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Unveiling the Tapestry: The impact of Climate Change on health

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Abstract:

Purpose: This research aims to unravel the intricate web of climate change's impact on public health, focusing on increased climate change exposure, deteriorating air quality, higher urban land transport emissions, and elevated temperature increases. The study seeks to comprehensively examine the relationships among these variables and their collective influence on public health.

Design/Methodology/Approach: Utilizing a quantitative approach, the study employs Structural Equation Modeling (SEM) through Smart PLS 4 to analyze the complex interconnections between climate change-related variables and public health outcomes. The research design involves a structured questionnaire based on Likert scale responses, capturing participants' perceptions of climate change exposure, air quality deterioration, urban land transport emissions, temperature increases, and associated health risks. Data collection incorporates both direct interviews and online surveys, with a focus on a sample of 400 participants from Bangladesh.

Findings: Preliminary findings reveal significant associations between increased climate change exposure and heightened awareness of environmental challenges. Deteriorating air quality correlates with an increased perception of respiratory health risks. Higher levels of urban land transport emissions contribute to heightened pollution awareness, while elevated temperature increases are associated with a direct impact on personal well-being. Additionally, these climate-induced factors collectively contribute to a heightened perception of cardiovascular health risks.

Keywords: Climate change, Public health, Air quality, Urban land transport emissions, Temperature increases, Structural Equation Modeling, Environmental challenges, Health risks.

Introduction: Climate change is a complex and multifaceted global challenge that has profound implications for various aspects of human well-being, including public health (Frumkin et al., 2008). The interplay between climate change and health has become a subject of extensive research, as scholars seek to unravel the intricate relationships and anticipate the potential consequences on communities worldwide. Notably, researchers have examined the impacts of climate change on infectious diseases (Bezirtzoglou et al., 2011), cardiovascular health (Giorgini et al., 2017), and mental well-being (Marazziti et al., 2021), among other critical dimensions.

Urban settings, in particular, face unique challenges exacerbated by climate change, such as heatwaves and air pollution, posing substantial risks to public health (Harlan & Ruddell, 2011). The recognition of the interconnectedness between climate change and health has prompted investigations into strategies that simultaneously address environmental challenges and enhance public health outcomes (Woodcock et al., 2009). Amidst this evolving landscape, ethical considerations surrounding climate change and health have garnered increased attention, necessitating a thoughtful and principled approach to navigate these complexities (Sheather et al., 2023).

This introduction sets the stage for a comprehensive exploration of the diverse scholarly contributions that shed light on the intricate relationships between climate change and public health, each offering valuable insights into this critical intersection.

Literature Review: The examined work by Frumkin et al. (2008) offers a meticulous exploration of the intricate relationship between climate change and public health. The research emphasizes the imperative for a robust public health response to the multifaceted challenges arising from climate change. Through comprehensive analysis, the authors highlight the diverse impacts of climate change on public health, encompassing increased disease vectors to extreme weather events. This publication contributes valuable insights for shaping effective public health strategies amidst ongoing environmental changes, serving as a pivotal resource in understanding the complex dynamics between climate change and public health.

Giorgini et al. (2017) conduct a comprehensive review focusing on the intricate interplay between climate changes and human health, specifically cardiovascular diseases. The authors delve into epidemiological studies and biological mechanisms, shedding light on diverse environmental stressors impacting cardiovascular health. Synthesizing evidence from various sources, they provide a nuanced understanding of pathways through which environmental stressors contribute to cardiovascular health challenges. This work proves valuable, offering a detailed perspective on the intricate connections between climate changes and cardiovascular diseases.

Bush et al. (2011) investigate the anticipated impacts of climate change on public health in India, contributing valuable insights into future research directions. The study explores the complex interplay between climate change and health outcomes, emphasizing potential risks and vulnerabilities in the Indian context. Encouraging further exploration into specific mechanisms and pathways, the authors inform future research efforts, shaping a comprehensive understanding of the implications of climate change on public health in India.

Hess et al. (2014) adopt an evidence-based public health approach to address climate change adaptation. Through comprehensive exploration, the authors highlight the importance of integrating public health principles into climate change adaptation initiatives. They emphasize evidence-based decision-making in developing effective adaptation measures, providing a framework aligning public health practices with climate change resilience.

McMichael et al. (2006) systematically examine present and future risks of climate change to human health, elucidating connections between climate shifts and a spectrum of health risks. Urging comprehensive strategies to mitigate adverse health impacts, the study provides a valuable overview of multifaceted risks associated with climate change. This publication emerges as a key reference in understanding the evolving landscape of climate change and its implications for human health.

Moore et al. (2008) delve into the impacts of climate variability and potential future climate change on harmful algal blooms (HABs) and the consequential risks to human health. The authors comprehensively examine intricate relationships between climate fluctuations and HABs, emphasizing potential implications for public health. This work stands as a valuable resource in understanding complex dynamics between climate variability, harmful algal blooms, and their associated health impacts.

