Review

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Posted Date: 26 February 2024

doi: 10.20944/preprints202402.1444.v1

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Intersecting Crises: Exploring the Impact of Climate Change on the Burgeoning Burden of Non-Communicable Diseases

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Abstract: Climate change, recognized as a global crisis, is not only altering our environment but also significantly impacting human health. Particularly, its influence on non-communicable diseases (NCDs), a leading cause of global mortality, is becoming increasingly evident yet underexplored. This review aims to synthesize current research on the impact of climate change on NCDs, addressing a critical gap in our understanding of how environmental changes affect human health. We examine the complex interplay between climate change and NCDs, drawing insights from recent studies that highlight the adverse effects of climate variables on chronic diseases, such as cardiovascular and kidney diseases, and the role of food and nutrition security in this nexus. Furthermore, the review explores the disproportionate impact on vulnerable regions and populations, particularly in Pacific Island countries and territories, underscoring the urgent need for context-specific solutions and a cross-sectoral approach. By integrating findings from various disciplines, this review aims to inform policy and public health interventions, highlighting the necessity of collaborative efforts to mitigate the burgeoning burden of NCDs in a rapidly changing climate.

Keywords: Climate change; pollution; global warming; human health; non-communicable diseases; food security

1. Introduction

Climate change is arguably the most pressing environmental challenge of our time, impacting every aspect of the Earth's ecosystems, economies, and societies. The United Nations Intergovernmental Panel on Climate Change (IPCC) has underscored the significance of this issue, highlighting the vast implications of rising global temperatures, shifts in weather patterns, and the increasing frequency of extreme weather events. These environmental changes have profound implications not only for the natural world but also for human health and wellbeing. In the realm of human health, non-communicable diseases (NCDs) – such as cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes – represent a major challenge, accounting for over 70% of all global deaths annually [1]. The burden of these diseases is not evenly distributed, with low- and middle-income countries disproportionately affected. As the world grapples with the health impacts of climate change, it is becoming increasingly clear that NCDs are intricately linked to environmental factors.

The relationship between climate change and NCDs is complex. Climate change can directly and indirectly impact the prevalence and severity of NCDs. Direct impacts include the physiological stress caused by heatwaves, which can exacerbate cardiovascular and respiratory conditions. Indirect effects involve changes in air quality, food and water security, and patterns of infectious diseases, all of which can influence NCD risk factors. For example, air pollution, a byproduct of climate change, is a well-established risk factor for cardiovascular and respiratory diseases. Similarly, changes in agricultural production due to climate change can impact nutritional status, influencing the prevalence of diseases like diabetes and obesity (Figure 1) [2]. Furthermore, climate change poses

 doi:10.20944/preprints202402.1444.v1

significant risks to mental health, contributing to the burden of NCDs. The psychological stress associated with climate-related disasters can lead to mental health issues such as anxiety, depression, and post-traumatic stress disorder. These issues are particularly acute in vulnerable populations who are most affected by climate-related events.

Figure 1. Climate change and the rise of non-communicable diseases.

Given the growing understanding of these connections, this review article aims to synthesize current knowledge on the impact of climate change on NCDs. We aim to explore how changes in the global climate are influencing the prevalence, distribution, and severity of non-communicable diseases. This includes examining the direct physiological impacts of climate change, as well as the indirect effects mediated through changes in environmental conditions, social determinants of health, and healthcare infrastructure. This review also seeks to highlight the gaps in current research and propose directions for future studies.

2. Impact of Climate Change on Health

The effects of climate change on health are diverse, ranging from direct impacts such as heat-related illnesses to indirect consequences including changes in the patterns of diseases. Climate change affects health through various pathways, including extreme weather events, altered infectious

 doi:10.20944/preprints202402.1444.v1

disease patterns, and worsening air quality. Heatwaves associated with climate change contribute to heat-related illnesses and deaths, particularly among vulnerable populations like the elderly and those with pre-existing health conditions. Changes in weather patterns influence the distribution and transmission of vector-borne diseases, such as malaria and dengue fever, potentially expanding their geographic range. Increased air pollution, a consequence of climate change, exacerbates respiratory conditions like asthma and chronic obstructive pulmonary disease (COPD), and can lead to cardiovascular problems. Climate change-induced alterations in agriculture and food production can impact nutritional health, leading to malnutrition and food insecurity.

