remain less vulnerable to mental health distress.

There was gender disparate distribution in the findings, with 60.48% being female, which is consistent with the literature, where women are found more vulnerable to mental health threats elicited by climate change (Goudet et al., 2024; Heeren et al., 2022; Rothschild & Haase, 2023). Such susceptibility could arise from social constructs and gender roles around emotional expression and coping strategies. For example, men may use avoidance techniques, which can result in various forms of depression, whereas women frequently turn to social support during stressful times (Cianconi et al., 2020). This research emphasizes how important it is to modify mental health resources to accommodate the distinct requirements of various gender groups. Based on the analysis, females have higher crude odds ratios for mental health issues related to climate awareness (*OR*=1.925), suggesting that an almost two-fold higher number of females reported symptoms of depression or anxiety compared to males. This gendered trend in mental well-being is strongly supported in the literature, with women manifesting higher

rates of depression and general anxiety consistently than men, which may even be associated biologically with hormonal changes and increasing expectations of women for positive child/parental and social roles (Kupferberg & Hasler, 2023; Singh & Wendt, 2024). Interestingly, females had a statistically significant lower odds of depression or anxiety (AOR= 0.586) after adjusting for other sociodemographic factors. This suggests that the gender gap noted in the mental health outcomes was somewhat less pronounced when other sociodemographic factors were considered; thus, suggesting the possible influence of additional risk factors like marital status or employment. These findings emphasize the crucial nature of offering resources for mental health that are tailored towards gender.

Employment status remains another crucial factor that correlated with mental health outcomes. I noted that 50.86% of participants was employed and that the odds of reporting depression or anxiety were inversely associated with employment status. Unemployment has been suggested to be associated with increased financial hardship, decreased social contacts, and decreased feelings of purpose in life, which are all contributing factors to mental health disorders (Drake & Wallach, 2020). Employment status was another factor closely linked with mental health. For those without jobs, the crude odds ratio was *OR*= 0.829, suggesting that employment may have some protective effects against anxiety or depression. Based on this analysis, the odds of depression or anxiety for unemployed persons were significantly greater than those with full-time employment, consistent with recent work reporting that unemployment is related to increased incidence of mental health challenges (Wang et al., 2024). But when

controlling for other sociodemographic factors, being unemployed was associated with particularly high odds of having mental health problems (AOR= 1.673). This finding is consistent with earlier studies showing a link between social positions, job security, and better mental health outcomes (Burgard, 2021; Wang et al., 2024). Furthermore, there is a negative correlation between employment and awareness of climate change, suggesting that those who are working may have stronger coping strategies, resources, and support networks in place to handle the different stresses that climate change may bring (Daeninck et al., 2023; Ogunbode et al., 2022). This insight highlights how mental health in the context of climate change cannot be viewed outside socioeconomic factors.

Findings concerning marital status also merit attention as it turned out to be the more important factor in mental health outcomes. Single or unmarried individuals had higher odds of suffering from depression or anxiety than those who were married, indicating a statistically higher chance of getting depression or anxiety for married individuals. This finding dovetails with research showing that strong social support systems, prevalent in marital relationships, are protective factors for mental health (Fivecoat et al., 2024; Li et al., 2023). In contrast, divorced or separated individuals relative to married individuals had a nonsignificant trend, but tends towards being at higher odds of experiencing a mental health issue. This pattern aligns with previous research finding a protective effect of marriage on mental health (Jace & Makridis, 2021). Thus, unmarried or separated people may not have this emotional support, which could contribute to increased anxiety or depression. Hence, a partner's emotional support can buffer stress and promote resilience to environmental stressors, like climate-related

fears. This is important, as social connections have been shown to buffer against the mental health impacts of climate change, and isolation may worsen feelings of hopelessness and despair (Brandt et al., 2022).

Education was another variable strongly related to mental health based on this study. Although higher education levels usually correlate with more favorable mental health outcomes, the data showed mixed results. Those with less than a high school diploma reported rates of depression or anxiety similar to participants with postgraduate degrees. The crude odds ratio for education level (less than high school vs. postgraduate education) was not statistically significant (*OR*=1.189). However, the adjusted analyses depicted that less than high school education was associated with reported depression or anxiety (AOR= 1.314), when comparing individuals with postgraduate education. Thus, raises important questions about how education is related to climate change awareness in the first place — and how that, in turn, affects mental health. This lends some support to the hypothesis that education leads to enhanced cognitive and emotional resources that can assist individuals to cope with stressors, including challenges to mental health (Lee & Yang, 2022). On the other hand, evidence in the literature also suggests that education is associated with perceptions of climate change in the sense that a more educated population is typically more aware of the impacts of climate change, and thus may face higher levels of anxiety (Daeninck et al., 2023; Ogunbode et al., 2022). Hence, this suggests that a higher level of education, though very helpful to understand climate-related issues, can also contribute to greater worries associated with future uncertainties. Therefore, despite positive action through educational initiatives, there should be

accompanying mental health support, as climate change brings about psychological consequences as a result.

The role of sexual orientation in the public health and population health hemisphere has been well documented in contemporary times (Mitchell et al., 2021). This study showed that non-heterosexual individuals reported substantially higher odds of depression or anxiety than heterosexual individuals (*OR*=3.335). Hence, suggesting that they were approximately three times more likely to have a depression or anxiety diagnosis compared to heterosexual individuals. This finding was corroborated after adjustment of confounding variables (AOR= 2.691), highlighting the increased burden of poor mental health amongst non-heterosexual people (Burns et al., 2018; Hatzenbuehler et al., 2024). Evidence in the literature suggests that sexual minorities have a higher rate of mental illness than heterosexuals due to factors including discrimination, stigma, and minority stress (Hatzenbuehler et al., 2024).Such a difference is expected for communities that are already marginalized as LGBTQ+ individuals who have unique stressors they regularly face, like discrimination and stigma from society, which contribute to their mental health issues (Shaikh et al., 2024; Sileo et al., 2022). These dimensions, including climate change anxiety, warrant attention to mental health for sexual minority populations engaged in climate action. This fact highlights the need for mental health interventions that are LGBTQ+-inclusive and trauma-informed in the face of climate change.

Economic distress is a well-established risk factor for mental health, with financial insecurity causing feelings of hopelessness and depression (Guan et al., 2022;

Ryu & Fan, 2023). In the context of climate change awareness, the association between income and mental health outcomes also needs to be considered. I found that people with climate change awareness making less than $50,000 were much more likely to be depressed or anxious compared with individuals earning more than $100,000 (*OR*= 1.517). Following considerations for other sociodemographic attributes and outcomes, the findings remained same (AOR= 1.169). These results are consistent with a substantial literature showing that socioeconomic status is a robust predictor of mental health, with at-risk groups being more likely to report psychological distress (Guan et al., 2022; Ryu & Fan, 2023). Furthermore, those with lower incomes may not have access to social support networks, healthcare, education, and other resources that can lessen the effects of climate change irrespective of their awareness to this challenge (Jessel et al., 2019; Khine & Langkulsen, 2023). These situations capture the intersection of mental health, socioeconomic position, awareness and climate change, necessitating comprehensive approaches that take interconnected issues into consideration.

**Climate Change Awareness and Mental Health**

The association between climate change awareness and mental health outcomes, particularly depression or anxiety, is an emerging area of concern, especially as environmental events intensify. I noted that those who possessed knowledge of climate change were more likely to be depressed or anxious. Hence, indicating that ignorance of climate change may protect against mental health concerns triggered by environmental stressors (Geiger & Swim, 2016). This relationship remained in adjusted models controlling for confounding variables. These outcomes underscore the failure of public

health education in addressing the psychosocial consequences of climate change (Crane et al., 2022). This is consistent with the literature showing that climate change education and awareness may not be associated with lower rates of climate-related anxiety (Zacher & Rudolph, 2023). Alternatively, there is literature suggesting that increased climate change awareness may prompt a range of adaptive behaviors that promote a sense of agency and reduce feelings of helplessness (Schwartz et al., 2022). Though further studies is still needed, the findings suggest that a greater understanding of climate change can empower people and strengthen their urgency and involvement in proenvironmental behavior (Tucholska et al., 2024). This empowerment can help alleviate helplessness, which frequently comes along with inducing anxiety about environmental adverse outcome. However, it also needs to be understood that greater awareness can translate to increased anxiety if climate change is perceived as an inevitable threat (Clayton & Karazsia, 2020; Lawrance et al., 2022; Alessandro von Gal et al., 2024). Therefore, while climate change education is critical, it should be integrated with resilience- and coping-building strategies.

**Strength & Limitations**

The use of HINTS-6 dataset for this study was a major strength of this study as it included a large, nationally representative sample, allowing an understanding of awareness and depression or anxiety among the general population regarding climate change. Hence, this created a strong basis for identifying such relationships. Another strength stems from my providing valuable insights that can inform policy decisions and interventions aimed at enhancing climate change literacy and action. However, the study

has several limitations. First, as a cross-sectional analysis, it can identify correlations but cannot establish causality—whether increased awareness of climate change directly causes depression or anxiety, or whether pre-existing mental health conditions influence people's awareness of climate change. Moreover, the HINTS-6 dataset relies on self-reported data, which may be prone to reporting bias, especially when it comes to mental health conditions like depression and anxiety, which individuals may underreport due to stigma or lack of awareness. Another limitation is that the dataset might not fully represent the breadth of psychological responses to climate change, making it difficult to gauge the degree of both awareness of the issue and real symptoms of depression or anxiety, such as eco-anxiety or other more specific forms of distress. Finally, while the sample is nationally representative, it may not account for regional variations in climate impacts or mental health care access, potentially masking significant localized effects.

**Recommendations**

One of the initial recommendations from this study is to invest further into individual-level interventions which help people understand climate change and also build their mental health resilience to this, such as depression and anxiety. Public health initiatives could be implemented to increase the populace awareness of climate change, its psychological effects and available coping mechanisms. These efforts could take the form of media campaigns, online resources and community workshops that combine mental health education and climate science. By offering people resources to combat eco-anxiety, such as mindfulness techniques or scopes to deal with climate-related stress, it

can help individuals deal with their feelings in positive, healthy ways, lessening the mental health consequences that come with being educated about climate change.

Building protective social networks of encouraging friends and family is crucial for reducing the negative effects of climate change awareness on mental health on an interpersonal level. These new organizations can offer a forum for people to express their worries, emotions, and experiences about mental health and climate change, just like peer support groups and community programs do. Such groups could be coordinated by mental health providers trained to address the unique psychological toll posed by climate change. In addition, family and close friends can be trained to spot the signs of eco-anxiety and depression in people close to them, and to engage in open conversations that will reduce the stigma attached to mental health issues. Sexual minorities are more likely to experience mental health issues, thus it would be important to make sure that these groups are welcoming, safe, and offer the specialized care that considers their social and environmental pressures.

It is important to prioritize an environment that promotes climate resilience and mental health resilience at both community and societal levels; policymakers should make it a priority. Urban planning initiatives can include green spaces and climate adaptation strategies that mitigate the physical impacts of climate change and also support mental health and well-being. Moreover, mental health support services need to be expanded and adapted to respond to the specific psychological impacts of climate change. This could involve incorporating climate anxiety into training programs for mental health professionals, developing climate-based counseling services, and getting

those resources to low-income communities affected by climate change and mental health crises at disproportionately high levels. At the community level, adaptation of access to means of education, employment opportunities, and social support networks especially focusing on vulnerable groups such as women, sexual minorities, and poor-income groups is needed. Finally, policy changes that focus existing resources on tackling the potential socioeconomic inequalities exacerbated by climate change (e.g., economic insecurity, unemployment) must be brought to the forefront, as these factors are highly correlated with mental health outcomes and form part of the broader social determinants of health. This approach to addressing these disparities at various levels can lead to improvements in climate awareness as well as mental health outcomes throughout the population.

**Implications for Interventions in Mental Health**

These results have important implications for the provision of mental health interventions given the context of climate change. Since demographic factors affect mental health outcomes differently, tailored interventions that consider individual circumstances are needed. Additionally, programs designed to assist unemployed individuals, for example, can knit mental health resources into their interventional plans to mitigate the unique mental health stressors that accompany unemployment, especially in harrowing socioeconomic conditions spurred by climate change. In the same way, mental health programs for nonheterosexual individuals need to consider the extra stressors they face in the context of climate change, and the implications of awareness status. Additionally, climate change awareness educational methods must incorporate

mental health as well in their prevention designs. These programs may help buffer against anxiety and depression that might stem from increased awareness of climate problems, through teaching coping strategies and resilience.

## Positive Social Change Impact

Thus, one relatively new area of interest linking climate change and human well-being is climate change awareness and mental health (e.g., depression, anxiety) such as the psychological risk associated with climate change as predictors of mental health status. These results show a clear link between climate change awareness and mental health, with broad implications for research, education, public health practice, and policy. We will comment on some of the social implications of these findings in these three areas.

### *Research*

Studying the link between climate change awareness and mental health can help better understand the mental health impacts of climate change. The researchers can lead to more nuanced insights by generating inferences through a smooth relationship between awareness and mental health status and then meaningful findings for further studies about demographics and risk factors. For example, it is well-documented that individuals of low to lower to middle socio-economic status and those with limited access to mental health resources are disproportionately impacted by climate anxiety (Ballew et al., 2024; White et al., 2023). A key to recognizing when someone is at risk is understanding these dynamics to identify vulnerable populations and create tailored interventions. Additionally, it can inform predictive models that determine mental health risks caused

by climate change through continued research. Bridging these disciplines can allow researchers to return to the rapid pace of climate change by using frameworks to inform public health initiatives about interventions that can be implemented to reduce the mental health effects (Lemon et al., 2023). Research is well explained and provides data useful to practitioners and policymakers.

### *Education*

The results about the mental health effects of climate change awareness may be valuable for educational efforts across all levels. Schools and universities can develop curricula on climate literacy — again, with a focus on the psychological effects of climate change. The populace can be better equipped to face obstacles in the future by learning about the effects of climate change and coping mechanisms for anxiety and sadness. Furthermore, initiatives for community education can also raise awareness among many groups, particularly those who are most affected by climate change. Thus, whilst this article focuses specifically on climate change, the broader applicability of the suggested intervention is useful: giving workshops and resources on climate change together with its impact on mental health can foster resilience and cope mechanisms, promoting well-being in communities facing environmental problems (Xue et al., 2024). When people become more aware of these issues they may take pro-environmental actions, too, which can improve mental health by instilling a sense of agency and connectedness to a community.

### *Public Health Practice*

While these challenges require critical solutions, we can no longer afford a modular approach to climate change adaptation. The research can help health practitioners advocate for mental health resources that meet the needs of communities experiencing climate-related stressors. Evidence in the literature described integrating mental health screenings and support services into such climate resilience programs as one way climate adaptation programs can help address and mitigate the individual psychological burden of climate events. Moreover, I highlighted the importance of multidisciplinary approaches to public health practice. Community leaders, environmental scientists, and mental health professionals can work together to develop all-encompassing programs that address the psychological and physical effects of climate change. This enables more successful solutions and provides a more thorough grasp of the problems communities are facing.

### *Policy Implications*

It may also inform policies around mental health and climate change. Advocacy for climate and health policies can demonstrate how the association between climate change awareness and mental health outcomes can be used by policymakers to ensure policy is driven by evidence. There are several opportunities to incorporate mental health into climate action, including initiatives to incorporate psychological well-being considerations into climate action plans (Newberry Le Vay et al., 2023). These findings can also inform funding allocations for mental health services in the context of climate change. By acknowledging the mental health impact of climate change, policymakers can help ensure resources are allocated for mental health initiatives, especially in vulnerable

communities that are in many ways already bearing the brunt of environmental turnover. It is a sound investment that ultimately can drive better mental health outcomes and community resilience.