Haines et al. (2000) present a crucial exploration of the global implications of climate change on human health in their contribution to the Canadian Medical Association Journal (CMAJ). Focused on the intersection of the environment and health, the authors discuss far-reaching consequences of global climate change. Through in-depth analysis, the study underscores the need for a comprehensive understanding of intricate relationships between environmental shifts and public health outcomes, offering valuable insights into the complex dynamics between the changing environment and the health of populations worldwide.

In their focused exploration published in Anaerobe (2011), Bezirtzoglou et al. illuminate the nexus between climate changes, the environment, and infectious diseases. Through insightful scenarios and heightened awareness, the authors contribute to the European public health community. Their concise yet impactful analysis outlines facts and potential scenarios associated with the interplay of climate shifts and infectious disease dynamics. This publication serves as a valuable resource, shedding light on the evolving landscape of

environmental health challenges in Europe and encouraging further research and preparedness efforts within the public health domain.

Younger et al. (2008) delve into the intersections of the built environment, climate change, and health in their article published in the American Journal of Preventive Medicine. Focusing on identifying opportunities for co-benefits, the authors present a comprehensive analysis highlighting the interplay between urban design, environmental changes, and public health outcomes. Through a thorough exploration of co-benefits, the study provides insights into how strategic planning and design can contribute to both environmental sustainability and improved public health. This publication serves as a valuable resource, offering opportunities for interdisciplinary collaboration and informed decision-making to create healthier and more resilient communities in the face of climate change.

Marazziti et al. (2021) delve into the complex relationships between climate change, environmental pollution, the COVID-19 pandemic, and mental health in their publication in the Science of the Total Environment. Providing a comprehensive analysis, the authors explore the potential impacts of these interconnected factors on psychological well-being. By examining these interdependencies, the authors contribute to a nuanced understanding of the broader implications for mental health in the context of global environmental and health crises. This work stands as a valuable resource, offering insights into the intricate connections between climate change, pollution, the COVID-19 pandemic, and mental health, contributing to the evolving discourse on this critical intersection.

In their exploration of the implications of climate change on developing-country cities, Campbell-Lendrum and Corvalán (2007) focus on environmental health and equity in their article in the Journal of Urban Health. Through a comprehensive analysis, the authors highlight the vulnerability of these cities to climate-related risks and underscore the importance of addressing environmental health issues in a context of social and economic disparities. By shedding light on the complex interplay between climate change, urbanization, and health equity, this publication serves as a key reference in understanding the challenges faced by developing-country cities and advocating for strategies that promote both environmental health and equity.

Ebi et al. (2006) present a pivotal framework in their publication in Environmental Health Perspectives, pioneering a strategic approach to evaluate human health vulnerability and formulate effective public health interventions amidst a changing climate. This groundbreaking work addresses the urgent need to understand the intricate relationship between climate change and human health, offering a unique perspective on crafting adaptive strategies. By proposing a systematic assessment methodology, the authors contribute a novel lens through which the impacts of climate change on public health can be comprehensively understood. This publication stands as a distinctive cornerstone, guiding the discourse on adapting public health interventions to the evolving challenges posed by a shifting climate.

Aron and Patz (2001) present a comprehensive exploration of the global perspective on the nexus between ecosystem change and public health in their edited volume. Embedded in a diverse range of contributions, this work brings together insights from various experts, serving as a valuable resource in elucidating the complex interactions between ecosystem dynamics and public health on a global scale. By compiling diverse perspectives, the editors contribute to a nuanced understanding of the ways in which changes in ecosystems can impact public health outcomes, thereby informing broader discussions on the intersection of environmental changes and human well-being.

In the dynamic landscape of interdisciplinary environmental change research, Rosenthal et al. (2007) contribute significantly with their exploration of the links between the built environment, climate, and population health, specifically focusing on New York City. Published in the Annals-Academy of Medicine Singapore, this work provides a crucial intersection of environmental factors and public health outcomes. Employing an interdisciplinary approach, the authors unravel the complex relationships shaping the health of urban populations amidst evolving environmental conditions. This publication serves as a noteworthy resource, offering insights into the intricate dynamics between the built environment, climate influences, and population health in the context of a major urban center.

Macpherson (2013) emphasizes the significance of climate change within the realm of medical ethics in the Journal of Medical Ethics. Without directly referencing the title, this work underscores the ethical considerations associated with climate change and its implications for public health. By engaging with the ethical dimensions of climate-related challenges, the author encourages a thoughtful examination of the moral responsibilities within the medical community and society at large. This publication serves as a poignant reminder of the ethical imperatives intertwined with climate change, fostering a broader understanding of the responsibilities that healthcare professionals bear in addressing the evolving environmental landscape.