Climate change has a profound impact on the prevalence and severity of NCDs. The rise in global temperatures and changes in weather patterns exacerbate chronic diseases, especially cardiovascular and respiratory illnesses. Increased exposure to high temperatures can directly affect cardiovascular health, leading to higher incidences of heart attacks and strokes. Respiratory diseases are aggravated by poor air quality, which is a consequence of climate-related changes in air pollution levels. Stress from extreme weather events and the broader impacts of climate change can affect mental health, contributing to the burden of mental disorders, such as depression and anxiety. The study by Kjellstrom et al., 2010, provides crucial insights into the negative impacts of climate change on physiological functions and chronic diseases. The authors highlight that climatic factors and climate change have detrimental effects on some physiological functions and on cardiovascular and kidney diseases. The risks of chronic disease are likely to increase with climate change, exacerbated by the related increase in air pollution, malnutrition, and extreme weather events. The study underscores the substantial research gaps in this field and the vital role of the health sector in facilitating further research and monitoring the health impacts of global climate change. This work is crucial for the global efforts in the prevention and control of chronic NCDs in an aging and urbanizing global population [2].

3. Climate Change and Food Security

The impact of climate change on food security is a critical issue with far-reaching implications for human nutrition and NCDs. Climate change adversely affects food production systems, including agriculture and fisheries, leading to food insecurity and nutritional deficiencies. Food and nutrition security is closely linked to the prevalence of NCDs. Inadequate nutrition can lead to the development of conditions such as obesity, diabetes, and cardiovascular diseases. Changes in climate patterns, including increased temperatures and altered precipitation, impact crop yields, food quality, and the availability of diverse and nutritious foods. Shifts in agricultural productivity due to climate change can lead to reduced availability of essential nutrients, affecting dietary quality and increasing the risk of NCDs. In fisheries, climate change impacts include altered fish distribution and reduced fish catches, which are crucial sources of protein and micronutrients. The loss of biodiversity and shifts in species composition due to climate change can lead to a decrease in dietary diversity, exacerbating nutritional deficiencies and the risk of NCDs.

Savage et al. (2020) highlight the complex interplay between climate change, food and nutrition security, and NCDs, particularly in Pacific Island Countries and Territories (PICTs). The review identifies four dominant pathways between climate change, food and nutrition security, and NCDs: impact on agriculture, fisheries, migration, and humanitarian food assistance. These pathways, if unaddressed, could lead to impaired food and nutrition security and an increased burden of NCDs in PICTs. The study emphasizes the urgency for Pacific nations to address the adverse impacts of climate change that exacerbate health risks and other socio-cultural, political, and economic drivers of food and nutrition insecurity and NCDs. It calls for further research to strengthen the evidence and develop integrated, context-specific solutions, advocating for a cross-sectoral, no-regrets, health-in-all-policies approach [3].

 doi:10.20944/preprints202402.1444.v1

4. Specific Non-Communicable Diseases Affected by Climate Change

4.1. Cardiovascular Diseases (CVDs)

Climate change affects cardiovascular health through various mechanisms, including extreme temperatures and increased air pollution. Studies have shown that heat waves significantly increase the risk of acute cardiovascular events, such as heart attacks and strokes. Ambient air pollution, a consequence of climate change, exacerbates cardiovascular diseases by increasing the risk of hypertension, atherosclerosis, and other heart-related conditions. Pollutants such as particulate matter (PM2.5) and ozone contribute to the development of hypertension, diabetes, and atherosclerosis, which are key risk factors for CVD [4]. Additionally, seasonal fluctuations in environmental factors such as temperature and sunlight exposure influence cardiovascular mortality. Winter months often see increased CVD events due to a combination of colder temperatures and behavioral changes [5].

Exposure to extreme temperatures, both hot and cold, has been linked to an increased risk of acute myocardial infarction (AMI) and other cardiovascular events. These temperature extremes can stress the cardiovascular system, leading to increased heart rate, blood pressure, and blood viscosity, thereby elevating the risk of thrombotic events [6]. Both cold and hot temperatures are associated with increased cardiovascular deaths or hospital admissions. The sensitivity to temperature is disease-specific, with different patterns for acute and chronic ischemic heart disease. Vulnerability to temperature-related mortality is associated with factors like age, location, socioeconomic condition, and comorbidities such as cardiac diseases, kidney diseases, diabetes, and hypertension. Temperature-induced damage is related to enhanced sympathetic reactivity followed by activation of the sympathetic nervous system, renin-angiotensin system, dehydration, and a systemic inflammatory response [7]. Heat exposure, particularly from traffic-related particulate matter and diesel emissions, can lead to renal damage by inducing oxidative stress, endoplasmic reticulum stress, and triggering apoptotic pathways in kidney tissues, which may also affect cardiovascular health [8]. Meanwhile, cold exposure can result in myocardial injury by inducing the levels of heat shock proteins, enhancing the generation of creatine phosphokinase-isoenzyme, and increasing the contents of inflammatory markers. It also triggers oxidative stress-involved signaling pathways, playing a pivotal role in myocardial injury resulting from hypothermia [9].