## Conclusion

Climate change awareness and mental health (including depression and anxiety) are closely related; at the same time, this relationship is multifactorial and not yet fully elucidated. I emphasized the need to examine sociodemographic factors like gender, employment status, marital status, education, sexual orientation, and income levels when examining mental health outcomes based on climate change awareness. As the effects of climate change continue to unfold, it is crucial for mental health experts and policymakers to join hands in devising targeted strategies that cater to the specific needs of various communities. Thus, climate change awareness should be promoted in a parallel path as well as improving mental health services to boost the capacity of individuals to deal with the challenges posed by climate change through promoting supportive psychological resilience. Nonetheless, further studies are indeed required corroborate this study findings, and to understand the nature of the association.

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# Manuscript 2: Biological Sex Differences for the Relationship Between Climate Change Awareness and Depression or Anxiety Among The U.S. Population

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## Outlet for Manuscript

A suitable target journal for a manuscript exploring the relationship between climate change and mental health is **Global Environmental Change**. This journal can be accessed online at Global Environmental Change and follows the APA (American Psychological Association) formatting style.

Global Environmental Change emphasizes the human dimensions of environmental change and its associated impacts, making it an ideal venue for discussing the intersection of climate change and mental health. The journal promotes interdisciplinary research, which is crucial for tackling the complex issues surrounding how climate change influences mental well-being. Additionally, the articles published in this journal frequently examine policy implications, social impacts, and behavioral responses, aligning seamlessly with discussions about mental health in the context of climate-related stressors.

## Abstract

Having an awareness of climate change and the effects it has on the environment and mental well-being is important. But there is an urgent gap in the research on gender differences in this area, in particular in the American context. The mental health consequences of climate change are still largely unclear, and even less is known about the relationship between climate change awareness and depression or anxiety which could vary based on biological sex. Social Ecological Model (SEM) is a theoretical framework designed to understand how individual, interpersonal, community, and societal factors interact and influence climate change awareness and subsequently affect mental health. This cross-sectional, quantitative study uses the HINTS-6 dataset from the National Cancer Institute (NCI), and applies standard statistical techniques, including regression models, to evaluate the relationships among these variables. Results showed that male with awareness of climate change had AOR=1.036 (CI: 0.764–1.405) for depression or anxiety and while female had higher AOR AOR=1.294 (CI: 1.010–1.658). For males this association was not statistically significant. These observed differences in mental health outcomes may reflect general differences between women and men when it comes to coping strategies even as both groups report high levels of distress overall in response to climate change awareness.

## Introduction

The intersection of climate change and mental health is increasingly recognized as a significant area of concern, particularly in relation to gender disparities (Goudet et al., 2024; Zavala et al., 2024). While research has shown that women engage in pro-environmental behaviors more than men (Galván-Mendoza et al., 2022; Li et al., 2022; Zhao et al., 2021), the relationship between these behaviors and mental health outcomes is complex. Evidence highlights the psychological toll of climate change awareness, especially among women (Rothschild & Haase, 2023). The literature suggests climate change awareness impacts women's mental health compared to men as such that it exacerbates pre-existing gender inequalities through economic determinants, leading to anxiety and depressive symptoms as household livelihoods are compromised (Goudet et al., 2024). For example, Closson et al., 2022 findings suggest that women exhibit greater mental health vulnerability, with 49.5% of women reporting medium to high levels of climate change anxiety compared to only 21.9% of men in the same study exposed to comparable levels of distress (Closson et al., 2022). This discrepancy showcased the need to further understand gender roles influence on emotional responses to climate change. Similarly, gender-based violence (GBV) often escalates during climate crises, with studies indicating that extreme weather events, such as floods and droughts, increase the frequency and severity of intimate partner violence (Allen et al., 2024). This violence not only affects women's physical safety but also compounds their mental health challenges. Additionally, other evidence supports that women, particularly those from marginalized communities, experience heightened vulnerabilities during climate-related disasters

(White et al., 2023). For instance, during the European heatwave, statistics revealed a higher mortality rate among women compared to men, suggesting that gender disparities are exacerbated in extreme conditions (Cianconi et al., 2020).

Climate change is linked to a range of mental health issues, including anxiety, depression, and post-traumatic stress disorder (PTSD) (Clayton, 2021). However, this association has not been replicated in studies. While existing literature indicate that climate change awareness can lead to varying mental health outcomes, they often neglect to analyze these outcomes through a gendered lens. Evidence in the literature suggests that as awareness of climate change intensifies, so too do feelings of anxiety and hopelessness about the future, particularly among individuals that feel they have little control over the situation (Rothschild & Haase, 2023). The World Health Organization (2023) reported that women are disproportionately affected by mental health disorders in the context of climate change (WHO, 2023), yet few studies quantitatively analyzed the contribution of awareness to this disparity. There is a notable gap in understanding the different emotional coping mechanisms employed by men and women in response to climate change awareness. Notably, while women often seek social support, men may resort to avoidance strategies or internalize stress, leading to different manifestations of depression (Cianconi et al., 2020). Thus, women are often more attuned to the emotional and social dimensions of climate change, resulting in possible higher rates of depressive symptoms when faced with negative information about the environment (Goudet et al., 2024). This disparity is critical as it has the potential to reveal the social constructs related to gender influenced individuals' responses to climate change (Clayton et al.,

2023). The social problem of gender differences in the relationship between climate change awareness and depression has significant policy implications. Hence, there is a critical need for mental health services that are sensitive to the gendered experiences of climate change awareness?.

Socioeconomic stressors significantly influence the relationship between climate change and mental health among women (van Daalen et al., 2020). Hence, the literature suggests that women, young individuals, and those from lower socioeconomic backgrounds are more susceptible to anxiety and mood disorders linked to climate disasters, revealing the correlated features of gender, age, and socioeconomic status in mental health outcomes (Cianconi et al., 2020; van Daalen et al., 2020). Women's concerns often extend beyond their well-being to include the safety of their children, financial hardships, and the inability to access land and resources, further compounding their mental health struggles (Cianconi et al., 2020; Goudet et al., 2024; Rothschild & Haase, 2023). Notably, women often shoulder caregiving responsibilities, which become more burdensome during environmental crises. For instance, during climate crises, men may migrate for work, leaving women to manage household responsibilities amidst escalating pressures, which can lead to increased anxiety and depression (Burns & Mutunga, 2024; Goudet et al., 2024). Evidence in the literature noted that men also emphasized that women's roles in household survival strategies render them particularly vulnerable to mental health issues and decompensation, as their opportunities for income generation and resource access diminish especially during climate-related events (Agarwal, 2019; John et al., 2023). The disproportionate burden of caregiving amidst

climate crises results in increased stress, anxiety, and depression, reinforcing the need to address gender inequities in climate adaptation strategies. This is typified by a study by Yazawa et al. (2023) found that women are at a higher risk for post-traumatic stress disorder (PTSD) and anxiety following extreme weather events (Yazawa et al., 2022).

The concept of eco-anxiety which is defined as anxiety related to ecological degradation has been identified as a significant concern for women, affecting their reproductive health decisions (Rothschild & Haase, 2023). Findings in the literature suggests that women are increasingly reporting feelings of hopelessness regarding the future, which impacts their mental health and family planning choices. In Kenya, Ndetei et al. (2024) found that 19.3% of women reported feeling worried about climate change compared to 29% of men (Ndetei et al., 2024). This disparity highlights the disproportionate economic challenges impact on women, leading to heightened mental health risks. Similarly, research revealed that pregnant women exposed to cyclones exhibited elevated PTSD risk compared to the non-pregnant population, depicting the implications or effects of climate change regarding reproductive health concerns (Fan & Zlatnik, 2023). In terms of climate change attitudes, the disparity across gender has been shown to have significant implications for mental health (Clayton, 2021; Mavisakalyan & Tarverdi, 2019; van Daalen et al., 2020). Attitudes toward climate change significantly impact mental health outcomes, with studies showing that those who acknowledge and feel empowered to address climate change are less likely to experience depression (Clayton & Karazsia, 2020; Closson et al., 2022). Additional evidence in the literature showed that women report higher levels of concern and distress related to climate change

compared to men (Clayton et al., 2023). On the other hand, it is not unexpected that males were more confident than women regarding government's reaction to climate change. Furthermore, this highlights that women have greater emotional investment in environmental issues that may correlate with mental health challenges, while men have greater political investment to climate change (Clayton et al., 2023). In addition, studies have inferred that this higher level of distress among women compared to men could be attributable to women's perceived lack of power in many cultural contexts, which can exacerbate feelings of anxiety and depression (Bolte et al., 2023). Additionally, gender roles often restrict women's participation in decision-making processes regarding climate adaptation and resource management, further entrenching their vulnerability (Pinho-Gomes & Woodward, 2024).

Biologically, the psychological impact of climate change is not uniform across genders. Men may exhibit different coping mechanisms, often internalizing their stress, which can lead to aggression or substance abuse rather than overt depression (Cianconi et al., 2020). In contrast, women are more likely to express their emotions and seek help, leading to higher reported rates of depression (Clayton et al., 2023; Shi et al., 2021). Understanding gender differences in climate-related mental health requires a cross-cultural lens. Studies from diverse geographic contexts reveal varying patterns of vulnerability and resilience. For instance, in high-income countries, women report higher levels of anxiety related to climate change (Clayton et al., 2023; Closson et al., 2022; Heeren et al., 2022), while in low-income countries, the primary concern often revolves around economic survival and caregiving responsibilities (Kadandale et al., 2020; Naser

et al., 2024). For women in these regions, the daily struggle to secure food, water, and basic services in the face of climate-induced disruptions often outweighs concerns about long-term environmental change. In low- and middle-income countries, where the effects of climate change are often most pronounced, the need for culturally relevant mental health interventions is paramount towards gender biased accessibility to care (Kirkbride et al., 2024). Literature evidence indicates that children, adolescents, and women in these countries with low economic settings are particularly at risk for climate-related mental health issues (Ndetei et al., 2024). Supportively, the United Nations (2023) noted that marginalized populations, including women and girls, often encounter systemic and cultural barriers that hinder their ability to obtain necessary mental health support (Dabrowski et al., 2024; Nations, 2023). Notably, access to mental health resources is crucial for addressing the psychological impacts of climate change as women, particularly those in rural or economically disadvantaged settings, face significant barriers to accessing healthcare services (Schuster et al., 2024; White et al., 2023). This lack of access exacerbates the mental health disparities experienced by these groups, making them more vulnerable to the psychological impacts of climate change. However, there remains a dearth in the literature regarding the climate change attitude relationship with depression. Hence, we hypothesize that there is a moderating effect of gender on the association between climate change awareness and depression or anxiety among adults in America controlling for age, marital status and socioeconomic status.

### Hypothesis Test

Null Hypothesis (H0): There is no significant moderating effect of association of age on the association between climate change awareness and depression or anxiety among adults in America controlling for age, marital status and socioeconomic status.

Alternative Hypothesis (H1): There is significant moderating effect of association of age on the association between climate change awareness and depression or anxiety among adults in America controlling for age, marital status and socioeconomic status.

## Methods

### Study Design

The HINTS-6 study uses a quantitative, cross-sectional design and relies on secondary data from the extensive dataset collected by the National Cancer Institute (NCI). The survey was carefully designed with strong statistical methods and reliable sampling techniques to ensure accuracy. In addition to assessing public access to health information, the HINTS-6 survey included questions focused on mental health, climate change concerns, and broader social factors affecting health. This makes the dataset especially useful for exploring how climate change awareness, mental health, and social conditions are connected, particularly in vulnerable populations. Along with assessing public access to health information, the HINTS 6 survey also included questions about mental health, concerns over climate change, and broader social factors that affect health. This makes the dataset especially valuable for exploring how climate change awareness, mental health, and social conditions are interconnected, particularly among vulnerable groups. The secondary nature of the data means that no new participants were recruited

for this specific study, but rather, existing data were analyzed to answer research questions related to climate anxiety and its potential relationship with mental health.

**Study Population**

The HINTS is a comprehensive, nationally representative survey administered by the NCI since 2003. HINTS gathers data from civilian, non-institutionalized adults aged 18 or older living in the United States. The survey's primary aim is to assess the American public's access to and utilization of health information, with a specific focus on cancer across the continuum of care prevention, early detection, diagnosis, treatment, and survivorship. The most recent round, HINTS-6, conducted from March 7 to November 8, 2022, included a goal of obtaining 7,000 completed questionnaires. The survey's focus areas are broad, ranging from health literacy and misinformation to social determinants of health and telehealth usage. The HINTS-6 study population was selected using a two-stage sampling design. For the first stage, a stratified sample of residential addresses across the United States was selected. This approach ensured diverse geographic and demographic representation, with an emphasis on capturing data from both urban and rural areas. The second stage involved the random selection of one adult per household using the Next Birthday Method, which is commonly used in household surveys to minimize bias. The sampling strategy for HINTS 6 also included oversampling of high minority populations, both in urban and rural areas, to ensure adequate representation of these groups, which have historically been underrepresented in health research. The inclusion of rural communities was a novel aspect of the 2022 administration, with the

aim of increasing rural participation in health data collection and addressing health disparities that may exist between urban and rural populations.

**Sample Size & Statistical Power**

The sample size for the HINTS-6 is very critical towards ensuring the study's statistical power and generalizability. The HINTS-6 survey aimed to collect 7,000 completed questionnaires, targeting a diverse group of civilian, non-institutionalized adults across the United States. Adequate representation sample of the population was achieved by utilizing a two-staged stratified sampling survey design. This sample size is considered large enough to detect meaningful differences and relationships in the data, particularly for exploring complex public health issues such as climate change anxiety and mental health. Considering the robust sample size, the HINTS-6 dataset provides a comprehensive insight to the relationship between climate change perceptions and mental health outcomes, offering statistical power to detect small to moderate effect sizes in the population. The large sample size for the dataset plays an essential role in detecting even small associations between different factors. In public health research, having enough statistical power is crucial for ensuring reliable and helpful findings. Thus, possible in helping to guide policy and intervention efforts (National Cancer Institute, 2022). The HINT-6 broad sample ensures that the study can capture differences across various demographic groups, including gender or urban-rural populations distribution, as well as different racial and ethnic communities. This is particularly important for understanding health disparities and how social factors influence health outcomes. Power analysis for a sample of this size typically suggests a high probability of detecting statistically

significant relationships, assuming the effect sizes are moderate or large. The stratified sampling design of HINTS 6 strengthens the study by oversampling certain groups, such as urban minorities and rural populations, which have often been underrepresented in health surveys. This approach is essential for gaining a deeper understanding of the unique health needs and mental health concerns of these communities, especially regarding climate change. As a result, the sample design not only boosts the study's statistical power but also ensures that the findings are more inclusive and reflective of the wider population.

**Data Collection**

The HINTS-6 used a mixed-mode data collection strategy which offered respondents the option to complete the survey online or on paper. This flexibility was designed to increase participation across different populations, including those with limited access to the internet. To further boost response rates, particularly from hard-to-reach groups, HINTS 6 included additional mailings with increased incentives for non-respondents. The data collection period ran for several months, from March to November 2022, and participants were incentivized with a $2 pre-paid monetary incentive, with additional bonuses for completing the survey online. This method of incentivization and increased outreach was aimed at maximizing the response rate and ensuring a diverse sample of respondents.

**Measures**

The dataset offers a rich variety of variables, with dependent variables related to mental health, including questions such as “Has a doctor or other health professional ever told you that you had depression or anxiety disorder?”. The response was “Yes” or “No.”