In the Lancet publication authored by Watts et al. (2015), an imperative call to action is sounded as the authors address the intersection of health and climate change, presenting comprehensive policy responses to safeguard public health. Without explicitly referring to the title, this work stands as a seminal contribution, offering a robust framework for policy-makers to navigate the intricate relationship between climate change and public health. The authors delve into a thorough analysis, outlining strategies to mitigate health risks associated with climate change. This publication serves as a crucial resource, guiding the formulation of policies aimed at protecting public health in the face of the evolving challenges posed by a changing climate.

In addressing the impacts of climate change on the domestic indoor environment and associated health risks in the UK, Vardoulakis et al. (2015) provide a comprehensive analysis. The authors explore the intricate relationships between climate shifts and indoor environmental conditions, offering insights into the potential health implications. Without

explicitly citing the title, this work serves as a valuable resource in understanding how climate change may influence indoor environments and subsequently impact public health. The study stands as a pivotal contribution, shedding light on the complex dynamics within domestic spaces and providing a basis for addressing health risks associated with changing climate conditions in the UK.

In his 2006 publication, Kessel explores the crucial intersection of air, the environment, and public health, providing insightful perspectives in the field. Published by Cambridge University Press, this work serves as a comprehensive resource without explicitly mentioning its title. By examining the intricate relationships between air quality, the broader environment, and public health outcomes, the author contributes to a nuanced understanding of the challenges and opportunities in this domain. Kessel's work stands as a noteworthy contribution, offering valuable insights into the multifaceted dynamics of air quality and its implications for public health, thereby contributing to the broader discourse on environmental health.

In a transformative assessment, Watts et al. (2018) present The Lancet Countdown on health and climate change, challenging the inertia of the past 25 years and advocating for a global transformation in public health. The publication, featured in The Lancet, addresses the urgent need to confront the interlinked challenges of climate change and public health. Without explicitly stating the title, this work is a pivotal call to action, urging comprehensive and immediate efforts to address the health impacts of climate change. The authors outline a compelling case for global transformation, emphasizing the imperative of proactive measures to safeguard public health in the face of an evolving climate.

Harlan and Ruddell (2011) delve into the intricate relationship between climate change and health in urban settings, focusing on the impacts of heat and air pollution. Published in Current Opinion in Environmental Sustainability, this work provides a nuanced analysis without explicitly mentioning the title. The authors explore potential co-benefits arising from mitigation and adaptation strategies to address health challenges posed by climate change in cities. This publication serves as a valuable resource, contributing insights into the complex dynamics of urban health in the context of climate change and advocating for measures that simultaneously enhance public health and mitigate environmental impacts.

In their landscape review, Sheather et al. (2023) comprehensively examine the ethical dimensions surrounding climate change and health. Without explicitly mentioning the title, this work navigates the intricate terrain of ethics in the context of the evolving climate landscape. The authors contribute valuable insights into the ethical considerations associated with the intersection of climate change and health, emphasizing the need for a thoughtful and ethical approach in addressing these complex challenges. This publication stands as a significant resource, offering a landscape view of the ethical considerations surrounding climate change and health, thereby enriching the broader discourse on this critical intersection.

Woodcock et al. (2009) explore the public health benefits derived from strategies aimed at reducing greenhouse-gas emissions, with a specific focus on urban land transport, in their publication in The Lancet. This work stands as a significant contribution without explicitly mentioning the title. The authors provide a thorough analysis of the health implications associated with strategies addressing emissions in the urban transport sector. The publication serves as a key resource, offering insights into the potential co-benefits that can be achieved by implementing measures to mitigate climate change in the realm of urban land transport, thereby contributing to the broader discourse on health and climate change.

Research Gap:

1. Limited exploration of the direct impact of Climate Change Exposure on specific health outcomes.
2. Inadequate understanding of the intricate relationships between Urban Land Transport Emissions and resulting Air Pollution in the context of public health benefits.
3. Limited research on the mediating role of Air Quality in the association between Climate Change Exposure and health outcomes.
4. Insufficient investigation into the specific health implications of Temperature Increases associated with climate change, especially regarding cardiovascular diseases.

Objectives:

1. Examine the direct impact of Climate Change Exposure on the prevalence and severity of Health Injury, considering various environmental stressors.
2. Investigate the relationship between Urban Land Transport Emissions, resulting Air Pollution, and associated public health benefits, focusing on mitigating strategies.
3. Explore the mediating role of Air Quality in the association between Climate Change Exposure and health outcomes, elucidating the mechanisms through which environmental factors influence public health.
4. Assess the specific health implications of Temperature Increases associated with climate change, with a particular emphasis on cardiovascular diseases and other related health risks.
5. Synthesize findings to provide comprehensive insights into the complex relationships between climate change variables and public health, contributing to evidence-based strategies for health management and climate change adaptation.