Changes in climate can influence lifestyle behaviors such as physical activity and diet, indirectly affecting CVD risk. Stress and anxiety induced by climate-related disasters can contribute to cardiovascular risk. Climate change can also exacerbate socioeconomic disparities, indirectly increasing CVD risk through reduced access to healthcare and healthy living conditions. A study in Cape Town, South Africa, demonstrated that temperature modifies the effects of air pollution on cardiovascular disease hospital admissions, indicating an interaction between climate variables and air quality [10]. Another study highlighted the biological mechanisms linking environmental changes to atherothrombotic events and the impact of climate change on cardiovascular health [11].

4.2. Kidney Diseases

Climate change contributes to the rise in kidney diseases, primarily through heat-related stress and dehydration. These conditions can cause acute kidney injury (AKI), which, if recurrent, may progress to chronic kidney disease (CKD) [2]. Increased temperatures lead to a higher incidence of heat-related renal failure and hospitalization due to renal diseases [12]. Individuals working in high-temperature environments or living in regions with extreme heat are at a higher risk of kidney diseases. This is particularly evident in agricultural and outdoor workers who are regularly exposed to high temperatures. This study by Borg & Bi, 2020, highlights the increasing incidence of kidney diseases as a consequence of global warming, emphasizing the need for action to minimize the negative impacts of climate change on kidney health [13]. Furthermore, a recent study showed an increased incidence of AKI and hospitalizations due to renal diseases during heat waves and in regions with higher temperatures [14]. The chronic consequences of climate change, such as the increased risk of heart failure in high ambient temperature regions, also have implications for kidney

 doi:10.20944/preprints202402.1444.v1

health. Socioeconomic disparities can exacerbate the risk of kidney diseases in the context of climate change, with lower-income populations being more susceptible due to limited access to healthcare and resources for managing heat stress and dehydration [15].

The burden of CKD attributed to environmental pollution is also a growing concern. The kidney is particularly vulnerable to environmental toxins, which are often concentrated during filtration, leading to increased risk of kidney damage [16]. Toxins and particulate matter in polluted air can lead to increased incidence of CKD and accelerated progression of existing kidney diseases. Fine Particulate Matter (PM2.5) and Coarse Particulate Matter (PM10) are primarily responsible for the adverse effects on kidney health. Gaseous co-pollutants, environmental tobacco smoke, and heavy metals in the air also contribute significantly to kidney disease progression [17]. Inhaled airborne particles can cause vascular injury, intraglomerular hypertension, or glomerulosclerosis through both non-hemodynamic and hemodynamic factors. These factors interact complexly to influence kidney function [17]. Exposure to traffic-related particulate matter, especially from diesel emissions, can lead to renal damage by inducing oxidative stress, endoplasmic reticulum stress, and triggering apoptotic pathways in kidney tissues [8]. Long-term exposure to ambient coarse particulate matter, nitrogen dioxide, and carbon monoxide is associated with an increased risk of chronic kidney disease, estimated glomerular filtration rate (eGFR) decline, and end-stage renal disease. These pollutants can induce systemic inflammation, oxidative stress, and DNA damage, aggravating kidney damage [18].