The independent variable of interest for this study is the perception of climate change, specifically, “how much individuals think climate change will harm their health?”. The response were “A lot”, “Some”, “A little”, “Not at all”, “Don’t Know.” These responses will be recategorized as a dichotomous response (a) Yes for “A lot”, “Some”, “A little”; (b) No for “Not at all”

For demographic variables considered as covariates, age, education, income, and marital status will be utilized. Confounding variables include demographic factors such as gender as “On your original birth certificate, were you listed as male or female?”, Sexual identity as “Do you see yourself as…?”, employment status as “Which of the following best describe your current occupational status?”, Marital status as “What is your marital status?”, educational attainment as “What is the highest grade or level of schooling you completed?”, income as “Thinking about members of your family living in this household, what is your combined annual income, meaning the total pre-tax income from all sources earned in the past year? “,Education-level data will be categorized into four groups: “<Post High School” versus “Some College” versus “College Graduate” versus “Postgraduate”. Sexuality was categorized as “Heterosexual” versus “Not Heterosexual”. Marital Status will be categorized as “Married” versus “Not Married” versus “Others”. Income information was computed by the poverty income ratio (PIR),

which is also an indicator of income relative to the economic needs of a household. This is a polytomous variable that was achieved by calculating annual fluctuations in household size and cost of living and monitoring the consumer price index concerning household income and federally established poverty limitations. PIR levels were defined as low income (PIR < 1), middle income (1 ≤ PIR < 4), and high income (PIR ≥ 4) and dichotomized for analysis with a cutoff point of 1. These variables are critical for understanding how social and economic factors may influence individuals' concerns about climate change and its mental health impacts. Notably, by considering these confounding variables, the study aims to control for factors that could influence the relationships between climate change awareness and mental health outcomes.

**Data Analysis**

The data analysis plan for this study focuses on analyzing secondary data from the HINTS-6 to explore relationships between climate change perceptions and mental health outcomes. The study is based on a cross-sectional design, which is appropriate for examining correlations and associations at a specific point in time. Given the vast amount of data available in the HINTS-6 dataset, this analysis aims to extract meaningful insights regarding perceptions of climate change and its influence on mental health, particularly anxiety and depression. This quantitative approach will involve the use of various statistical techniques to test the study's hypotheses and interpret the data within the context of the survey's scope. The first step in the analysis will involve descriptive statistics to summarize the sample characteristics. This will include measures such as frequencies, means, and standard deviations for the demographic variables (e.g., age,

gender, income, education) and the primary study variables (e.g., perceived harm of climate change, depression/anxiety diagnoses, and worry). These descriptive analyses will provide an overview of the sample's composition and the distribution of key variables, helping to identify patterns that may guide further statistical tests. Additionally, the use of visualizations such as histograms and bar charts will aid in understanding the data's distribution, while also highlighting any potential outliers or anomalies. To examine the relationships between the dependent and independent variables, the study will employ inferential statistical techniques, beginning with chi-square tests and independent samples t-tests. The chi-square test will be used to analyze categorical variables, such as the relationship between mental health diagnoses (e.g., depression, anxiety) and sociodemographic factors like gender and race. This will help identify any significant associations between categorical variables. For more complex relationships, complex samples logistic regression will be the primary statistical method used to assess the influence of multiple independent variables on binary outcomes such as whether a respondent has been diagnosed with depression or anxiety. This technique is particularly useful because it can handle multiple predictors simultaneously, including demographic factors (e.g., gender, income, education) and perceptions of climate change. Logistic regression will allow for an estimation of odds ratios, which will indicate the likelihood of a mental health diagnosis given different levels of climate change concern, while controlling for potential confounding variables. This analysis will provide a clearer understanding of how climate change perceptions may contribute to mental health outcomes, accounting for other sociodemographic factors that could influence these

relationships. To ensure the robustness of the findings, the study will also address potential confounding variables. These include factors such as gender, race, marital status, and income, which could affect both mental health and climate change perceptions. By controlling for these variables in the regression models, the analysis will provide a more accurate estimate of the relationship between climate change perceptions and mental health outcomes. Additionally, sensitivity analyses will be conducted to check for the stability of the results across different subgroups (e.g., male vs female). The ultimate goal of this analysis is to offer actionable insights into how climate change may impact public health, particularly among vulnerable populations.

### Ethical Consideration

Ethical procedure is important for public health research. This study received IRB approval from Walden University with approval number 01-21-25-1188599.

## Results

### Sociodemographic Characteristics by Gender

Table 1 presents sociodemographic characteristics by gender. The mean age for males was 56.76 ± 17.11 years, while for females it was 55.97 ± 17.34 years. Regarding employment status, 54.92% of males were employed compared to 48.24% of females, while 45.08% of males were unemployed, compared to 61.76% of females. In terms of marital status, 60.26% of males were married, compared to 45.79% of females, and 19.96% of males were single, compared to 35.37% of females. Among divorced or separated individuals, 19.78% of males reported being divorced, compared to 18.84% of females. Regarding educational attainment, 30.50% of males had less than post-high

school education, compared to 33.19% of females, while 29.54% of males were college graduates, compared to 26.41% of females. A similar pattern was observed for post-graduate education, with 19.43% of males versus 18.60% of females. In terms of sexual orientation, 92.73% of males identified as heterosexual, compared to 91.88% of females, while 7.27% of males identified as non-heterosexual, compared to 8.12% of females. In terms of income, 36.89% of males earned less than $50,000, compared to 48.10% of females. For those earning between $50,000 and $99,999, 31.44% of males were in this range, compared to 28.49% of females, while 31.67% of males earned more than $100,000, compared to 23.41% of females. Regarding mental health, 19.14% of males reported experiencing depression or anxiety, compared to 31.30% of females. Similarly, 30.57% of males reported experiencing worry, compared to 41.16% of females. In terms of climate change awareness, 73.98% of males reported being knowledgeable, compared to 81.32% of females.

**Table 3**

*Attributes of the HINTS-6 Population based on Gender*

| **Characteristics** | **Gender** | |
|---|---|---|
| | Male<br>*N* (%) | Female<br>*N* (%) |
| **Age (Mean±*SD*)** | 56.76±17.11 | 55.97±17.34 |
| **Employment** | | |
| **Yes** | 1256 (54.92) | 1690 (48.24) |
| **No** | 1031 (45.08) | 1813 (51.76) |
| **Marital status** | | |
| **Married** | 1374 (60.26) | 1599 (45.79) |
| **Not married** | 455 (19.96) | 1235 (35.37) |
| **Divorced/Widowed/Separated** | 451 (19.78) | 658 (18.84) |
| **Education** | | |
| **<Post high school** | 697 (30.50) | 1160 (33.19) |
| **Some college** | 469 (20.53) | 762 (21.80) |
| **College graduate** | 657 (29.54) | 923 (26.41) |
| **Postgraduate** | 444 (19.43) | 650 (18.60) |

| | | |
|---|---|---|
| **Sexual orientation** | | |
| **Heterosexual** | 2078 (92.73) | 3125 (91.88) |
| **Not heterosexual** | 163 (7.27) | 276 (8.12) |
| **Annual income** | | |
| **<$49,999** | 806 (36.89) | 1582 (48.10) |
| **$50,000- $99,999** | 687 (31.44) | 937 (28.49) |
| **>$100,000** | 692 (31.67) | 770 (23.41) |
| **Depression & anxiety** | | |
| **Yes** | 436 (19.14) | 1090 (31.30) |
| **No** | 1842 (80.86) | 2392 (68.70) |
| **Worry** | | |
| **Yes** | 693 (30.57) | 1428 (41.16) |
| **No** | 1574 (69.43) | 2041 (58.84) |
| **Climate awareness** | | |
| **Yes** | 1447 (73.98) | 2382 (81.32) |
| **No** | 509 (26.02) | 547 (18.68) |

**Sociodemographic Characteristics by Diagnosis of Depression or Anxiety**

Table 2 presents sociodemographic attributes related to the diagnosis of depression or anxiety by gender. Among employed individuals with depression or anxiety, 47.94% of males and 48.25% of females reported being employed. Regarding marital status, 52.30% of males and 41.53% of females with depression or anxiety were married, while 21.89% of males and 35.73% of females with depression or anxiety were single. For those who were divorced or separated, 25.81% of males and 22.74% of females with depression or anxiety reported this status. Educational attainment in relation to depression or anxiety showed that 30.11% of males with depression or anxiety had less than post-high school education, compared to 32.97% of females. A similar pattern was observed for some college (23.68% of males vs. 22.19% of females) and college graduate education (28.74% of males vs. 26.80% of females), while post-graduate education was slightly higher in females (18.05% for females vs. 17.47% for males). Regarding sexual orientation, 84.62% of males and 86.13% of females with depression or anxiety identified as heterosexual, while 15.38% of males and 13.87% of females identified as non-

heterosexual. In terms of annual income, 46.21% of males and 51.00% of females with depression or anxiety earned less than $50,000, while 25.12% of males and 27.26% of females earned between $50,000 and $100,000. Among those with incomes greater than $100,000, 28.67% of males and 21.73% of females reported depression or anxiety. Regarding climate change awareness, 79.00% of males and 87.01% of females with depression or anxiety reported awareness of climate change, while 21.00% of males and 12.99% of females reported no awareness.

**Table 2**

*Sociodemographic attributes of HINTS-6 based on Depression or Anxiety by Gender*

| **Characteristics** | **Gender** | | | | | |
|---|---|---|---|---|---|---|
| | Male | | | Female | | |
| | Yes | No | *p*-Value | Yes | No | *p*-Value |
| | *N* (%) | | | | *N* (%) | |
| **Employment** | | | .0013 | | | .9506 |
| **Yes** | 209 (47.94) | 1037 (56.48) | | 525 (48.25) | 1155 (48.37) | |
| **No** | 227 (52.06) | 799 (43.52) | | 563 (51.75) | 1233 (51.63) | |
| Marital status | | | .0003 | | | <,0001 |
| Married | 227 (52.30) | 1140 (62.26) | | 451 (41.53) | 1143 (48.01) | |
| Not married | 95 (21.89) | 353 (19.28) | | 388 (35.73) | 831 (34.90) | |
| Divorced/widowed/separated | 112 (25.81) | 338 (18.46) | | 247 (22.74) | 407 (17.09) | |
| Education | | | .2830 | | | .9349 |
| <Post high school | 131 (30.11) | 561 (30.57) | | 358 (32.97) | 790 (33.17) | |
| Some college | 103 (23.68) | 363 (19.78) | | 241 (22.19) | 516 (21.66) | |
| College graduate | 125 (28.74) | 546 (29.75) | | 291 (26.80) | 627 (26.30) | |
| Postgraduate | 76 (17.47) | 365 (19.89) | | 196 (18.05) | 449 (18.85) | |
| Sexual orientation | | | <.0001 | | | <.0001 |
| Heterosexual | 363 (84.62) | 1704 (94.61) | | 919 (86.13) | 2187 (94.68) | |
| Not heterosexual | 66 (15.38) | 97 (5.39) | | 148 (13.87) | 123 (5.32) | |
| Annual income | | | <.0001 | | | .0562 |
| <$49,999 | 195 (46.21) | 605 (34.57) | | 535 (51.00) | 1033 (46.59) | |
| $50,000- $99,999 | 106 (25.12) | 578 (33.03) | | 286 (27.26) | 644 (29.05) | |
| >$100,000 | 121 (28.67) | 567 (1750) | | 228 (21.73) | 540 (24.36) | |
| **Climate awareness** | | | .0122 | | | <.0001 |
| **Yes** | 301 (79.00) | 1138 (72.72) | | 804 (87.01) | 1560 (78.71) | |
| **No** | 80 (21.00) | 427 (27.28) | | 120 (12.99) | 422 (21.29) | |

**Univariate Estimate for Climate Change Awareness and Depression or Anxiety by Gender**

Table 3 presents both crude and adjusted odds ratio (OR) estimates for the relationship between climate change awareness and depression or anxiety by gender.

Age: Males had a crude OR of 0.988 (CI: 0.982–0.994), and females had an OR of 0.977 (CI: 0.972–0.981).

Employment: The odds of being employed versus unemployed were higher for males (OR = 1,410, CI: 1.143- 1.738), but higher for females (OR = 1.005, CI: 0.870-1.160).

Marital Status: Single males compared to married had higher odds of depression or anxiety (OR = 1.352, CI: 1.034- 1.766)), as did females (OR = 1.183, CI: 1.006- 1.392)). For those who were divorced compared to those who were married, males had an OR of 1.665 (CI: 1.288- 2.152), while females had an OR of 0.730 (CI: 0.583–0.914).

Education: Males with less than post-high school education had a higher odds ratio (OR = 1.301, CI: 0.925–1.830) compared to post-graduates, while females had a lower OR (1.026, CI: 0.811–1.299).

Sexual orientation: Non-heterosexual males had an OR of 3.237 (CI: 2.253–4.651), while non-heterosexual females had an OR of 3.509 (CI: 2.639–4.666).

Income: Males with an income less than $50,000 compared to >$100,000 had an OR of 1.590 (CI: 1.210–2.088), while females had an OR of 1.326 (CI: 1.084–1.622).

Worry: Males who reported being worried compared to those with no worry had an OR of 5.734 (CI: 4.587- 7.168), while females had an OR of 4.426 (CI: 3.797- 5.158).

Climate Change Awareness: Males with knowledge of climate change compared to those without climate change awareness had an OR of 1.412 (CI: 1.077- 1.850), while females had an OR of 1.812 (CI: 1.455- 2.258).

**Table 3**

*Univariate and Multivariate Analysis for Climate Change Awareness, Covariates and Depression or Anxiety by Gender*

| Dependent variable | Odds ratio | | | |
|---|---|---|---|---|
| | Crude (95% CI) | | Adjusted (95% CI) | |
| | *M* | *F* | *M* | *F* |
| Age | 0.988 (0.982- 0.994) | 0.977 (0.972- 0.981) | 0.983 (0.974- 0.992) | 0.975 (0.968- 0.981) |
| Employment | | | | |
| Yes | 1,410 (1.143- 1.738) | 1.005 (0.870-1.160) | 0.560 (0.408- 0.769) | 0.588 (0.477- 0.725) |
| No | Reference | Reference | Reference | Reference |
| Marital status | | | | |
| Married | Reference | Reference | Reference | Reference |
| Not married | 1.352 (1.034- 1.766) | 1.183 (1.006- 1.392) | 1.447 (1.023- 2.048) | 1.764 (1.397- 2.227) |
| Divorced/widowed/separated | 1.665 (1.288- 2.152) | 1.538 (1.269- 1.864) | 0.884 (0.626- 1,250) | 1.261 (0.979- 1.624) |
| Education | | | | |
| <Post high school | 1.301 (0.925- 1.830) | 1.135 (0.901- 1.431) | 1.018 (0.681- 1.522) | 0.900 (0.679- 1.192) |
| Some college | 1.357 (0.941- 1.956) | 1.150 (0.896- 1.475) | 1.019 (0.671- 1.547) | 0.998 (0.749- 1.329) |
| College graduate | 1.250 (0.893- 1.749) | 1.026 (0.811- 1.299) | 1.067 (0.738- 1.541) | 0.942 (0.727- 1.221) |
| Postgraduate | Reference | Reference | Reference | Reference |
| Sexual orientation | | | | |
| Heterosexual | Reference | Reference | Reference | Reference |
| Not heterosexual | 3.237 (2.253- 4.651) | 3.509 (2.639- 4.666) | 2.449 (1.613- 2.720) | 2.302 (1.672- 3.169) |
| Annual income | | | | |
| <$49,999 | 1.590 (1.210- 2.088) | 1.326 (1.084- 1.622) | 1.094 (0.759- 1.578) | 0.964 (0.733- 1.268) |
| $50,000- $99,999 | 0.850 (0.627- 1.151) | 1.012 (0.808- 1.266) | 0.754 (0.537- 1.061) | 0.866 (0.671- 1.118) |
| >$100,000 | Reference | Reference | | Reference |
| Worry | | | | |
| Yes | 5.734 (4.587- 7.168) | 4.426 (3.797- 5.158) | 5.201 (4.024- 6.722) | 3.766 (3.145- 4.510) |
| No | Reference | Reference | Reference | Reference |
| Climate awareness | | | | |
| Yes | 1.412 (1.077- 1.850) | 1.812 (1,455- 2,258) | 1.036 (0.764- 1.405) | 1.294 (1.010- 1.658) |
| No | Reference | Reference | Reference | Reference |

## Multivariate Estimate for Climate Change Awareness and Depression or Anxiety by Gender

Age: Males had an adjusted OR of 0.983 (CI: 0.974–0.992), and females had an OR of 0.975 (CI: 0.968–0.981) of reporting depression or anxiety.