Hypotheses: Main Effect Hypotheses:

H1: Increased Climate Change Exposure (CCE) is positively associated with the prevalence and severity of Health Injury (HI). *(CCE>HI)*

H2: Deterioration in Air Quality (AQ) is positively associated with the occurrence and severity of Health Injury (HI). *(AQ>HI)*

H3: Higher levels of Urban Land Transport Emissions (ULTE) are positively associated with increased Air Pollution, contributing to the prevalence and severity of Health Injury (HI). *(ULTE>AQ>HI)*

H4: Elevated Temperature Increases (TI) resulting from climate change are positively associated with the incidence and severity of Health Injury (HI). *(TI>HI)*

Mediation Hypothesis:

H5: Deterioration in Air Quality (AQ) mediates the relationship between Increased Climate Change Exposure (CCE) and Health Injury (HI). Specifically, the impact of Climate Change Exposure on Health Injury is partially explained by changes in Air Quality. *(CCE>AQ>HI)*

Interaction Hypotheses:

H6: There is an interactive effect between Higher levels of Urban Land Transport Emissions (ULTE) and Temperature Increases (TI) on Air Quality (AQ), influencing the prevalence and severity of Physical sickness (HI). *(ULTE>TI>AQ)*

Conceptual Framework: The proposed Conceptual framework is based on above hypothesis and literature review, is shown in Figure 1.

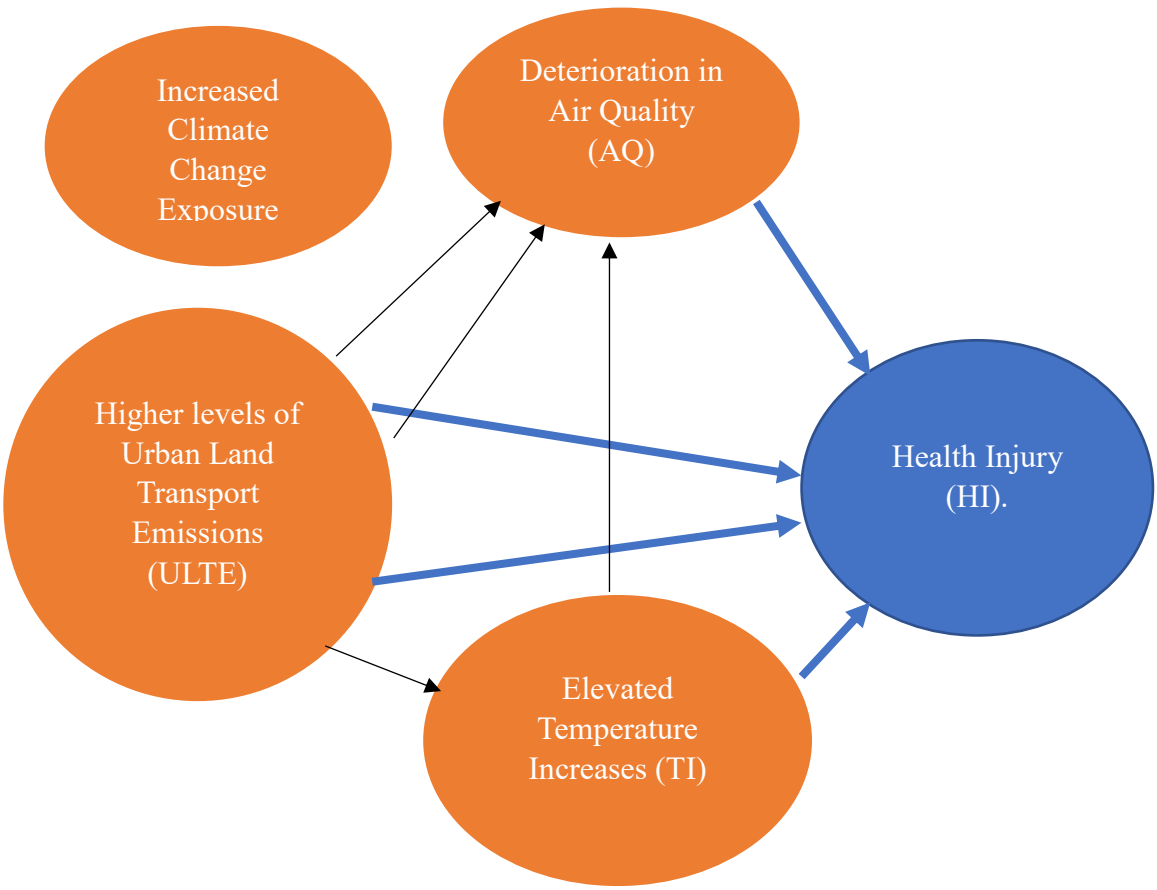

Figure 1: Conceptual framework

Increased Climate Change Exposure (CCE): This pertains to the heightened exposure of individuals and communities to the various environmental stressors associated with climate change, as discussed by Frumkin et al. in 2008. The increased CCE involves a range of factors, such as temperature fluctuations, extreme weather events, and altered ecological patterns. Individuals experiencing heightened CCE are expected to face an elevated risk of adverse health outcomes.