4.3. Metabolic Diseases

Climate change-induced heat stress can lead to metabolic dysregulation. Heat exposure affects physiological processes that can exacerbate conditions like diabetes and obesity [19]. A systematic review exploring the impact of climate factors like temperature and humidity on gestational diabetes mellitus indicated that climate change could influence metabolic functions and insulin sensitivity, further impacting metabolic health [20]. Heat exposure can induce metabolic diseases such as diabetes and obesity through various cellular mechanisms: First, obesity and associated metabolic dysfunction are linked with ischemic adipose tissue initiating an inflammatory cascade, resulting in systemic insulin resistance and potentially leading to type 2 diabetes mellitus. Regular heat exposure (heat therapy) may improve cardiometabolic health in obese individuals through mechanisms including heat shock proteins, hypoxia-inducible factor (HIF) 1α, and hemodynamic effects [21]. Second, heat exposure can trigger the emergence of beige adipocytes in white adipose depots, which are an inducible form of thermogenic adipocytes. This process is regulated by epigenetic mechanisms, particularly histone methylation, affecting metabolic processes related to obesity and diabetes [22]. Third, obesity is associated with chronic low-level inflammation, contributing to metabolic diseases like diabetes. Heat stress may exacerbate this inflammation, impacting insulin signaling and glucose homeostasis [23]. At last, chronic free fatty acid treatment induces insulin resistance and beta-cell dysfunction. Heat exposure may influence these pathways, impacting the development of metabolic disorders like diabetes [24].

The role of environmental endocrine-disrupting chemicals (EDCs) in the pathogenesis of metabolic diseases is vital, emphasizing the need to consider these factors in addressing the rising rates of metabolic conditions [25]. Climate change is associated with the release and distribution of metabolism-disrupting chemicals (MDCs), which are linked to obesity, diabetes, and non-alcoholic fatty liver disease. These MDCs can disrupt metabolic functions and contribute to the development of metabolic diseases [26]. MDCs, largely belonging to the category of EDCs, include compounds like Bisphenol A (common in plastic products), Tributyltin chloride (used in antifouling paint for boats), and Genistein (a phytoestrogen found in soy-based foods). These substances can disrupt metabolic processes leading to diseases like metabolic syndrome, obesity, Type 2 diabetes mellitus, or fatty liver [27]. MDCs act on fat tissue and liver, may regulate gut functions, and alter hypothalamic peptidergic circuits that control food intake and energy metabolism. For instance, EDCs that bind estrogen receptors may promote metabolic changes through their action on hypothalamic circuits [27]. These chemicals can contribute to metabolic diseases such as liver steatosis and cholestasis by different molecular mechanisms, thereby contributing to the metabolic syndrome. For example, specific MDCs

 doi:10.20944/preprints202402.1444.v1

could induce insulin resistance, dyslipidemia, proinflammatory cytokines, and liver necrosis, leading to conditions like metabolic dysfunction-associated fatty liver disease (MAFLD) [28]. The exposure to MDCs can alter the expression of neuropeptides within the hypothalamic circuits involved in food intake and energy metabolism, which are crucial for maintaining metabolic health. Disruptions in these circuits can lead to metabolic disorders like obesity and diabetes [27]. MDCs also affect various endocrine mechanisms and thus different cell types that are implicated in metabolic control, such as hepatocytes, pancreatic endocrine cells, myocytes, and adipocytes. Their actions include affecting gene expression and the biosynthesis of key enzymes, hormones, and adipokines essential for controlling energy homeostasis [26].

Importantly, altered food availability and environmental conditions due to climate change can lead to unhealthy dietary habits and physical inactivity, increasing the risk of metabolic diseases. Economic stressors resulting from climate change can limit access to healthy food options and healthcare, contributing to the prevalence of metabolic diseases.

4.4. Respiratory Diseases

Climate change increases pollen and allergen production, mold proliferation, and ground-level ozone and particulate matter concentrations, all contributing to respiratory diseases like asthma, rhinosinusitis, chronic obstructive pulmonary diseases (COPD), and respiratory infections. Vulnerable groups include those with pre-existing cardiopulmonary diseases or disadvantaged individuals [29]. Climate change, particularly the increase in greenhouse gases like CO_2, affects plants and molds, leading to shifts in airborne pollen seasons and increased pollen abundance. This can result in higher sensitization rates and exacerbation of allergic diseases. Extreme events such as thunderstorms during pollen seasons can cause asthma attacks in sensitized individuals. The allergenicity of pollen from various plants is also heightened by greenhouse gases like NO_2 [30]. Next, climate change poses a significant health threat, akin to cigarette smoking, causing severe and prolonged heat waves, air pollution, forest fires, droughts, and floods, all of which put respiratory health at risk. These environmental changes substantially increase respiratory morbidity and mortality, particularly for those with chronic lung diseases like asthma and COPD [31]. Climate changes and air pollution have shown consistent increases in asthma prevalence and severity. The interaction between airborne allergens and air pollutants is significant, and the combined exposure enhances IgE-mediated responses and airway inflammation. Pollen allergy studies have revealed complex interrelationships between climate change, air pollution, and respiratory allergic diseases [32]. The synergistic effects of extreme heat and aeroallergens intensify the toxic effect of air pollutants, which in turn augment the allergenicity of aeroallergens. Urban residents and children are particularly sensitive to these environmental exposures [33].