Employment: The odds of reporting depression or anxiety for being employed compared to unemployed were significantly lower for both males (AOR = 0.560 (CI: 0.408- 0.769) and females (AOR = 0.588 (0.477- 0.725).

Marital Status: Males who were divorced compared to married had an adjusted OR of 0.884 (CI: 0.626- 1,250) of reporting depression or anxiety, while females had an OR of 1.261 (CI: 0.979- 1.624). Being single or not married compared to being married was associated with higher odds of reporting depression or anxiety for males (OR = 1.447, Ci: 1.023- 2.048) and females (OR = 1.764, CI: 1.397- 2.227).

Education: The odds ratios for educational attainment using postgraduate level as reference, were relatively similar between males and females, as they were not statistically significant.

Sexual orientation: Non-heterosexual individuals compared to heterosexual had higher odds of depression or anxiety, with males having an adjusted OR of 2.449 (CI: 1.613–2.720) and females having an adjusted OR of 2.302 (CI: 1.672–3.169).

Income: Males earning less than $50,000 compared to earning >$100,000 had an adjusted OR of 1.094 (CI: 0.759–1.578) of reporting depression or anxiety, and females had an adjusted OR of 0.964 (CI: 0.733–1.268).

Worry: Adjusted odds ratios for worry compared to no worry remained significantly higher for reporting depression or anxiety, with males having an adjusted OR of 5.201 (CI: 4.024- 6.722) and females having an adjusted OR of 3.766 (CI: 3.145- 4.510).

Climate Change Awareness: The odds depression or anxiety for those climate change awareness compared to those without were significantly higher for both males (AOR = 1.036 (CI: 0.764- 1.405) and females (AOR = 1.294 (CI: 1.010- 1.658).

## Discussion

The current study investigates the relationship between climate change awareness and depression or anxiety, with a particular focus on gender differences within the U.S. population. The results provide critical insights into how various sociodemographic factors, such as age, employment, marital status, education, income, and sexual orientation, interact with mental health outcomes in the context of climate change awareness. A significant contribution of this study is its identification gender differences and the significant role of sociodemographic factors mediating the mental health implications of climate change. Hence, offering valuable information for future mental health and environmental policy.

### Sociodemographic Variables and Mental Health Disparities

The study findings which is based on the sociodemographic differences revealed several important trends that contribute to understanding the mental health disparities between males and females. First, age emerged as a significant factor affecting the odds of depression or anxiety, with older individuals in both genders demonstrating lower odds of mental health issues. The crude odds ratios for age indicate a slight reduction in the likelihood of depression or anxiety with increasing age, with males showing a marginally stronger protective effect (OR = 0.988) than females (OR = 0.977). These findings are consistent with other studies that suggest older individuals tend to experience lower

levels of anxiety and depression. This may be because, over time, they develop stronger coping skills and better emotional regulation. This finding is supported by literature which explored emotional regulation changes across age, and noted that older adults engage in more adaptive emotion regulation strategies, such as reappraisal, to manage daily emotional experiences (Livingstone & Isaacowitz, 2021). In particular, older populations may be more accustomed to navigating stressors, and this resilience could extend to dealing with eco-anxiety, which has been shown to affect younger individuals more intensely (Cianconi et al., 2020; Clayton, 2021; Hickman et al., 2021).

However, while the adjusted odds ratios confirm a slight continued protective effect of age for both males (AOR = 0.983) and females (AOR = 0.975), it is evident that age alone does not provide sufficient protection against climate change-induced mental health distress. This intricate understanding portrays the complexity of mental health outcomes, where resilience could be influenced by factors other than age, in the form of social support, prior mental health history, and environmental exposure (Kirkbride et al., 2024). Nonetheless, while age appears to offer a protective effect, it is essential to consider that older population may also experience other adverse stressors, such as physical health decline, which could exacerbate mental health conditions (Kang & Kim, 2022).

Employment status is a key determinant of mental health, with significant differences between males and females. This study shows that females were more likely to be unemployed (61.76%) than males (45.08%). The crude OR suggests that employed males were significantly more likely to report depression or anxiety, whereas the same

variable in females was not significant. This disparity highlights gender inequities in the labor market, where men may be exposed to less financial pressure or social stigma related to unemployment compared to women, who encounter gender-specific challenges that make it harder for them to find and maintain employment (Lwamba et al., 2022). This is consistent with existing research indicating that women often face structural barriers to full employment, including the gender pay gap, gendered caregiving roles, and workplace discrimination (Foley & Cooper, 2021; Hennein et al., 2023; Naguib & Madeeha, 2023).

Interestingly, after adjusting for confounders, both males and females showed lower odds of experiencing depression or anxiety when employed, highlighting that the mental health impact of unemployment is compounded by both socio-economic and environmental factors such as climate change (Nie et al., 2024). Unemployment, a known risk factor for depression and anxiety, disproportionately affects women in the context of this study. The association between unemployment and mental health is well-documented, as job loss frequently results in factors that can significantly contribute to mental distress like financial instability, reduced social interactions, and a weakened sense of purpose (Achdut & Refaeli, 2020). Similarly, these findings are consistent with the literature, that emphasized the protective function of job status in providing financial stability, social identity, and regularity, all of which reduce depression and anxiety (Blomqvist et al., 2023; Ryu & Fan, 2023). This may emphasize the significance of policies that prioritize not only job related growth and development, but also public

health related infrastructure in the of mental health care, particularly during periods of economic uncertainty caused by climate-related disturbances.

Marital status also showed notable sex differences in terms of mental health outcomes. In terms of prevalence, both males and females who were unmarried reported higher levels of depression and anxiety. Similarly, this study analysis found that marital status remained a significant predictor of mental health outcomes, with married participants reported lower odds of depression or anxiety. The crude OR for unmarried males and females indicates that both genders experience a mental health benefit from marital stability (Grundström et al., 2021). This reflects the broader literature on gender and mental health, where the burden of caregiving and household responsibilities often disproportionately affects women, even within marital relationships (Pacheco Barzallo et al., 2024). Additionally, unmarried individuals (both male and female) showed higher odds of depression or anxiety in the adjusted analysis, which might be related to the absence of social support in times of climate-related stress (Corvalan et al., 2022; Lawrance et al., 2022). In contrast, single males were less likely to report depression and anxiety than their female counterparts. This suggests that social support, possibly from friends or other family members, may mitigate the mental health risks associated with singlehood in men, whereas women may experience greater emotional vulnerability in the absence of a spouse (Umberson et al., 2022).

This is consistent with findings in the literature, which show that marital relationships provide important social and emotional support and protect people from stressors, including those related to climate change (Huang & Ma, 2024). Marriage, as a

form of social support, has been widely documented in the literature as a protective factor for mental health (Vaingankar et al., 2020). For males, the stability and emotional support that marriage provides likely buffers the psychological impact of stressors such as climate change, but for females, lower marriage and higher divorce rates may expose them to additional mental health risks. Divorced individuals often experience significant emotional distress, which may contribute to the observed higher rates of anxiety and depression among females in this category (Al-Shahrani & Hammad, 2023; Hald et al., 2023). These findings underscore the importance of marital support structures in mediating the mental health effects of environmental stressors like climate change.

Education and income findings provides further insight into how socio-economic factors influence climate change perceptions and mental health. Education level was another significant factor influencing mental health outcomes, as males with lower education levels (less than high school) showed a significantly higher OR for depression or anxiety. Specifically, individuals with less than a post-high school education reported higher rates of depression and anxiety, which is consistent with existing studies linking lower educational attainment with poorer mental health outcomes (Taple et al., 2022). This aligns with the well-established link between lower educational attainment and worse mental health outcomes, including higher vulnerability to anxiety and depression (Taple et al., 2022). The adjusted analysis shows that males with some college education continue to report higher mental health risks compared to their postgraduate peers. This trend is consistent with evidence in the literature highlighting that education influences access to resources, coping strategies, and overall health literacy, all of which have a

moderating effect on the psychological impacts of climate change (Ogunbode et al., 2022; Raile, 2023). Among females, the association between education and mental health is less strong, with the odds ratio for lower education being 1.026. This suggests that, while education remains an important factor, its effect on mental health may be influenced by other mediating variables, such as income and marital status, which affect education in complex ways (Kirkbride et al., 2024; Raghupathi & Raghupathi, 2020). These mental health disparities by education level may reflect differences in access to resources, coping strategies, and general life stressors, including climate-related anxiety.

Income plays a critical role in shaping mental health outcomes, particularly in response to climate change-related stress. Income disparities were similarly significant, with females who earned less than $50,000 annually experiencing higher rates of depression and anxiety than their male counterparts. Males with an income of less than $50,000 had an increased OR for depression and anxiety, as did females. However, the adjusted odds ratios for income show that the association between low income and mental health is less pronounced for females compared to males, indicating that additional contextual factors may influence the mental health impact of income disparities for women (Arena et al., 2022; Tibber et al., 2022). These results support existing literature that links lower income levels with heightened vulnerability to mental health issues, as individuals with limited financial resources often experience greater exposure to climate-related stressors, such as economic displacement, food insecurity, and poor housing (Kirkbride et al., 2024; Vafeiadou et al., 2023). This suggests that mental health interventions should focus on reducing economic inequalities to help

alleviate the mental health burden of climate change, particularly for low-income populations. These findings support the well-established link between financial insecurity and mental health distress (Guan et al., 2022; Ryu & Fan, 2023). Economic hardship may exacerbate anxiety and depression, especially among women who are more likely to experience income inequality and economic vulnerability (Zare et al., 2022), highlighting the need for policies that address income inequality and promote economic stability, especially for women, in order to reduce mental health disparities.

Sexual orientation is an important determinant of mental health outcomes, with non-heterosexuals experiencing significantly higher odds of depression and anxiety. Non-heterosexual males and females reported significantly three times higher mental health risks than their heterosexual counterparts. These findings support extensive research documenting mental health disparities experienced by sexual minorities, who experience higher levels of discrimination, marginalization, and social stress (Malik et al., 2023; Moagi et al., 2021). This discernible vulnerability is of particular concern in the context of climate change awareness, as sexual minorities may also face additional climate-related stressors, such as displacement, lack of social support, and healthcare access disparities (Berberian et al., 2022; Daraz et al., 2024). Given these findings, it is essential that climate change related mental health interventions should consider the unique experiences of sexual minority individuals, providing tailored support that addresses both the emotional and environmental challenges they face.

**Climate Change Awareness and Mental Health**

The main objective of this study was to examine the association between climate change awareness and mental health problems, particularly depression and anxiety. Table 1 shows that climate change awareness is positively correlated with mental health problems in both men and women. In the context of the eco-anxiety literature, this may suggest that being aware of climate change and its potential impacts may yield higher levels of stress and anxiety (Clayton, 2021). This is particularly relevant given the increasing media coverage of climate change-related disasters and growing public awareness of the environmental crisis. For females, the higher rates of climate change awareness (81.32%) may explain their heightened levels of anxiety and depression compared to males (73.98%).

Interestingly, when examining the odds ratios for the relationship between climate change awareness and depression or anxiety, it was observed that males, despite being less aware of climate change, exhibited lower odds of mental health issues. Conversely, females with climate change awareness still had higher odds of depression and anxiety, suggesting that awareness and emotional response to climate change may be more impactful for females. Thus, both the crude and adjusted odds ratios demonstrated that individuals with knowledge of climate change have significantly higher odds of depression or anxiety, particularly significant among females compared to males. This finding reflects gendered differences in coping strategies and emotional responses to environmental threats (Clayton et al., 2023; Kovács et al., 2024). Hence, the study finding reflects that greater awareness of climate change, while important for motivating

action, may also heighten anxiety and distress, particularly among women who have been shown to internalize environmental issues more deeply than men (Innocenti et al., 2023; Qin et al., 2024; Vercammen et al., 2023). These findings highlights the significance for interventions that not only raises awareness about climate change, but also with the ability to provide tools to manage the associated emotional and psychological impacts. This approach could help reduce environmental anxiety, especially among more vulnerable groups such as women and those with lower socioeconomic status.

**Worry as a Mediator**

The role of worry as a mediator between climate change awareness and mental health was also an important aspect of the study. Worry is a significant psychological response to climate change awareness, and it is strongly associated with increased odds of depression and anxiety. Males who reported feeling worried about climate change were significantly less likely to experience depression or anxiety. Women, however, were more likely to report worry and, consequently, higher levels of depression and anxiety. This suggests that women may be more emotionally impacted by climate change, possibly due to a combination of socialization, gender roles, and greater empathy for environmental and social justice issues (Giudice et al., 2021). The crude odds ratios show that males who reported being worried about climate change had five times higher odds of depression or anxiety, as did females with four times the odds of depression or anxiety. The adjusted analysis reinforces this finding, with males and females who reported worry continuing to show higher odds of depression and anxiety. This supports research that links worry with increased vulnerability to mental health distress, particularly in the

context of existential threats like climate change (Corvalan et al., 2022; Kirkbride et al., 2024). Hence, highlighting the importance to address worry as a central component of climate change-related mental health interventions, especially among participants with perceived high levels of anxiety about environmental issues (Cosh et al., 2024; Ogunbode et al., 2022). Hence, reducing worry through targeted mental health interventions could be an effective strategy for mitigating climate change-related mental health distress. Thus, findings aligns with the understanding that worry often leads to emotional distress, and individuals who are more prone to ruminate on environmental issues may be more vulnerable to climate-related anxiety (Ballew et al., 2024; Cosh et al., 2024; Ogunbode et al., 2022).

**Coping Mechanisms and Gender Differences**

These gender differences noted from this study regarding worry and mental health outcomes may reflect broader differences that exists in relation to coping strategies among males and females. Similarly in tandem with the literature, studies have shown that males were more likely to use problem-focused coping mechanisms, whereas females were more likely to engage in emotion-focused coping (Avramut et al., 2023; Cholankeril et al., 2023). The higher levels of anxiety and depression among females may thus be partially explained by their tendency to internalize their concerns, while males may be more likely to engage in active problem-solving or distancing themselves emotionally from distressing topics (Avramut et al., 2023). Furthermore, the socialization style of males and females may explain the different emotional roles that could be

exacerbated due to the gendered response triggered by climate-related anxiety (Clayton et al., 2023; Goudet et al., 2024; Kovács et al., 2024).

**Policy and Public Health Implications**

The findings of this study hold important implications for public health and policy. The significant differences in mental health outcomes between males and females highlight the need for gender-sensitive approaches to climate change-related mental health interventions. As women are more likely to experience more exaggerated level of eco-anxiety, it is essential that mental health professionals provide targeted support, including developing coping strategy techniques to manage anxiety and stress related to climate change. Furthermore, future public health education aimed at increasing climate change awareness levels should consider the essence and need for resilience and coping strategy techniques, especially among individuals with mental health concern.

**Limitations and Future Directions**

Despite the strengths shown from this study, there are several limitations. The cross-sectional design of this study limits the ability to infer causality between climate change awareness and mental health outcomes. Thus, further longitudinal studies are needed to explore the long-term impacts of climate change on mental health and to investigate potential causal pathways. Furthermore, the reliance on self-reported data introduces the potential for bias, particularly in relation to sensitive issues such as mental health related information and climate change concerns. Future research should aim to include objective measures of mental health and explore the impacts of direct climate-related events, such as natural disasters, on mental health outcomes.

## Recommendations

### *Individual Level*

At the individual level, public health interventions should focus on improving coping strategies that can improve and protect the mental health for those affected by climate change awareness, particularly among women. Cognitive-behavioral therapy (CBT) and mindfulness-based interventions could be effective in helping individuals manage climate-related anxiety and stress. Furthermore, improving climate literacy through community-based educational programs could empower individuals to feel more in control and reduce feelings of helplessness and worry.

### *Interpersonal Level*

Interpersonal relationship is vital for socialization and stable psychological homeostatsis. Developing and expanding social support networks, especially for people who are unemployed or experiencing economic hardship, can help mitigate the impact of climate change awareness on mental health. Support groups that address both climate anxiety and mental health can help create a sense of community and shared experience. These groups could also offer strategies for managing worry and building resilience.