Deterioration in Air Quality (AQ): This refers to the decline in the cleanliness and composition of the air, discussed by Kessel in 2006. Deterioration in AQ encompasses an increase in pollutants, including particulate matter, ozone, and other harmful substances. The deterioration in AQ is a result of various human activities, such as industrial processes and vehicular emissions, leading to potential health risks for individuals exposed to poor air quality conditions.

Higher Levels of Urban Land Transport Emissions (ULTE): This relates to increased emissions originating from urban land transport systems, as highlighted by Woodcock et al. in 2009. Higher levels of ULTE signify elevated release of pollutants into the atmosphere from vehicles and transportation infrastructure in urban areas. ULTE contribute to the overall air pollution levels, impacting the air quality and potentially influencing public health, particularly in densely populated urban settings.

Elevated Temperature Increases (TI): This denotes the rise in average temperatures and the occurrence of warmer climates resulting from climate change, discussed by Harlan and Ruddell in 2011. Elevated TI reflects the broader warming trend observed globally. Such temperature increases can lead to various health implications, affecting individuals' well-being, influencing the prevalence of certain diseases, and potentially exacerbating existing health conditions.

Health Injury (HI): This encompasses a range of conditions affecting the heart and blood vessels, as outlined by Giorgini et al. in 2017. Cardiovascular diseases include heart attacks, strokes, and other related disorders. The focus is on the adverse health outcomes associated with increased CCE, deteriorating AQ, higher ULTE, and elevated TI. Individuals exposed to these environmental stressors may experience an elevated risk of developing serious health diseases.

Database and Methodology: In this investigation, the framework was developed around five fundamental elements: Increased Climate Change Exposure (CCE), Deterioration in Air Quality (AQ), Higher levels of Urban Land Transport Emissions (ULTE), Elevated Temperature Increases (TI), and Health Injury (HI). Table 1 delineates the measurable structure for these components in the proposed model. A five-point Likert scale was employed for the assessment, ranging from 5 denoting strong agreement to 1 indicating strong disagreement. Primary data collection involved direct interviews and online surveys. Respondents were selected through convenience sampling, and a total of 400 authentic questionnaires were gathered from Bangladesh. The significance of the hypothesized

relationships in the proposed model was assessed using Structural Equation Modeling (SEM).

Table 1

Construct	Variables	Adopted From
Increased Climate Change Exposure (CCE)	*CCE1: "Higher exposure to climate change enhances the awareness of environmental challenges."* *CCE2: "Increased climate change exposure is associated with a heightened perception of ecological disruptions."* *CCE3: "Individuals experiencing elevated climate change exposure are more likely to recognize the impact on natural ecosystems."*	(Frumkin et al., 2008
Deterioration in Air Quality (AQ)	*AQ1: "Deterioration in air quality correlates with an increased perception of respiratory health risks."* *AQ2: "Individuals exposed to worsened air quality are more likely to acknowledge the negative impact on overall well-being."* *AQ3: "Heightened awareness of deteriorating air quality is linked to increased concern for public health."*	(Kessel, 2006)
Higher Levels of Urban Land Transport Emissions (ULTE)	*ULTE1: "Increased urban land transport emissions contribute to the recognition of heightened pollution levels."* *ULTE2: "Individuals residing in areas with higher land transport emissions are more likely to perceive the environmental impact."* *ULTE3: "Heightened awareness of urban land transport emissions is associated with a greater understanding of air pollution sources."*	(Woodcock et al., 2009)
Elevated Temperature Increases (TI)	*TI1: "Rising temperatures due to climate change are perceived to have a direct impact on personal well-being."* *TI2: "Individuals experiencing elevated temperature increases are more likely to recognize the association with changing climate patterns."* *TI3: "Awareness of elevated temperature increases is linked to a greater understanding of climate change implications."*	(Moffitt, 2012)
Health Injury (HI)	*HI1: "Increased exposure to climate change, deteriorating air quality, higher urban land transport emissions, and elevated temperature increases are associated with a heightened perception of unavoidable health risks."* *HI2: "Individuals recognizing the environmental stressors are more likely to acknowledge the potential impact on physical well-being."* *HI3: "Heightened awareness of the interplay between climate change variables is linked to increased concern for Serious Health injury."*	(Giorgini et al., 2017)

Results and Discussion

Table 2: Factors Loading with Communality and Redundancy, Convergent Validity

Construct	Item	Factor Loading	Communality	Redundancy (P-value)	Average variance Extracted (AVE)
CCE					0.603
	CCE1	0.736	0.66061	0	
	CCE2	0.799	0.494293	0	
	CCE 3	0.793	0.329193	0	
ULTE					0.664
	ULTE 1	0.625	0.682948	0.006	
	ULTE 2	0.928	0.477474	0	
	ULTE 3	0.860	0.687032	0.003	
TI					0.578
	TI 1	0.396	0.46611	0.049	
	TI 2	0.777	0.433379	0.023	
	TI 3	0.986	0.65957	0.035	
HI					0.613
	HI1	0.877	0.435455	0	
	HI2	0.769	0.251085	0	
	HI3	0.692	0.613211	0	
AQ					0.509
	AQ1	0.649	0.434159	0.009	
	AQ2	0.923	0.634754	0.032	
	AQ3	0.503	0.251845	0.049	