4.5. Mental Health

Climate change significantly impacts mental well-being, leading to an increase in mental health disorders. Extreme weather events and environmental changes induced by climate change can cause psychological distress, anxiety, post-traumatic stress disorder, and depressive symptoms. For instance, experiencing or witnessing natural disasters can result in post-traumatic stress disorder (PTSD) and depression [34]. Indirect effects include socioeconomic disruptions caused by climate change, such as displacement and migration, loss of livelihoods, and food insecurity. These changes can lead to chronic stress, anxiety, and feelings of helplessness [35]. The study by Bourque & Cunsolo Willox, 2014, indicates that climate change impacts mental health at both individual and community levels, with outcomes ranging from psychological distress to increased suicide rates [36]. The mental health effects of climate change are particularly pronounced in vulnerable populations and those living in ecologically sensitive areas. Certain populations, such as children, the elderly, and those with pre-existing mental health conditions, are more vulnerable to the mental health impacts of climate change. Individuals in lower socioeconomic groups are often more exposed to the detrimental effects of climate change, increasing their risk of mental health issues [37]. People living in regions that are more prone to climate-related disasters (e.g., coastal areas, drought-prone regions) also face

 doi:10.20944/preprints202402.1444.v1

a higher risk of mental health impacts. Interestingly, increasing awareness of climate change and its potential catastrophic consequences can lead to eco-anxiety and climate grief, characterized by chronic fear and mourning over environmental losses and future implications [38].

5. Vulnerable Populations and Geographical Areas

Climate change disproportionately affects certain regions and populations due to geographical, socio-economic, and health-related factors. Regions like the Hindu Kush Himalayan (HKH) area and the PICTs are particularly vulnerable due to their geographic and climatic conditions. Vulnerable populations include those living in poverty, indigenous communities, and people with pre-existing health conditions, who are more susceptible to the health effects of climate change. Climate change exacerbates existing health disparities, impacting food security, increasing the risk of heat-related illnesses, and affecting the spread of infectious diseases, all of which contribute to the burden of NCDs.

The HKH region, for instance, is witnessing a rise in infectious diseases, NCDs, malnutrition, and injuries due to climate change [39]. The PICTs are experiencing significant health challenges due to climate change, as these islands are particularly susceptible to rising sea levels, extreme weather events, and changing ecosystems. Savage et al., 2020, provide a comprehensive review of how climate change impacts food and nutrition security (FNS) and the resulting increase in NCDs in the PICTs. Four dominant pathways identified include the impact of climate change on agriculture, fisheries, migration, and humanitarian food assistance. These changes lead to impaired FNS, contributing to an increased burden of NCDs, such as diabetes, heart disease, and obesity. The review calls for urgent action to address these issues through integrated, context-specific solutions and a health-in-all-policies approach [3].

Climate change impacts on health in vulnerable regions encompass a wide range of issues, from direct effects like heat-related illnesses to indirect effects like malnutrition and mental health disorders. In regions like the HKH and PICTs, there is an observed increase in cardiovascular and kidney diseases, as well as mental health issues, due to the environmental stressors caused by climate change. The effects are more pronounced among populations with limited resources and access to healthcare, exacerbating existing health inequalities. Addressing the health impacts of climate change in vulnerable populations and regions requires a multi-faceted approach. Strategies include strengthening healthcare systems, implementing climate-resilient agricultural practices, improving water and sanitation facilities, and enhancing surveillance and response systems for climate-sensitive diseases. Global and regional cooperation is crucial in supporting these adaptation and mitigation measures, particularly in resource-limited settings.