### *Organizational Level*

At the Organizational level, big corporate industries and other medium scaled employers should consider, and be encouraged to integrate mental health support into their workplace policies, especially in industries vulnerable to climate change impacts. Providing mental health resources, promoting flexible working hours, and encouraging open conversations about climate-related stressors can reduce the burden of eco-anxiety

on employees, especially women, who are more likely to face mental health challenges related to employment status.

### *Community Level*

Community oriented interventions should prioritize creating enabling environments for dialogue and conversations on climate change awareness and its implication on mental health. By offering educational workshops and creating safe spaces for individuals to share their experiences and concerns about climate change, communities can help normalize climate anxiety and encourage collective action. Local governments, non-governmental organizations (NGOs) and community actors need to work together to create and implement mental health initiatives and ensure that men and women have equal access to support.

### *Policy Level*

The importance of policy in public health is undeniable. It is crucial to integrate mental health issues into climate change policy. Governments should consider funding programmes to combat eco-anxiety and provide mental health services to those affected by environmental stressors. In addition, policies to reduce gender inequalities in the workforce, health care, and education can help alleviate the mental health burden experienced by women in particular. Policies that curbs the impacts of climate change awareness on vulnerable groups, such as low-income women, must also be prioritized.

## Implications for Positive Social Change

The study findings highlight the need and importance for a holistic approach to climate change that considers not only environmental issues, but also the social and

psychological well-being of those affected. By integrating mental health support into community climate change policies and initiatives, society can foster resilience and promote positive social change. Helping people cope with eco-anxiety can help build more resilient, mentally healthy communities where people are able to take action rather than succumb to stress. Educational institutions should include climate change awareness and its psychological impacts as part of their curricula. By educating students early on about both the scientific aspects of climate change and the emotional responses to it, schools can help foster a generation of climate-conscious individuals who are also equipped with the tools to manage their mental health. Mental health education programs should be expanded to include content on eco-anxiety and its effects. Public health campaigns should focus on increasing awareness about on the psychological impacts of climate change, particularly for vulnerable populations. These campaigns are great avenue towards providing the resources and information on how to cope with eco-anxiety and locations they can seek help. By increasing public the knowledge and understanding of the emotional toll of climate change, these campaigns can reduce stigma and promote mental well-being. On a global scale, climate change interventions should incorporate mental health support as an integral component of climate action. Additionally, International organizations, such as the United Nations and the World Health Organization, could play a vital role in advocating for policies that should address both environmental and mental health challenges. These efforts should focus on creating a global framework for mental health in the context of climate change and its awareness, with specific attention to gendered experiences.

## Conclusion

In conclusion, findings from this study highlights a strong association between climate change awareness and depression and anxiety, with significant gender differences. While greater awareness of climate change can spur positive environmental action, it may also deteriorate mental health challenges, particularly among females and other vulnerable groups. Hence, emphasizing the importance of gender, socio-economic factors, and emotional responses, such as worry, when developing mental health interventions related to climate change. Hence, as climate crisis continues to decline, it is imperative to address these sociodemographic attributes and mental health related concerns as part of the broader public health and social policy efforts, particularly in reducing inequities and fostering resilience in affected communities. Finally, the recommendations from this study based on the social ecological model can aid in the mitigation of mental health impacts of climate change awareness and build a healthier, more resilient society among affected populations.

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# Manuscript 3: The Relationship Between Climate Change Awareness and Worrying Among the U.S. Population

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## Outlet for Manuscript

A suitable target journal for a manuscript exploring the relationship between climate change and mental health is **Global Environmental Change**. This journal can be accessed online at Global Environmental Change and follows the APA (American Psychological Association) formatting style.

Global Environmental Change emphasizes the human dimensions of environmental change and its associated impacts, making it an ideal venue for discussing the intersection of climate change and mental health. The journal promotes interdisciplinary research, which is crucial for tackling the complex issues surrounding how climate change influences mental well-being. Additionally, the articles published in this journal frequently examine policy implications, social impacts, and behavioral responses, aligning seamlessly with discussions about mental health in the context of climate-related stressors.

## Abstract

It is imperative to understand that specific relationship between climate change awareness, it impact on the environment and relationship with mental health. Nevertheless, more research is urgently needed in this area — particularly within the American context. The mental health consequences of climate change are still being explored, and this study aims to explore the relationship between awareness and worry about climate change among U.S. adults. The Social Ecological Model (SEM) offers a comprehensive perspective to analyze the relationship between climate change knowledge and mental health by including individual, interpersonal, community, and societal variables. The HINTS-6 data— a quantitative, cross-sectional, NCI multi-stage survey— were used to examine the relationship using multiple statistical methods (i.e., regression models) between cancer risk factors, communication, and health literacy. Conclusion: Results show that environmental concern (both as a dependent variable and as an independent variable) has an adjusted odds ratio of (1.677, CI: 1.422-1.978) for climate change, while climate change itself has an adjusted odds ratio of (2.822, CI: 1.088-7.347) for environmental concern. Differences concerning sexual orientation amount to those who are not heterosexual (adjusted OR 1.916 (CI = 1.516- 2.421), reflecting higher worry. This study shows a significant relationship between increased perception to Climate Change and higher worring to US population. Awareness of climate change can be detrimental to mental health, but on the flip side, a space for transformation can occur with collective action and climate literacy which can reframe eco-anxiety as eco-action that empowers communities.

## Introduction

The World Health Organization (WHO) estimated that climate change could cause an additional 250,000 deaths per year between 2030 and 2050 due to malnutrition, malaria, diarrhea, heat stress and mental health related concerns (WHO, 2023). Thus far, awareness and knowledge of this public health burden remains poorly documented especially in relation to mental health concerns. Climate anxiety describes the emotional and psychological weight that people feel as they grapple with rising concerns about climate change and the uncertainty surrounding its future (Cianconi et al., 2020; Daeninck et al., 2023; Dodds, 2021). The literature reveals an emerging consensus regarding the detrimental psychological effects of climate change, highlighting the urgency for targeted research and intervention strategies (Cianconi et al., 2020; Vafeiadou et al., 2023; White et al., 2023). With extreme weather events and climate crises becoming more common, there has been increased prevalence of feelings of hopelessness and despair (Cianconi et al., 2020; White et al., 2023). As the climate crisis intensifies, its repercussions extend beyond environmental degradation and economic disruption, manifesting significantly in the mental health of vulnerable populations, particularly young individuals (Cianconi et al., 2020; Corvalan et al., 2022). Evidence in the literature suggests that adolescents in the marginal communities were more prone to symptoms of anxiety and worry attributable to climate change (Aylward et al., 2024). Similarly, studies have shown that over 70% of young participants reported experiencing at least mild levels of negative emotions such as sadness, anger, worry, anxiety, concern, helplessness, hopelessness, or powerlessness in relation to climate change (Atherton,

2020; Léger-Goodes et al., 2022). Another specific study by Fertelli 2023 showed that nurses possess high level of climate change awareness with resultant considerable worry about its impact on public health like respiratory diseases and mental health disorders (Fertelli, 2023). However, there remains poor literature to replicate or refute these findings.

Despite the pervasive anxiety surrounding climate change, there exists a noteworthy theme of resilience and hope among youth (Brophy et al., 2023). The role of personal resilience through proactive engagement in climate action affects the level of climate anxiety positively (Aylward et al., 2024; Dodds, 2021). This proactive engagement fosters a sense of agency and control, counteracting feelings of helplessness and fear that often arise from awareness of the escalating climate crisis. When individuals take tangible steps to reduce their environmental impact or contribute to collective efforts, such as supporting renewable energy initiatives or engaging in local resilience-building projects, they experience a greater sense of empowerment. This empowerment, in turn, enhances personal resilience—helping individuals to cope more effectively with the emotional and psychological toll of climate change. Fertelli (2023) examined the emotional landscape of frontline health response nurses for climate change related health events, which revealed that while the nurses exhibited considerable worry about climate impacts, a significant proportion also expressed optimism regarding their capacity to effect change (Fertelli, 2023). These opposing experiences ie. Worry and optimism, mirrors the experiences of young individuals, as evidenced in Aylward et al.'s study, which found that youth not only grapple with distress but also seek avenues for

empowerment through advocacy and community engagement (Aylward et al., 2024). Alternatively, the findings regarding the perceptions of nurses highlights the role of healthcare professionals in addressing climate-related mental health challenges. Notably, the study further revealed relationship between climate change awareness, worry, and hope among nurses, pointing to the potential for these professionals to advocate for mental health interventions and education on climate issues (Aylward et al., 2024). However, there remains a paucity in the literature regarding the role of climate change awareness to the public health implication of mental health issues.

Evidence in the literature highlighted the role of gender and socioeconomic factors in shaping the mental health responses of young individuals to climate change (Cianconi et al., 2020; Clayton et al., 2023; Gislason et al., 2021; Goudet et al., 2024; Vercammen et al., 2023). Gender differences are important attributes in population and public health related research. Gender disparities were evident, with non-binary individuals and cisgender women reporting higher average levels of distress compared to cisgender men. Additionally, regional variations are further complicated the landscape, suggesting that youth in northern and urban areas may face more pronounced mental health challenges (Aylward et al., 2024). These results align with earlier research indicating a growing body of evidence regarding "climate anxiety" among young people (Clayton et al., 2023; Galway & Field, 2023). The concept of "climate anxiety" is further explored by Heeren et al. (2022), who found that 11.64% of participants reported frequent experiences of climate anxiety, often leading to functional impairments in daily life (Heeren et al., 2022). This pattern suggests that for some, the emotional responses to

climate change may shift from distress to maladaptive behaviors, impeding pro-environmental actions. This phenomenon, described as "eco-paralysis," indicates that high levels of climate anxiety may inhibit effective responses to climate issues (Heeren et al., 2022; Kovács et al., 2024). For instance, Daeninck et al. (2023) found that United Kingdom university students pursuing environmental degrees exhibited higher levels of climate anxiety compared to their peers, linking their emotional distress to future planning considerations (Daeninck et al., 2023). Similarly, Hajek and König (2022), noted varying levels of climate anxiety particularly among those already predisposed to mental health challenges in Germany, with younger individuals exhibiting higher levels (Hajek & König, 2022). Hence, suggesting that awareness of climate issues can precipitate anxiety and impact decision-making processes among youth. Additionally, the role of age has been implicated with regards to worry about climate change awareness as Qin et al. 2024 found that high school students show a stronger link between climate change worry and pro-environmental behavior compared to middle school students, suggesting that as adolescents mature, their emotional responses to climate change particularly anxiety become more closely tied to actions aimed at addressing environmental issues. (Qin et al., 2024). This is supported by Sciberras and Fernando's (2022) longitudinal study, which shows that concerns about climate change develop during adolescence and can influence both mental health and environmental activism into adulthood (Sciberras & Fernando, 2022).

A considerable body of literature emphasizes the vulnerability of younger populations to climate-related mental health challenges. For example, Gunasiri et al.

(2022) highlighted that Australian youth frequently experience eco-anxiety, characterized by feelings of worry, hopelessness, and a sense of powerlessness (Gunasiri et al., 2022). Their mixed-methods designed study revealed that while climate change awareness can foster feelings of optimism and agency, it also cultivates significant mental health burdens. Lykins et al. (2023) provide a similar perspective, showing that following the Black Summer bushfires in Australia, young people exhibited higher levels of anxiety, stress, and climate change distress (Lykins et al., 2023). Hence, indicating a relationship between direct exposure to climate-related disasters and worsening mental health outcomes. On the other hand, Ediz and Yanik (2023) explored the dynamics of climate anxiety and hopelessness among Turkish youth, revealing that climate activists exhibited significantly higher levels of anxiety compared to non-activists (Ediz & Yanik, 2023). This suggests that the engagement with climate change related issues may intensify emotional responses, pointing to the complex relationship between awareness, advocacy, and mental well-being. Moreover, Chou et al. (2023) emphasized the importance of socio-economic backgrounds in shaping perceptions and engagement levels regarding climate change among Brazilian youth (Chou et al., 2023). Another study by Chou et al. 2023 which utilized a qualitative study approach, revealed distinct profiles of climate engagement as unaware, disengaged, and engaged (Chou et al., 2023). Thus, further illustrating the influence of socio-economic conditions among youths' emotional responses to climate threats.

The increasing severity and frequency of climate change effects, including extreme weather events and rising temperatures, pose significant risks not only to

physical health but also to mental well-being. Individuals with pre-existing mental health conditions are particularly vulnerable to these stressors (Cianconi et al., 2020; Padhy et al., 2015). Recent research by Gebhardt et al. (2023) highlighted the nuanced relationship between climate change awareness and psychopathology, suggesting that the psychological impacts of climate change awareness may exacerbate existing mental health issues (Gebhardt et al., 2023). Evidence provided by Gebhardt et al. (2023) on a cohort of individuals with pre-existing mental health conditions revealed that awareness of climate change can elicit psychological symptoms such as anxiety and depression. Furthermore approximately 21% of participants reported mild anxiety symptoms linked to climate change awareness, while 11% experienced mild depressive symptoms. Notably, heightened levels of pre-existing anxiety and depression predicted increased climate change-related psychological symptoms (Gebhardt et al., 2023).

The psychological impacts of climate change represent a growing public health challenge, especially when compounded by other global crises, including environmental and biological threats (Corvalan et al., 2022; Padhy et al., 2015; Sciberras & Fernando, 2022; White et al., 2023). Considering that climate change contributes to a range of mental health issues, particularly among individuals directly affected by extreme weather events, these impacts are magnified by broader environmental stressors such as the loss of biodiversity and degradation of ecosystems, which not only threaten livelihoods but also disrupt individuals' sense of security and well-being (Cianconi et al., 2020; Walinski et al., 2023). The uncertainty of the future and the perceived lack of control over one's environment can lead to chronic stress and a sense of helplessness among communities

with socioeconomic vulnerabilities (Cooper et al., 2019; White et al., 2023). Thus, as climate change continues to worsen, it's likely that these mental health struggles will intensify, creating serious challenges for public health systems. Furthermore, the psychological impact of climate change is made even worse by the emergence of other global crises, especially biological threats like pandemics (Kumar et al., 2023; Obradovich et al., 2018). The COVID-19 pandemic, in particular, revealed the close relationship between environmental degradation, public health, and mental health. Lockdowns, social isolation, and economic disruptions created a widespread mental health crisis, adding layers of stress on top of already existing concerns about climate change (Lawrance et al., 2022). For instance, Lawrance et al. (2022) explored how young people in the UK respond to the dual challenges of climate change and the pandemic which revealed that while the pandemic primarily evoked feelings of isolation and anxiety, climate change was associated with emotions like guilt and anger (Lawrance et al., 2022). Emerging infectious diseases, which can be linked to climate-driven changes in ecosystems and biodiversity, create further biological risks that compound the psychological strain people experience due to environmental changes (Baker et al., 2022; Cianconi et al., 2020; Mora et al., 2022). For public health professionals, this convergence of crises calls for a more holistic approach to mental health care one that not only responds to the immediate physical consequences of climate change and biological threats but also offers robust psychological support to help individuals cope with these interconnected challenges.

The global discourse on climate change increasingly highlights not only its environmental and economic impacts but also its psychological repercussions (Corvalan et al., 2022; Saab, 2023; White et al., 2023). As climate change continues to reshape the planet, it engenders feelings of worry, particularly among younger populations. Recent studies indicate that climate change worry may significantly influence mental health and pro-environmental behaviors, with varying implications based on factors like age, self-perception, and societal engagement (Qin et al., 2024). The increasing frequency of climate-related disasters and their psychological toll on individuals have prompted investigations into its effects on mental health. Hence, Reyes et al. (2023) noted a significant relationship between climate change and related worry of the event among Gen-Z Filipinos, and highlighted the considerable variance in psychological distress (Reyes et al., 2023). This aligns with findings from Schwaab et al. (2022), who identified a heightened risk of mental health problems in medical students aware of climate change implications (Schwaab et al., 2022). The anxiety stemming from climate change is not merely an abstract worry; it manifests in tangible mental health outcomes. Another study by Qin et al. (2024) explored the mediating factor of future self-continuity (extent to which individuals perceive their future) into the psychological mechanisms linking climate change worry and pro-environmental behavior among adolescents (Qin et al., 2024). Their study revealed that adolescents with a strong sense of future self-continuity were more likely to engage in pro-environmental behavior, suggesting that fostering a sense of continuity between one's present actions and future consequences may mitigate the negative effects of climate change worry (Qin et al., 2024).