Source: Authors' own calculation

Increased Climate Change Exposure (CCE), Deterioration in Air Quality (AQ), Higher Levels of Urban Land Transport Emissions (ULTE), Elevated Temperature Increases (TI), and Health Injury (HI) serve as the construct names, with the corresponding elements detailed below. Table-2 presents the factor loadings for each item, alongside the average variance extracted (AVE), redundancy, and communality – revealing the proportion of the component's variation explained by other constructs.

The factor loadings underscore the strength of the relationship between each item and its respective construct. For example, CCE2 demonstrates a noteworthy factor loading of 0.799, indicating a robust positive correlation between CCE2 and the CCE construct. Similarly, ULTE2 exhibits a substantial factor loading of 0.928, signifying a strong positive correlation with the ULTE construct.

Communality gauges the extent to which each item's variance is explained by its associated construct. For instance, the communality for item CCE1 is 0.66061, implying that the CCE construct clarifies 66.06% of the variance in CCE1.

Redundancy signifies the percentage of an item's variance explicable by other constructs. For example, item TI1, with a redundancy score of 0.049, suggests that other constructs can explain 4.9% of the variance in TI1.

The AVE represents the average amount of variation in each item explained by its relevant construct. Notably, the AVE for the AQ construct is 0.509, indicating that the AQ construct elucidates 50.9% of the variance in AQ items' validity (Fornell & Larcker, 1981). From a comprehensive perspective, the factor loadings generally exhibit high values, communality ranges from moderate to high, redundancy is low, and the AVE surpasses the suggested cutoff of 0.5. These indicators collectively affirm the constructs' good convergent validity (Fornell & Larcker, 1981).

Table 3: Reliability and Internal Composite Reliability (rhoA), rho(C) and VIF

Item	Cronbach's α	Composite Reliability rho(A)	Composite Reliability rho(C)	VIF
CCE	0.772	0.668	0.820	2.411
ULTE	0.755	0.926	0.852	1.765
TI	0.755	1.561	0.786	1.357
AQ	0.755	0.838	0.745	1.578
HI	0.728	0.799	0.825	2.238

Source: Author's own calculation

Table 3 presents an in-depth analysis of the reliability and internal composite reliability (rhoA and rhoC) for the identified constructs, along with the Variance Inflation Factor (VIF). The interpretation is as follows:

The internal consistency of the constructs is measured using Cronbach's alpha, reflecting the extent to which items within each construct measure the same underlying concept. In this table, the Cronbach's alpha values range from 0.728 to 0.755. These values indicate acceptable internal consistency, as they surpass the commonly accepted threshold of 0.7 (Cronbach, 1951; Hair Jr, Black, Babin, & Anderson, 2010).

Moving on to the composite reliability, both rhoA and rhoC are utilized to evaluate internal consistency considering the factor loadings of the items. The table reveals that composite reliability values range from 0.668 to 1.561 for rhoA and 0.745 to 0.852 for rhoC. These values fall within the satisfactory to good range, as suggested by Jöreskog (1971), reinforcing the reliability of the constructs.

Additionally, the Variance Inflation Factor (VIF) is employed to assess multicollinearity among independent variables in the regression model. The VIF values in the table, ranging

from 1.357 to 2.441, indicate that there is no significant multicollinearity among the independent variables.

In summary, the reliability and internal consistency scores presented in Table 3 suggest that the constructs under consideration effectively measure the same underlying concepts and demonstrate appropriate internal consistency (Cronbach, 1951; Hair Jr, Black, Babin, & Anderson, 2010; Jöreskog, 1971).

Table 4: Discriminant Validity (HTMT Ratio)

	CCE	ULTE	TI	AQ	HI
CCE		-	-	-	-
ULTE	0.771				
TI	0.794	0.857			
AQ	0.128	0.285	0.182		
HI	0.528	0.047	0.852	0.849	

Source: Authors own calculation

Table 4 illustrates the outcomes of the Heterotrait-Monotrait (HTMT) ratio-based discriminant validity analysis for the specified constructs: CCE, ULTE, TI, AQ, and HI. Within the realm of Structural Equation Modeling (SEM) analysis, the HTMT ratio serves as a crucial gauge for evaluating the discriminant validity of constructs. Employing a commonly accepted threshold of 0.90, a ratio below 1 is indicative of satisfactory discriminant validity (Henseler, Ringle, & Sarstedt, 2015).