6. Policy and Public Health Implications

Public health initiatives are pivotal in managing the health impacts of climate change. These include programs for increasing public awareness, preventive healthcare measures, and strengthening healthcare infrastructure. The initiatives focus on reducing risk factors associated with NCDs, such as promoting healthy lifestyles and improving air quality, which are also beneficial in mitigating climate change impacts. A study by Borg et al. (2021) highlights the importance of public health initiatives in informal settlements in low- and middle-income countries, particularly in addressing climate change's impact on health, including NCDs [40]. Policy adaptations are required to mitigate the impact of climate change on NCDs effectively. These adaptations include integrating climate change considerations into health policies and programs. Emphasis on reducing air pollution, as it is a significant contributor to NCDs, is crucial. Policies promoting clean energy and sustainable transportation can significantly impact NCD prevention [41]. The development of resilient healthcare systems capable of withstanding climate-related challenges is vital for ensuring continuous care for individuals with NCDs. Rother et al., 2019, emphasize the need for interdisciplinary approaches to address climate-sensitive NCDs. This involves collaboration across various sectors, including health, environment, urban planning, and policy-making. Their study underscores the importance of research in understanding the linkages between climate change and NCDs and developing effective

 doi:10.20944/preprints202402.1444.v1

strategies for adaptation and mitigation. The paper advocates for a comprehensive approach, incorporating climate change considerations into all aspects of health policy and planning [42]. An integrated approach is essential, where climate change strategies also address the risk factors and determinants of NCDs. Encouraging cross-sectoral collaboration and ensuring that climate policies are health-centric can lead to co-benefits for both climate mitigation and NCD prevention. Investing in research to better understand the complex interactions between climate change and NCDs will inform more effective public health policies and interventions.

7. Future Research and Directions

The intersection of climate change and NCDs presents an evolving field of research, with significant gaps and potential areas for future exploration. Current research on the relationship between climate change and NCDs is not comprehensive. There are gaps in understanding the direct and indirect pathways through which climate change influences various NCDs. Moreover, research on certain NCDs, such as mental health disorders and their relation to climate change, is limited and requires more attention. The study by Frick et al., 2021, discusses the knowledge-action gap in healthy and climate-friendly behavior, indicating a need for more research on behavior change to mitigate both climate change and the spread of NCDs [43].

There is a pressing need for integrated studies that combine climate science and health research. This approach will enhance our understanding of the complex interactions between environmental changes and human health. Research should also focus on the socio-economic impacts of climate change and how they indirectly influence NCDs through changes in lifestyle, food security, and stress levels. The study by Bi et al., 2020, highlights the knowledge gaps in studying the impact of climate change on health, emphasizing the need for integrated research approaches [44]. Colagiuri et al., 2015, suggest prioritizing research areas at the interface of NCDs and climate change. They emphasize the importance of exploring the impacts on water security, transport, and urban planning to support policy formation. The suggestion includes a focus on reducing the carbon footprint of cities and understanding how urban design and transport policies can mitigate both climate change and NCD prevalence. Their study calls for a comprehensive approach that integrates NCD prevention strategies with climate change mitigation efforts [45].

Future research should prioritize identifying vulnerable populations most affected by the dual challenges of climate change and NCDs. Interdisciplinary collaboration across climate science, public health, urban planning, and policy-making is crucial for developing comprehensive strategies. Funding agencies and international bodies should support research that addresses these intersections and contributes to the global understanding of climate change impacts on health.

8. Summary

The interplay between climate change and NCDs presents critical challenges for global health. This review has synthesized key findings that underscore the multifaceted impact of climate change on NCDs and the urgent need for comprehensive strategies to mitigate these effects. Key findings from the reviewed studies reveal that climate change directly and indirectly influences the prevalence and severity of NCDs. For instance, extreme weather conditions exacerbate cardiovascular and kidney diseases, while changes in agricultural productivity and food security heighten the risks of malnutrition and related NCDs. Additionally, mental health is adversely affected, particularly in vulnerable populations and regions such as the PICTs, which face significant health challenges due to climate change. As climate change continues to impact environmental and social determinants of health, the burden of NCDs is likely to escalate, particularly in low- and middle-income countries. This calls for an urgent integration of climate change considerations into public health policies and NCD prevention strategies. Addressing these challenges requires collaborative efforts across disciplines and sectors. Interdisciplinary research combining insights from climate science and health is essential to understand the complex dynamics at play and to develop effective mitigation and adaptation strategies. Moreover, global cooperation and policy alignment are necessary to ensure that health systems are resilient and capable of responding to the increasing burden of NCDs amid

 doi:10.20944/preprints202402.1444.v1

changing climatic conditions. In summary, the intersection of climate change and NCDs represents a significant public health issue that necessitates a concerted global response. By embracing an integrated and collaborative approach, there is potential to safeguard health and well-being in the face of a changing climate.

Funding: This research receives no external funding.

Conflicts of Interest: The authors have no competing interests to declare.

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