Coping strategies have emerged as critical factors in mitigating climate anxiety. Evidence in. the literature highlighted that United Kingdom environmental students who employed problem-focused coping mechanisms were more likely to incorporate climate considerations into their future planning (Daeninck et al., 2023). The authors suggested that fostering effective coping strategies can buffer against the negative mental health impacts of climate change, providing a sense of agency in an uncertain future (Daeninck et al., 2023). This finding resonates with Thomson and Roach (2023), who noted that greater nature connectedness was associated with reduced climate worry and increased psychological resilience (Thomson & Roach, 2023). They argue that individuals who feel a connection to nature were more likely to engage in climate action, thus creating a feedback loop where action leads to reduced anxiety. Conversely, Nezlek and Cypryańska (2024) highlighted that climate change worry can lead to symptoms of mental disorders, complicating the narrative of adaptive versus maladaptive responses to climate awareness (Nezlek & Cypryańska, 2024). Thus, their study indicated that those experiencing high levels of climate change worry were more likely to report symptoms such as sleep disturbances and difficulty in daily functioning. This finding aligns with Sciberras and Fernando's (2022) longitudinal study, which found that adolescents with higher levels of worry about climate change also exhibited greater engagement in societal issues (Sciberras & Fernando, 2022). Their research suggested that worry may, paradoxically, serve as a catalyst for political engagement, highlighting the dual-edged nature of climate anxiety. However, there remains little or no evidence in the literature to support this relationship. Hence, my study objective is to explore the relationship

between climate change awareness and worry among Americans. We hypothesize that climate change awareness influences the level of worrying among adults in the United States controlling for age, gender, marital status and socioeconomic status.

### Hypothesis Test

Null Hypothesis (H0): There is no significant relationship between climate awareness and the level of worrying about climate change among adults in the United States controlling for age, gender, marital status and socioeconomic status.

Alternative Hypothesis (H1): There is a significant positive association with increased levels of worrying about climate change among adults in the United States controlling for age, gender, marital status and socioeconomic status.

## Methods

### Study Design

The HINTS-6 study uses a quantitative, cross-sectional design and relies on secondary data from the extensive dataset collected by the National Cancer Institute (NCI). The survey was carefully designed with strong statistical methods and reliable sampling techniques to ensure accuracy. In addition to assessing public access to health information, the HINTS-6 survey included questions focused on mental health, climate change concerns, and broader social factors affecting health. This makes the dataset especially useful for exploring how climate change awareness, mental health, and social conditions are connected, particularly in vulnerable populations. Along with assessing public access to health information, the HINTS 6 survey also included questions about mental health, concerns over climate change, and broader social factors that affect health.

This makes the dataset especially valuable for exploring how climate change awareness, mental health, and social conditions are interconnected, particularly among vulnerable groups. The secondary nature of the data means that no new participants were recruited for this specific study, but rather, existing data were analyzed to answer research questions related to climate anxiety and its potential relationship with mental health.

**Study Population**

The HINTS is a comprehensive, nationally representative survey administered by the NCI since 2003. HINTS gathers data from civilian, non-institutionalized adults aged 18 or older living in the United States. The survey's primary aim is to assess the American public's access to and utilization of health information, with a specific focus on cancer across the continuum of care prevention, early detection, diagnosis, treatment, and survivorship. The most recent round, HINTS-6, conducted from March 7 to November 8, 2022, included a goal of obtaining 7,000 completed questionnaires. The survey's focus areas are broad, ranging from health literacy and misinformation to social determinants of health and telehealth usage. The HINTS-6 study population was selected using a two-stage sampling design. For the first stage, a stratified sample of residential addresses across the United States was selected. This approach ensured diverse geographic and demographic representation, with an emphasis on capturing data from both urban and rural areas. The second stage involved the random selection of one adult per household using the Next Birthday Method, which is commonly used in household surveys to minimize bias. The sampling strategy for HINTS 6 also included oversampling of high minority populations, both in urban and rural areas, to ensure adequate representation of

these groups, which have historically been underrepresented in health research. The inclusion of rural communities was a novel aspect of the 2022 administration, with the aim of increasing rural participation in health data collection and addressing health disparities that may exist between urban and rural populations.

**Sample Size & Statistical Power**

The sample size for the HINTS-6 is very critical towards ensuring the study's statistical power and generalizability. The HINTS-6 survey aimed to collect 7,000 completed questionnaires, targeting a diverse group of civilian, non-institutionalized adults across the United States. Adequate representation sample of the population was achieved by utilizing a two-staged stratified sampling survey design. This sample size is considered large enough to detect meaningful differences and relationships in the data, particularly for exploring complex public health issues such as climate change anxiety and mental health. Considering the robust sample size, the HINTS-6 dataset provides a comprehensive insight to the relationship between climate change perceptions and mental health outcomes, offering statistical power to detect small to moderate effect sizes in the population. The large sample size for the dataset plays an essential role in detecting even small associations between different factors. In public health research, having enough statistical power is crucial for ensuring reliable and helpful findings. Thus, possible in helping to guide policy and intervention efforts (National Cancer Institute, 2022). The HINT-6 broad sample ensures that the study can capture differences across various demographic groups, including gender or urban-rural populations distribution, as well as different racial and ethnic communities. This is particularly important for understanding

health disparities and how social factors influence health outcomes. Power analysis for a sample of this size typically suggests a high probability of detecting statistically significant relationships, assuming the effect sizes are moderate or large. The stratified sampling design of HINTS 6 strengthens the study by oversampling certain groups, such as urban minorities and rural populations, which have often been underrepresented in health surveys. This approach is essential for gaining a deeper understanding of the unique health needs and mental health concerns of these communities, especially regarding climate change. As a result, the sample design not only boosts the study's statistical power but also ensures that the findings are more inclusive and reflective of the wider population.

**Data Collection**

The HINTS-6 used a mixed-mode data collection strategy which offered respondents the option to complete the survey online or on paper. This flexibility was designed to increase participation across different populations, including those with limited access to the internet. To further boost response rates, particularly from hard-to-reach groups, HINTS 6 included additional mailings with increased incentives for non-respondents. The data collection period ran for several months, from March to November 2022, and participants were incentivized with a $2 pre-paid monetary incentive, with additional bonuses for completing the survey online. This method of incentivization and increased outreach was aimed at maximizing the response rate and ensuring a diverse sample of respondents.

**Measures**

The dataset offers a rich variety of variables, with dependent variables related to mental health, including questions such as “How often have you been bothered by not being able to stop or control worrying?”. The response was “Nearly Everyday” versus “More than half the day” versus “Several days” versus “Not at all.” These responses will be recategorized as a dichotomous response (a) Yes for “Nearly Everyday” versus “More than half the day” versus “Several days”; (b) No for “Not at all”

The independent variable of interest for this study is the perception of climate change, specifically, “how much individuals think climate change will harm their health?”. The response were “A lot”, “Some”, “A little”, “Not at all”, “Don’t Know.” These responses will be recategorized as a dichotomous response (a) Yes for “A lot”, “Some”, “A little”; (b) No for “Not at all”

For demographic variables considered as covariates, age, sex, education, income, and marital status will be utilized. Confounding variables include demographic factors such as gender as “On your original birth certificate, were you listed as male or female?”, Sexual identity as “Do you see yourself as…?”, employment status as “Which of the following best describe your current occupational status?”, Marital status as “What is your marital status?”, educational attainment as “What is the highest grade or level of schooling you completed?”, income as “Thinking about members of your family living in this household, what is your combined annual income, meaning the total pre-tax income from all sources earned in the past year? “,Education-level data will be categorized into four groups: “<Post High School” versus “Some College” versus “College Graduate”

versus “Postgraduate”. Sexuality was categorized as “Heterosexual” versus “Not Heterosexual”. Marital Status will be categorized as “Married” versus “Not Married” versus “Others”. Income information was computed by the poverty income ratio (PIR), which is also an indicator of income relative to the economic needs of a household. This is a polytomous variable that was achieved by calculating annual fluctuations in household size and cost of living and monitoring the consumer price index concerning household income and federally established poverty limitations. PIR levels were defined as low income ($PIR < 1$), middle income ($1 \leq PIR < 4$), and high income ($PIR \geq 4$) and dichotomized for analysis with a cutoff point of 1. These variables are critical for understanding how social and economic factors may influence individuals’ concerns about climate change and its mental health impacts. Notably, by considering these confounding variables, the study aims to control for factors that could influence the relationships between climate change awareness and mental health outcomes.

**Data Analysis**

The data analysis plan for this study focuses on analyzing secondary data from the HINTS-6 to explore relationships between climate change perceptions and mental health outcomes. The study is based on a cross-sectional design, which is appropriate for examining correlations and associations at a specific point in time. Given the vast amount of data available in the HINTS-6 dataset, this analysis aims to extract meaningful insights regarding perceptions of climate change and its influence on mental health, particularly anxiety and depression. This quantitative approach will involve the use of various statistical techniques to test the study’s hypotheses and interpret the data within the

context of the survey's scope. The first step in the analysis will involve descriptive statistics to summarize the sample characteristics. This will include measures such as frequencies, means, and standard deviations for the demographic variables (e.g., age, gender, income, education) and the primary study variables (e.g., perceived harm of climate change, depression/anxiety diagnoses, and worry). These descriptive analyses will provide an overview of the sample's composition and the distribution of key variables, helping to identify patterns that may guide further statistical tests. Additionally, the use of visualizations such as histograms and bar charts will aid in understanding the data's distribution, while also highlighting any potential outliers or anomalies. To examine the relationships between the dependent and independent variables, the study will employ inferential statistical techniques, beginning with chi-square tests and independent sample t-tests. The chi-square test will be used to analyze categorical variables, such as the relationship between mental health diagnoses (e.g., depression, anxiety) and sociodemographic factors like gender and race. This will help identify any significant associations between categorical variables. For more complex relationships, complex samples logistic regression will be the primary statistical method used to assess the influence of multiple independent variables on binary outcomes such as whether a respondent has been diagnosed with depression or anxiety. This technique is particularly useful because it can handle multiple predictors simultaneously, including demographic factors (e.g., gender, income, education) and perceptions of climate change. Logistic regression will allow for an estimation of odds ratios, which will indicate the likelihood of a mental health diagnosis given different levels of climate change concern, while

controlling for potential confounding variables. This analysis will provide a clearer understanding of how climate change perceptions may contribute to mental health outcomes, accounting for other sociodemographic factors that could influence these relationships. To ensure the robustness of the findings, the study will also address potential confounding variables. These include factors such as gender, race, marital status, and income, which could affect both mental health and climate change perceptions. By controlling for these variables in the regression models, the analysis will provide a more accurate estimate of the relationship between climate change perceptions and mental health outcomes. Additionally, sensitivity analyses will be conducted to check for the stability of the results across different subgroups (e.g., male vs female). The ultimate goal of this analysis is to offer actionable insights into how climate change may impact public health, particularly among vulnerable populations.

### Ethical Consideration

Ethical procedure is important for public health research. This study received IRB approval from Walden University with approval number 01-21-25-1188599.

## Results

### Demographic Attributes of the Population

Table 1 presents the demographic profile of the study population for the Health Impacts of Climate Change and Health Interventions (HINT-6) study. The average age of respondents was 55.6 years, with a standard deviation of 17.4 years, indicating a mature sample with a broad age range. Gender distribution showed a predominance of males at 60.48%, while females constituted 39.52%. Employment status revealed that just over

half (50.86%) of the participants were employed, while 49.14% were unemployed, highlighting potential economic implications of climate-related worries. Marital status was also examined, showing that a majority (51.49%) of respondents were married. In contrast, 29.28% were unmarried, and the remaining 19.24% identified as divorced, widowed, or separated. Educational attainment varied among respondents, with 32.11% possessing less than a high school education, while 21.28% had attended some college. Graduates made up 27.67%, and those with postgraduate education accounted for 18.94%. This educational diversity is crucial for understanding how knowledge and awareness about climate change may differ across demographic groups. Sexual orientation data indicated that 92.22% of respondents identified as heterosexual, while 7.78% identified as non-heterosexual. Annual income levels were also assessed, revealing that 43.66% earned less than $50,000, 29.66% earned between $50,000 and $99,999, and 26.68% earned over $100,000. These financial strata are significant for analyzing how economic factors may influence worry about climate change. Overall, 36.79% of respondents reported feeling worried about climate change, while 63.21% did not express such concerns. Additionally, awareness of climate change was notable, with 78.28% of participants indicating they understood the concept, contrasting with 21.72% who did not.

**Table 4**

*Attributes of the HINTS-6 Population*

| **Characteristics** | **Sample (N= 6154)** | |
|---|---|---|
| | **N** | % |
| **Age (Mean±*SD*)** | | 55.60±17.43 |
| **Gender** | | |

| | | |
|---|---|---|
| **Male** | 2293 | 39.52 |
| **Female** | 3509 | 60.48 |
| **Employment** | | |
| **Yes** | 2952 | 50.86 |
| **No** | 2852 | 49.14 |
| Marital status | | |
| Married | 2979 | 51.49 |
| Not married | 1694 | 29.28 |
| Divorced/widowed/separated | 1113 | 19.24 |
| Education | | |
| <Post high school | 1860 | 32.11 |
| Some college | 1233 | 21.28 |
| College graduate | 1603 | 27.67 |
| Postgraduate | 1097 | 18.94 |
| Sexual orientation | | |
| Heterosexual | 5212 | 92.22 |
| Not heterosexual | 440 | 7.78 |
| Annual income | | |
| <$49,999 | 2396 | 43.66 |
| $50,000- $99,999 | 1628 | 29.66 |
| >$100,000 | 1464 | 26.68 |
| Depression or anxiety | | |
| Yes | 1565 | 26.40 |
| No | 4364 | 73.60 |
| **Climate awareness** | | |
| **Yes** | 3924 | 78.28 |
| **No** | 1089 | 21.72 |

**Worry Status and Sociodemographic Factors**

Table 2 shows the relationship between sociodemographic factors and worry status regarding climate change. The findings indicate that a higher percentage of females (32.67%) reported feeling worried compared to males (43.54%) who did not express worry. Employment status also played a role; 52.55% of employed individuals reported worry, while 50.27% did not, suggesting that those with jobs may have a heightened sense of responsibility towards climate-related issues. The marital status of respondents showed varying levels of worry. Among married individuals, 47.90% expressed worry

compared to 53.80% who did not, while those who were not married reported lower percentages of worry (28.27% versus 29.72%, P<.0001). Among the divorced, widowed, or separated group, 22.83% expressed worry, which was slightly lower than the 16.48% who did not. Education levels correlated with worry; individuals with less than a high school education reported 33.95% worry versus 30.70% who did not. In contrast, those with postgraduate education reported lower worry levels (16.53%) compared to those without. When examining sexual orientation, heterosexual individuals reported 88.11% non-worry versus 94.68% of non-heterosexual respondents. This discrepancy underscores the complex interplay between sexual identity and emotional responses to climate change. In terms of income, those earning less than $50,000 showed a significant worry percentage (49.19%), compared to 40.18% who did not, while those earning between $50,000 and $100,000 reported similar proportions of worry. The data on climate change awareness is particularly striking; those who reported understanding climate change had an 84.64% rate of worry, compared to 74.48% who did not express worry. Conversely, individuals without awareness demonstrated higher rates of non-worry (25.52%). This suggests that increased knowledge and awareness may directly influence emotional responses to climate change.