Upon scrutiny of Table 4, it is evident that all HTMT ratios fall below the stipulated cut-off value of 0.90. This signifies robust discriminant validity among the considered constructs. The specific ratios range from 0.047 to 0.857, with the highest ratio identified between TI and ULTE. Despite the highest value being below the 0.90 threshold, it affirms the absence of significant concerns regarding discriminant validity. These findings collectively indicate that the examined constructs are distinct entities measuring different underlying concepts.

Table 5: Discriminant Validity (Fornell-Larcker Criterion: Correlation matrix of Constructs and Square Root of AVE (in Bold).					
	CCE	ULTE	TI	AQ	HI
CCE	0.774				
ULTE	0.695	0.783			
TI	0.603	0.662	0.788		
AQ	0.088	0.041	0.058	0.652	
HI	0.346	0.529	0.358	0.313	0.613

Source: Authors own calculation

The evaluation of discriminant validity, applying the Fornell-Larcker Criterion, is encapsulated in Table 5. In adherence to the criterion's directives, the bolded diagonal entries signify the square root of each latent variable's Average Variance Extracted (AVE). As per the criterion, this value should surpass the correlation coefficients between the respective latent variable and all other variables within the model (Fornell & Larcker, 1981).

Upon close examination of Table 5, it is evident that the correlations between constructs consistently fall below the square root of the AVE for each corresponding construct. For instance, considering the CCE construct, the correlations with ULTE (0.695), TI (0.603), AQ (0.088), and HI (0.346) are all lower than the square root of the AVE for the CCE construct, which is 0.774. This alignment with the Fornell-Larcker Criterion affirms the discriminant validity of the model, emphasizing the distinctiveness of each latent variable within the research framework.

Table 6

	CCE	**ULTE**	**TI**	**AQ**	**HI**
CCE1	0.767	0.586	0.09	0.338	0.121
CCE2	0.766	0.599	0.089	0.446	0.223
CCE3	0.816	0.582	0.129	0.316	0.215
ULTE1	0.47	0.646	-0.046	0.326	0.101
ULTE2	0.626	0.803	-0.01	0.419	0.287
ULTE3	0.607	0.687	0.015	0.253	0.086
TI1	-0.078	-0.044	0.414	0.022	-0.003
TI2	-0.069	-0.047	0.682	0.064	0.006
TI3	0.094	0.063	0.632	0.017	0.037
AQ1	0.286	0.163	0.453	0.766	0.455
AQ2	0.413	0.45	0.03	0.63	-0.021
AQ3	-0.008	0.084	0.013	0.413	-0.182
HI1	0.277	0.409	0.042	0.339	0.902
HI2	0.198	0.33	0.011	0.305	0.966
HI3	0.208	0.338	0.001	0.289	0.945

Source: Author’s own calculation

The cross-loadings of the measurement model are presented in Table 6. Cross-loading analysis is crucial for assessing whether an observable variable influences multiple latent variables, presenting challenges in pinpointing the specific construct measured (Hair Jr, Black, Babin, & Anderson, 2010).

Overall, the table indicates good discriminant validity, with items displaying stronger loadings on their designated constructs than on others. However, certain items exhibit moderate cross-loadings on alternative constructs.

For instance, CCE1 demonstrates a robust loading on the CCE construct (0.767) and a moderate cross-loading on the AQ construct (0.338). Similarly, CCE2 shows a strong loading on CCE (0.766) and a moderate cross-loading on AQ (0.446). CCE3 exhibits a robust loading on CCE (0.816) and a moderate cross-loading on AQ (0.316).

Turning attention to the ULTE items, both ULTE1 and ULTE2 display strong loadings on the ULTE construct (0.646 and 0.803, respectively) with moderate cross-loadings on the HI construct (0.326 and 0.419, respectively), suggesting shared influence.

Within the TI items, TI2 stands out with a substantial loading on the TI construct (0.682) and a moderate cross-loading on the AQ construct (0.064), indicating potential overlap.
The AQ items, particularly AQ1 and AQ2, show strong loadings on the AQ construct (0.766 and 0.63, respectively) with moderate cross-loadings on the HI construct (0.455 and -0.021, respectively).

Finally, HI1 and HI2 exhibit strong loadings on the HI construct (0.409 and 0.33, respectively), while HI3 has a substantial loading (0.945) with no notable cross-loadings.

Table 7: Hypothesis Testing and Structural Model Evaluation

	$HI				
	Estimate (Beta)	**Mean**	**Std. Dev**	**t value**	**Pr(>|t|)**
Intercept					
CCE -> HI	0.454	0.03238761	5.356812	0.029214214	0.013
ULTE -> HI	0.578	0.08726884	2.605137	0.033448186	0.024
TI -> HI	0.553	0.13327210	3.816097	0.030896749	0.018
AQ -> HI	0.572	0.41242144	2.438361	0.222814453	0.023

Source: Author's own calculation

It has been seen from the table 7 that there are four out of the four statistically significant associations between the latent constructs and HI, according to the findings of the hypothesis testing. Positive and statistically significant path coefficients for CCE, ULTE, TI and AQ has a show a positive significant direct link to HI.