**Table 2**

*Sociodemographic attributes of HINTS-6 based on Worry*

| **Characteristics** | **Worry** | | |
|---|---|---|---|
| | Yes<br>*N* (%) | No<br>*N* (%) | *p*-Value |
| Gender | | | <.0001 |
| Male | 693 (32.67) | 1574 (43.54) | |
| Female | 1428 (67.33) | 2041 (56.46) | |

| | | | |
|---|---|---|---|
| Employment | | | .0988 |
| Yes | 1114 (52.55) | 1819 (50.27) | |
| No | 1006 (47.45) | 1798 (49.71) | |
| Marital status | | | <.0001 |
| Married | 1013 (47.90) | 1939 (53.80) | |
| Not married | 598 (28.27) | 1071 (29.72) | |
| Divorced/widowed/separated | 504 (22.83) | 594 (16.48) | |
| Education | | | <.0001 |
| <Post high school | 719 (33.95) | 1108 (30.70) | |
| Some college | 486 (22.95) | 734 (20.34) | |
| College graduate | 563 (26.58) | 1028 (28.48) | |
| Postgraduate | 350 (16.53) | 739 (20.48) | |
| Sexual orientation | | | <.0001 |
| Heterosexual | 1823 (88.11) | 3348 (94.68) | |
| Not heterosexual | 246 (11.89) | 188 (5.32) | |
| Annual income | | | <.0001 |
| <$49,999 | 997 (49.19) | 1370 (40.18) | |
| $50,000- $99,999 | 568 (28.02) | 1047 (30.70) | |
| >$100,000 | 462 (22.79) | 993 (29.12) | |
| Climate awareness | | | <.0001 |
| Yes | 1582 (84.64) | 2309 (74.48) | |
| No | 287 (15.36) | 791 (25.52) | |

**Univariate Estimates of the Associations**

Table 3 presents the odds ratio estimates for various sociodemographic attributes and their association with worry related to climate change. The crude odds ratio for age indicated a slight decrease in worry with increasing age (OR = 0.981, CI = 0.978- 0.984). Female respondents had significantly higher odds of reporting worry compared to males, with an OR of 1.589 (CI = 1.421- 1.777), emphasizing the gendered nature of climate-related anxiety. Employment status also influenced worry, where employed individuals exhibited an odds ratio of 0.914 (CI: 0.821- 1.017) compared to their unemployed counterparts. Marital status further revealed that divorced individuals had higher odds of worry (OR = 1.624 (CI: 1.411- 1.870) compared to married individuals. Notably, those

who were single compared to married showed an OR of 1.069 (CI: 0.943- 1.212), indicating that marital status plays a role in emotional responses to climate concerns. Educational attainment was significantly associated with worry levels. Those with less than a high school education exhibited an odds ratio of 1.493 (CI = 1.253- 1.778) compared to postgraduate-educated individuals. Similarly, individuals with some college education had an odds ratio of 1.452 (CI = 1.202- 1.753) compared to postgraduate counterparts. This suggests that higher education levels may correlate with reduced worry, potentially due to increased awareness and coping resources. Sexual orientation also played a crucial role, as non-heterosexual individuals had an odds ratio of 2.513 (CI = 2.015- 3.133) for reporting worry, indicating a heightened sensitivity to climate change concerns. Income analysis showed that individuals earning less than $50,000 had an OR of 1.669 (CI = 1.438- 1.937) for worry compared to those earning over $100,000. This finding highlights the impact of economic status on emotional health concerning climate change. Lastly, climate change awareness significantly influenced worry, with those with awareness showing an OR of 1.876 (CI: 1.601- 2.199) compared to those who understood climate change. This stark contrast emphasizes the importance of education and awareness in shaping emotional responses to environmental issues.

**Table 3**

*Univariate and Multivariate Analysis for Climate Change Awareness, Covariates and Worry*

| **Dependent Variable** | **Odds Ratio** | |
|---|---|---|
| | Crude (95% CI, *p*)<br>Yes vs No | Adjusted (95% CI, *p*)<br>Yes vs No |

| | | |
|---|---|---|
| **Age** | 0.981 (0.978- 0.984, <.0001) | 0.979 (0.974- 0.984, <.0001) |
| Gender | | |
| Male | Reference | Reference |
| Female | 1.589 (1.421- 1.777, <.0001) | 0.660 (0.578- 0.754, <.0001) |
| Employment | | |
| Yes | 0.914 (0.821- 1.017, .0989) | 0.927 (0.798- 1.078, .3266) |
| No | Reference | Reference |
| Marital status | | |
| Married | Reference | Reference |
| Not married | 1.069 (0.943- 1.212, .0048) | 1.032 (0.874- 1.218, .8635) |
| Divorced/widowed/separated | 1.624 (1.411- 1.870, <.0001) | 1.034 (0.867- 1.233, .8397) |
| Education | | |
| <Post high school | 1.493 (1.253- 1.778, 0.0010) | 1.314 (1.077- 1.603, 0.0317) |
| Some college | 1.452 (1.202- 1.753, 0.0144) | 1.302 (1.060- 1.599, 0.0413) |
| College graduate | 1.176 (0.986- 1.403, 0.1620) | 1.072 (0.891- 1.290, 0.1309) |
| Postgraduate | Reference | Reference |
| Sexual orientation | | |
| Heterosexual | Reference | Reference |
| Not heterosexual | 2.513 (2.015- 3.133, <.0001) | 1.916 (1.516- 2.421, <.0001) |
| Annual income | | |
| <$49,999 | 1.669 (1.438- 1.937, <.0001) | 1.565 (1.295- 1.893, <.0001) |
| $50,000- $99,999 | 1.197 (1.019- 1.407, <.0001) | 1.159 (0.974- 1.379, 0.2802) |
| >$100,000 | Reference | Reference |
| Climate awareness | | |
| Yes | 1.876 (1.601- 2.199, <.0001) | 1.677 (1.422- 1.978, <.0001) |
| No | References | Reference |

**Multivariate Estimate of the Association**

The analysis of adjusted odds ratios provides further clarity on the relationship between sociodemographic factors, climate change awareness, and worry. The adjusted

odds ratio for age remained consistent at 0.979 (CI = 0.974- 0.984), indicating a sustained trend of decreasing worry with age. However, the gender disparity persisted, with females exhibiting an adjusted OR of 0.660 (CI = 0.578- 0.754), reinforcing the notion that women may experience different emotional responses compared to men. In terms of employment status, the adjusted odds ratio for uemployment compared to unemployment was 0.927 (CI: 0.798- 1.078), showing minimal change in worry levels. Marital status also revealed nuanced findings; divorced individuals had an adjusted OR of 1.034 (CI: 0.867- 1.233) compared to married individuals. Interestingly, the odds for unmarried individuals compared to married respondents were close to 1 (OR = 1.032 (CI: 0.874- 1.218), suggesting similar levels of worry. The educational attainment analysis indicated that individuals with less than a high school education had an adjusted OR of 1.314 (CI = 1.077- 1.603) compared to those with postgraduate education. Those with some college experience had an OR of 1.302 (CI = 1.060- 1.599), suggesting that educational attainment is a protective factor against worry. For college graduates compared to postgraduate individuals, the adjusted OR was 1.072 (CI = 0.891- 1.290), indicating only a slight association.

Sexual orientation continued to show significant differences, with non-heterosexual individuals having an adjusted OR of 1.916 (CI = 1.516- 2.421), illustrating heightened levels of worry. The income analysis also revealed compelling insights; individuals earning less than $50,000 had an adjusted OR of 1.565 (CI = 1.295- 1.893) compared to those earning over $100,000. Those earning between $50,000 and $100,000 exhibited a modest OR of 1.159 (CI = 0.974- 1.379), suggesting that lower income is

closely linked to increased worry. Finally, the adjusted odds ratio for climate change awareness was 1.677 (CI: 1.422- 1.978), indicating that having awareness is strongly associated with increased worry levels. This underscores the necessity for public education and outreach efforts to enhance understanding of climate change and its implications, which may ultimately help alleviate anxiety and worry in the population.

## Discussion

The association between climate change awareness and mental health, particularly worry, is an emerging area of public health focus, especially as inclemental and adverse climate condition worsens following continued greenhouse emissions. The growing body of research on climate change underscores its profound implications not only for the environment but also for public health and mental well-being. As climate change continues to manifest through extreme weather events, rising sea levels, and biodiversity loss, individuals' emotional responses—including worry and anxiety—are gaining increasing attention. This study is unique as it also explored the role of sociodemographic attributes on the relationship between climate change awareness and worry, and considers how demographic factors shape these relationships and what implications this has for public health policies and interventions.

### Demographic Influence on Worry

The demographic attributes described in this study reveal significant patterns relating to ways individuals experience worrying related to the concept of climate change awareness. Notably, age was inversely associated with worry (OR= 0.981), suggesting a slight decrease in worry with increasing age. This relationship with age was supported by

existing literature, which suggests that older adults tend to exhibit greater emotional stability and may be less susceptible to climate change-related anxiety (Cosh et al., 2024; Heeren et al., 2022; Qiu & Qiu, 2024). As individuals age, they may have a greater sense of life experience and coping mechanisms, making them less likely to experience heightened emotional responses to environmental threats (Hoyt et al., 2020). However, it is crucial to highlight that the trend toward lower worrying levels with age, while statistically significant, was minor, implying that other factors may play a more critical role in shaping emotional reactions to climate-related worries.

Gender differences also emerged from the study as a significant predictor of climate-related worry. Females reported much higher levels of worry compared to males. This finding underscores the gendered nature of climate change anxiety, which has been widely observed in climate psychology studies (Clayton et al., 2023; Heeren et al., 2022). Women, particularly in vulnerable populations, may experience heightened emotional responses to climate change due to a variety of factors, including caregiving responsibilities, societal expectations, and greater exposure to environmental risks such as natural disasters (Goudet et al., 2024). Furthermore, the association reversed when other factors were taken into account, showing that women were less likely than men to experience extreme worry. The current discussion about gender disparities in emotional reactions to climate change is further illustrated by this finding. This suggests that while controlling for other sociodemographic factors reduces the magnitude of the gender difference, but does not eliminate them, highlighting the need for targeted interventions to address gender related aspect of climate change worries. This finding aligns with

previous studies indicating that women are generally more sensitive to environmental risks and may be more emotionally affected by climate-related issues (Farhane-Medina et al., 2022). Such gendered emotional responses may be attributable to socialization processes that encourage females to express concern more openly or from the greater caregiving roles they often take on within families and communities (Tabassum & Nayak, 2021).

Employment status also showed an interesting relationship with worry. Employed individuals showed a slightly higher prevalence to worry, which could reflect the pressure due to sense of responsibility for their livelihoods and those of their families amid growing uncertainties related to climate change. Unemployed, on the other hand, may either feel a decreased sense of urgency or be more interested with the immediate financial concerns, and may lead to different emotional reactions (Achdut & Refaeli, 2020; Ryu & Fan, 2023). The crude odds ratio for unemployment compared to employment, though not significant showed reduced estimate, suggesting a slight trend towards reduced worry among employed individuals. However, the adjusted estimate indicates similar in this relationship, suggesting that while unemployment may be a contributing factor, its influence on worry may not be as strong when other sociodemographic characteristics are accounted for (Mathieu et al., 2022). This intricate relationship, though not statistically significant, suggests that interventions could be tailored to consider these demographic variations in emotional responses. This result is consistent with literature suggesting that psychological stress related to employment status may exacerbate worry and anxiety, especially among individuals who are already

experiencing economic instability (Ryu & Fan, 2023). However, the not significant but minimal change in the adjusted odds ratio estimates, suggests that other factors, such as education and income, may mediate the relationship between unemployment and worry about climate change.

This study also noted that educational exposure correlated with levels of worry, in relation to climate change awareness. Educational attainment was strongly associated with worry levels, with individuals who had less than a high school education exhibiting significantly higher odds of reporting worry. Similarly, individuals with some college education had elevated odds compared to those with postgraduate education. This indicates that the decline in education may probably be correlated with an increase in concerns about climate change due to a decrease in access to information for dealing with environmental stressors or a limited number of resources. The adjusted odds ratio analysis further reinforced this trend by showing similar pattern. Thus, higher educational attainment may confer both a better understanding of climate change and enhanced coping resources, leading to a reduction in worry (Daeninck et al., 2023). The relatively modest adjusted odds ratio for college graduates compared to those with postgraduate education suggests that while education is protective, the relationship is less pronounced once individuals reach higher education levels. Thus, the outcomes of this study underscore the importance of climate change education in raising awareness, which may alter emotional responses. Furthermore, studies have shown that higher levels of education often result in a better understanding and participation with climate issues, which may assist to lessen worry (Hoekstra et al., 2024).

This study also showed that socioeconomic status (SES) is another critical predictor of worry in the context of climate change awareness. In terms of prevalence, participants earning less than $50,000 annually demonstrated higher levels of concern compared to those with higher incomes. This is consistent with findings from the literature, which indicated that individuals from lower SES backgrounds are often more vulnerable to the impacts of climate change and may experience heightened worry as a result (Eom et al., 2018; White et al., 2023). Similarly, this suggests that economic insecurity may exacerbate anxiety, particularly in the context of climate change, which can be perceived as an additional stressor on top of financial challenges (Ryu & Fan, 2023). The adjusted odds ratio for those earning less than $50,000 compared to those earning over $100,000 remained substantial, indicating that income is a key determinant of emotional responses to climate-related risks (Vercammen et al., 2023). Interestingly, individuals earning between $50,000 and $100,000 had a more modest outcome, suggesting that while lower income is strongly linked to worry, individuals in the middle-income range may experience somewhat less anxiety, likely due to a combination of financial security and awareness of climate change. Thus, it follows that economic instability can worsen feelings of helplessness and environmental anxiety among people that do not have the means to cope or deal with climate change (Ogunbode et al., 2022).

The results also depict the significant role that sexual orientation plays in shaping emotional responses to climate change, with non-heterosexual individuals exhibiting substantially higher levels of worry compared to their heterosexual counterparts. This indicates that non-heterosexual individuals were more than 2.5 times as likely to report

worry about climate change compared to heterosexual individuals. The observed heightened sensitivity to climate change concerns in non-heterosexual populations is consistent with emerging research that identifies unique mental health and emotional vulnerability factors in sexual minorities, especially in the context of environmental stressors (Goldsmith & Bell, 2022; Mann et al., 2024). The intersectional experiences of non-heterosexual people, who might encounter further levels of social and environmental discrimination, could be one reason for this increased concern. This finding is consistent with emerging literature that highlights the compounded vulnerabilities faced by LGBTQ+ individuals in the context of climate change (Alibudbud, 2023; Goldsmith & Bell, 2022). Studies have shown that sexual minorities often experience higher rates of discrimination, mental health challenges, and social exclusion, which can exacerbate the emotional toll of other stressors, including climate change (Alibudbud, 2023). Anxiety and concern about the future may rise as a result of the combined stress caused by environmental dangers and prejudice in society (Alibudbud, 2023; Goldsmith & Bell, 2022; Mann et al., 2024). The significance of this finding emphasizes the importance to recognize the variety of emotional responses that could emanate based on level of awareness for climate change, particularly in disadvantaged groups that may already be coping with mental health concerns.

The adjusted odds ratio further corroborates this relationship as non-heterosexual individuals still exhibited a heightened level of worry. Hence, suggesting that sexual orientation continues to be a powerful determinant of worry about climate change, even when factors such as age, income, education, and climate change awareness are

considered. The significance of addressing the particular vulnerabilities of sexual minorities in climate change-related interventions is flawed by this persistent disparity, which suggests that other sociodemographic characteristics alone may not adequately explain the emotional responses of these groups to climate change. This finding is supported by existing literature that links social determinants of health, including discrimination, stigma, and minority stress, to increased emotional vulnerability in sexual minority populations (Alibudbud, 2023). For example, Meyer's (2003) minority stress model suggests that the chronic stress associated with stigma and discrimination may increase susceptibility to psychological distress (Meyer, 2003). Given that climate change is perceived as a pervasive and existential threat, the additional stressors faced by non-heterosexual individuals may magnify their emotional responses to environmental concerns. Furthermore, current disparities may be exacerbated by the consequences of climate change, such as extreme weather events, which disproportionately affect vulnerable groups, including sexual minorities (Mann et al., 2024). As a result, elevated worry among non-heterosexual people might be indicative of a larger trend of susceptibility to social and environmental problems. Because of enduring systemic injustices, some groups may feel more anxious in the complicated environment created by the junction of gender identity, sexual orientation, and socioeconomic class (Collins et al., 2021).

**Climate Change Awareness and Its Emotional Impact**

Lastly, there was a rather unusual connection between worry and climate change awareness. Because those who reported knowing climate change had considerably higher

rates of anxiety than those who did not, the study's findings highlight the crucial role that awareness plays in determining worry levels. This odds estimates highlights the critical role of education in shaping emotional responses to adverse environmental issues (Cordero et al., 2020; Newberry Le Vay et al., 2023). Hence, individuals who are aware of climate change and its potential impacts are more likely to engage in adaptive behaviors and experience worry that is motivated by a sense of urgency to act (A. von Gal et al., 2024). After controlling for covariates, the estimate of the association remained similar, underscoring the importance of public educational initiatives targeted at increasing knowledge and lowering worry about climate change. Through the prism of emotional engagement, this paradox—wherein greater awareness is correlated with increasing worry—can be understood. People may suffer anxiety as a result of cognitive dissonance when they learn about the hazards that climate change poses (Cosh et al., 2024). The study also emphasizes how crucial it is to differentiate between awareness and action. Although awareness might cause concern, it can also inspire people to take up environmental causes or adopt pro-environmental actions (Si et al., 2022). Studies suggest that individuals who feel empowered to take action whether through lifestyle changes or political engagement may experience reduced anxiety and a greater sense of control over their circumstances (Ogunbode et al., 2022; Si et al., 2022). This goes beyond the need for public health campaigns that will not only raise awareness but also concentrate and offer practical prevention advice to people in order to lessen the negative effects of climate change.

**Strength & Limitation**

The use of HINTS-6 dataset for this study is a major strength of this study as it includes a large, nationally representative sample, allowing an understanding of awareness and worry among the general population regarding climate change. Hence, this creates a strong basis for identifying such relationships. Another strength stems from the study providing valuable insights that can inform policy decisions and interventions aimed at enhancing climate change literacy and action. Despite these strengths, there are some limitations to keep in mind. The first is that because the study design is cross-sectional which identifies association but not causality between climate change awareness and worry. This restricts our ability to discern whether growing cognizance generates more worry or if those who are already troubled by climate change look for more information. Finally, a self-reported survey was used to generate the dataset, and self-reported data can be affected by social desirability bias or recall bias, so it may not 100% reflect the actual behaviors. Additionally, the study fails to reflect the complexity and dynamism of climate change perceptions or how attitudes may change over time or be influenced by specific events. Finally, though the dataset is nationally representative, regional differences and local environmental factors may have subtle effects on climate change awareness and worry that the dataset may not fully control for.

**Implications for Public Health Interventions**

The results of this study have important consequences on public health policy and intervention strategies. Given the relationships identified between demographic factors, socio-economic status and worrying with regard to climate change, individual

interventions are important. For example, an educational program to raise awareness and understand climate change needs to take into account the various individualized preferences of the target participants. In order to increase relevance and comprehension, these educational programs could incorporate community-oriented learning by utilizing local knowledge and experiences (Fox et al., 2019). Moreover, addressing socioeconomic disparities is essential in developing effective interventions. Targeted support for low-income individuals, including financial assistance for climate adaptation measures, could alleviate some of the anxiety associated with economic vulnerability in the face of climate change (Xue et al., 2024). Furthermore, mental health interventions that address climate-related worry may be impactful, particularly for the vulnerable populations like low-income and non-heterosexual individuals that are disproportionately impacted by climate-related unfavorable events.

**Future Research Directions**

This study opens several avenues for a lot of conversations and future research. The relationship between worry and climate change awareness may be better understood through longitudinal studies as it changes over time, especially in reaction to major climate events or policy changes. It would also be beneficial to investigate how well particular educational programs work to lessen fear. Better educational frameworks and communication tactics can be developed by taking into account how various demographic groups interact with knowledge about climate change. Another important area for future investigation is the intersection of climate change, mental health, and resilience. Research on how people manage worry related to climate change and the

tactics that help different groups become more resilient may provide important information for creating services that can help. Additionally, examining how social networks influence people's awareness and emotional reactions to climate change may help identify opportunities for group action and community involvement.

## Positive Social Change Impact of the Study

Research on the societal effects of climate change knowledge, especially its relationship to public and mental health perspectives, is becoming more and more urgent. Research on the correlates of concerns and perceptions about climate change reveals important connections that can guide education, public health practice, policy, and research. Understanding these processes can help us better understand the fears associated with climate change and suggest strategies to foster societal change and resilience.

### *Research*

The results and findings of this study supports to the expanding body of the literature that looks at the connections between psychological reactions and climate awareness. According to research, people may experience increased anxiety and fear as a result of climate change (Dodds, 2021). This study opens the door for more complex research frameworks that take gender, social status, and educational background into consideration by identifying the demographic elements impacting these emotions. For example, the study noted that people with lower socioeconomic status, especially females were more likely to express concerns about climate change awareness. Thus, this noteworthy findings of this study may guide future research and motivate researchers to

seek into focused solutions for vulnerable populations that are at risk. Therefore, researchers can create and focus on comprehensive models that can guide public health interventions promoting mental health in the terms of adverse climatic condition, by cultivating a greater understanding of these relationships from the study.

### *Education*

The study's findings also highlight the importance of educational programs aimed at increasing public awareness of climate change. Educational awareness campaigns will be an important tool in helping the populace understand the severe consequences of climate change and embracing eco-friendly practices. Study findings depicting that people with higher levels of education tend to have lower levels of anxiety suggest that educational programs can effectively reduce anxiety through knowledge acquisition (Ramírez-Martínez et al., 2024). Hence, educational interventions can focus on equipping students, providers, stakeholders, and local residents with the skills necessary to respond to climate-related challenges. For example, programs that integrate climate science to practical applications, such as the practice of stability and preparing for natural disasters can give people a chance to take information -based measures. By promoting an understanding of climate change and its social implications, educational initiatives can foster resilience and a sense of agency, reducing anxiety associated with climate uncertainties (Newberry Le Vay et al., 2023).

### *Public Health Practice*

This study has different implications for public health practice, emphasizing the need for provision of mental health resources that treat worrying related to climate

change. Additionally, a lot of educational resources is required to improve awareness of climate change. The study found that a large percentage of people worry about climate change, which can have a negative impact on mental health and general well-being (Cianconi et al., 2020). Public health practitioners must recognize the psychological dimensions of climate change and incorporate strategies to educate and address mental health concerns in their programming. Interventions could include community workshops that provide coping strategies for managing climate-related anxiety. Mental health professionals can play a vital role in helping individuals process their feelings about climate change, thereby fostering resilience. Additionally, integrating climate literacy into mental health services can prepare practitioners to address clients' concerns effectively, ensuring that the emotional impacts of climate change are acknowledged and treated (Raile, 2023).

***Policy***

The findings of this study could influence climate change policy more broadly by emphasizing the need for equitable access to information and resources. Therefore, to promote inclusivity in future programs, policymakers could consider data on socioeconomic status, education, and emotional responses to climate change. Policies that prioritize climate education in underserved areas, for example, can help bridge the knowledge gap and motivate individuals to become more actively involved in climate action. Furthermore, attempts for tailored mental health care may result from an understanding of the psychological effects of climate change on particular communities in terms of disaster preparedness orientation. Funding that explicitly addresses the mental health needs of individuals most impacted by stressors related to climate change might be promoted by policymakers. This strategy can support the development of emotionally healthy communities that are robust to climate change (Xue et al., 2024).

## Conclusion

The findings from this study highlight the complex interplay between sociodemographic factors, climate change awareness, and worry among the U.S. population. Age, gender, education, income, and sexual orientation all contribute to shaping how individuals emotionally respond to climate-related risks, with women, those with lower education and income, and non-heterosexual individuals exhibiting higher levels of worry. However, climate change awareness emerged as one of the most significant factors in reducing worry, underscoring the importance of education and public outreach efforts. Addressing these sociodemographic differences and increasing the awareness of climate change will be essential in reducing climate-related worry, and

building a more resilient populace as the effects of climate change become more noticeable. Public health strategies that integrate these insights will be crucial for navigating the challenges posed by climate change and ensuring that all individuals have the resources and support needed to cope effectively.

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Part 3: Summary

## Integrating the Findings Across Studies

The three manuscripts—(a) The Relationship Between Climate Change Awareness and Depression or Anxiety Among the U.S. Population, (b) Gender Differences for the Relationship Between Climate Change Awareness and Depression or Anxiety Among the U.S. Population, and (c) The Relationship Between Climate Change Awareness and Worrying Among the U.S. Population—collectively provide insights into how climate change awareness intersects with mental health outcomes, such as depression, anxiety, and worry. All manuscripts focused on themes — that the overall psychological impact of climate change awareness is certain and demonstrates a complex relationship between environmental knowledge and mental health. The results were consistent in showing that those more aware of climate change report higher rates of mental health distress (i.e., depression, anxiety, and worry). This is consistent with the growing body of literature on eco-anxiety and climate distress, which suggests that increased awareness of environmental issues may contribute to heightened emotional distress, particularly when individuals feel helpless or overwhelmed by the scale of climate change.

One of the major insights between these manuscripts is the important role gender plays in this relationship between climate change awareness and mental health. I found that women were more likely than men to experience mental health challenges (depression, anxiety) related to awareness of climate change. This aligns with existing research on gender differences in mental health, where women are generally more

susceptible to depression and anxiety (see Kuehner, 2017). I also found that gender played a role in how participants responded to climate change, which is an important finding because it suggests that women may experience different psychological stressors related to climate change compared to men, such as increased emotional labor (i.e., providing emotional support to others) or social expectations about being environmentally responsible. Such knowledge can inform interventions specific to females who may require components of mental health and climate change education that recognize these differentiated experiences.

Another common theme was the relationship between climate change awareness and increased worry, which emerged particularly in the third study. Individuals who reported higher levels of climate change awareness were more likely to express concern or worry about the future, which in turn contributed to greater mental health distress. This supports findings from previous research that have linked eco-anxiety to increased worry and rumination about environmental issues (see Gifford, 2013). Worry, in this context, may act as a form of emotional processing or coping, but when unchecked, it can lead to anxiety and depression. Overall, these studies insinuate that climate change awareness can exacerbate emotional and psychological distress among certain demographic groups (e.g., women), even if it strengthens an individual's ability to respond to climate issues meaningfully.

**Insights and Implications for Positive Social Change**

One unanticipated insight was the potential protective role of climate change awareness in some individuals. Although the first narrative showed an increased

awareness of climate change as correlating with more mental health distress, I found that there are signs indicating that people well-informed about climate change also feel empowered, will act on their own, engage with communities, and participate in environmental advocacy. This finding could inform positive social change, as it suggests that fostering an understanding of climate change might not only raise awareness but could also motivate individuals to engage in coping behaviors that reduce anxiety and depression (Cunsolo Willox et al., 2015). Community-based interventions that increase climate literacy and help catalyze collective action may buffer some of the psychological distress from climate change, transforming worry into proactive engagement and resilience. This aligns with the SEM, where interventions at multiple levels (individual, interpersonal, and community) could reduce mental health vulnerabilities associated with climate change awareness.

**Insights into Broader Literature Gaps and the Role of Capitalism and Politics**

Despite the growing body of research on the psychological impacts of climate change, there remains a significant gap in literature regarding the direct mental health impacts of climate change awareness in the U.S. population. One potential reason for this gap is the lack of interdisciplinary research linking climate science with mental health disciplines. Climate change research has focused primarily on physical and environmental impacts, with limited integration with public health and mental health research. This gulf may be a symptom of institutional barriers within academia, where environmental sciences and mental health disciplines tend to operate in silos. Furthermore, the role of capitalism and politics plays a significant part in maintaining this

gap. The politicization of climate change in the United States, often driven by industries that profit from fossil fuels and climate change denial (e.g., oil, gas, and coal industries), has hindered public acceptance and awareness of the issue (Si et al., 2023). The broader public is dissuaded from acknowledging the mental health implications of climate change, in part because corporate interests often fight the acknowledgment of the severity of climate science. Furthermore, the lack of political action on addressing climate change can compound psychological distress, as people witness their concerns being ignored and a general lack of leadership. Policy inertia is a major hurdle to tackling both the climate crisis and its mental health toll, as it creates a sense of immobility and anger in people and aggravates emotional suffering.

**Future Research Directions**

Through my results, I found several areas for future research. Longitudinal studies are needed to better understand the causal pathways between climate change awareness and mental health outcomes. The cross-sectional data offered important correlations, future research should examine how these relationships evolve over time, — especially following climate events like natural disasters or changes in policy or environmental shock. Intervention studies exploring the effectiveness of climate education and mental health support programs in mitigating eco-anxiety and depression would be valuable. Furthermore, research that dissects the intersectionality of factors like gender, race, sexual orientation, and socioeconomic status in relation to climate change and mental health would help fine-tune interventions and better address the needs of vulnerable populations. Finally, the importance of coping mechanisms — e.g., social support,

participation in the community, and environmental activism — in buffering climate change-related mental health distress should be further investigated.

**Lessons Learned in the Research Process**

One of the main takeaways from these studies is to consider multidimensional approaches to understanding the consequences of climate change on mental health. The results highlight the need to incorporate both demographic (e.g., gender, income, education) and psychological (e.g., worry, anxiety, resilience) factors into the research framework. This method helps operate in a larger context than found with a single case study and provides a more nuanced understanding of how various aspects of climate change affect people in different ways. In addition, the studies emphasize the importance of assessing both positive and negative emotional outcomes that arise in response to awareness of climate change. Although people do suffer from anxiety and worry, the possibility of feeling empowered with climate perspectives should not be neglected. Finally, the research process confirmed the value and importance of community-based interventions in addressing mental health issues. Thus, these results suggest that social networks and community engagement are key factors in mitigating the psychological effects of climate change.

## Conclusion

The overall research project provides important insights into the associations between climate change awareness and mental health problems (depression, anxiety, worry) among American adults. The three manuscripts collectively highlight a clear link between greater climate change awareness and increased psychological distress. A good

example of this is the increase of eco-anxiety and eco-depression as people become more aware of the ecological crisis. But they also paint a more nuanced picture, showing how, although awareness of climate change can heighten emotional distress, it can also lead to empowerment — especially when such concerns manifest in climate mitigation efforts and community involvement.

The gendered character of the relationship between climate change knowledge and mental health—women being much more susceptible than males to the negative effects of climate change on mental health—was one of the study's main conclusions. In order to address the psychological effects of climate change, gender-sensitive therapies are therefore required. People from less educated demographic groups, and poorer background are reported to be more prone to stress, making sociodemographic characteristics like income and education crucial in regulating emotional reactions to climate change knowledge. These results demonstrate the need of using a comprehensive approach when developing interventions to support mental health in the context of climate change.

A notable contribution of this work is its fit with the SEM, which calls for multilevel interventions targeting the individual, community, and larger societal structures. However, there are means of coping with the heightened psychological stressors caused by increased awareness of climate change through community-based initiatives and mental health support systems. In addition, encouraging shared understanding and collective action with respect to climate change can empower people,

as it helps attenuate feelings of helplessness and enhances resilience in an era of environmental uncertainty.

This research suggests that climate change can no longer just be considered a public health problem; it also needs to be incorporated into discussions about mental health. It does not mean that there is no psychological cost of climate change  but it is an opportunity, and it has the power of collective empowerment. Furthermore, long-term collaborative, cross-disciplinary research is needed to comprehensively identify the effects of climate change on mental health and to inform effective, community-specific solutions. Until then, there is societal action that needs to be done not only for climate change but also for the mental health of the survivors of climate change.

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