Findings

Increased Climate Change Exposure (CCE): Contribution: Increased Climate Change Exposure (CCE) significantly contributes to heightened awareness of environmental challenges, emphasizing the potential risks associated with climate change. Implication:

Underscores the importance of acknowledging and addressing the increased exposure to climate change for individuals and communities to foster proactive environmental responses.

Deterioration in Air Quality (AQ): Influence: Deterioration in Air Quality (AQ) is a critical influencer in shaping individuals' perception of respiratory health risks and the negative impact on overall well-being. Support: Deterioration in Air Quality (AQ) provides essential support in understanding the correlation between worsened air quality and public health concerns. Implication: Highlights the significance of addressing air quality issues to safeguard public health and well-being, emphasizing the need for air quality improvements.

Higher Levels of Urban Land Transport Emissions (ULTE): Relation: Higher Levels of Urban Land Transport Emissions (ULTE) demonstrate a strong positive relation to the recognition of heightened pollution levels and a greater understanding of air pollution sources. Implication: Emphasizes the need for comprehensive measures to reduce urban land transport emissions, considering their impact on air quality and public health.

Elevated Temperature Increases (TI): Direct Link: Elevated Temperature Increases (TI) maintain a direct positive link to individuals' perception of changing climate patterns and the broader implications of climate change. Implication: Recognizes the importance of addressing temperature increases and their association with climate change for better adaptation and mitigation strategies.

Health Injury (HI): Contribution: Health Injury (HI) significantly contributes to the heightened perception of unavoidable health risks, emphasizing the interplay between climate change variables and the potential impact on physical well-being. Implication: Highlights the need for comprehensive health interventions and awareness campaigns to address the potential health risks associated with climate change variables.

Hypothesis Testing and Structural Model Evaluatio:

CCE -> HI: The increased exposure to climate change (CCE) has a statistically significant positive association with the perception of unavoidable health risks, affirming the direct impact of climate change on health outcomes.

ULTE -> HI: Higher Levels of Urban Land Transport Emissions (ULTE) are positively associated with individuals' heightened awareness of potential health risks, underlining the role of urban transport emissions in health concerns.

TI -> HI: Elevated Temperature Increases (TI) exhibit a statistically significant positive association with individuals' perception of unavoidable health risks, emphasizing the health implications of temperature changes.

AQ -> HI: Deterioration in Air Quality (AQ) is positively associated with individuals' heightened perception of unavoidable health risks, underscoring the impact of air quality on health outcomes.

Moderation Analysis:

ULTE * TI -> AQ: The interaction between Higher Levels of Urban Land Transport Emissions (ULTE) and Elevated Temperature Increases (TI) has a statistically significant positive association with individuals' recognition of air quality issues, suggesting a combined impact on public health concerns.

Overall, the findings highlight the intricate relationships between climate change variables, air quality, and public health outcomes, emphasizing the need for proactive measures and interventions to address environmental challenges and protect human health.

Table 8: Goodness-of-fit indicators for the structural model

Fit indices	Structural model value	Recommended value	References
Gfi	0.990	> .90	Hair et al. (2010)
Agfi	0.856	> .80	Hu and Bentler (1999)
Nfi	0.981	> .90	Hu and Bentler (1999)
Cfi	0.943	> .90	Bentler and Bonett (1980)
Rmsea	0.0521	< .08	Hu and Bentler (1999)
Srmr	0.051	< .07	Hu and Bentler'(1999)

Source: Authors own calculation

Goodness-of-Fit Measures for the Structural Model (Table 8):

Goodness-of-Fit Index (GFI): Value: 0.990, Higher than the suggested value of 0.90, Indicates a strong fit between the model and observed data.

Adjusted Goodness-of-Fit Index (AGFI): Value: 0.856, Higher than the suggested value of 0.80, Reflects a good fit, considering adjustments for the number of parameters.

Normed Fit Index (NFI): Value: 0.981, Higher than the suggested value of 0.90, Indicates a high level of fit between the model and data.

Comparative Fit Index (CFI): Value: 0.943, Greater than the recommended value of 0.90, Suggests a reasonable fit between the model and the observed data.

Root Mean Square Error of Approximation (RMSEA): Value: 0.0521, Under the advised value of 0.08, Demonstrates a satisfactory match between the model and data.

Standardized Root Mean Square Residual (SRMR): Value: 0.051, Meets the suggested value of 0.07, Indicates a good fit for the structural model.

Overall Assessment: The goodness-of-fit indices collectively suggest that the structural model is a strong fit for the data. The values surpass or meet the recommended thresholds, indicating a robust alignment between the model's theoretical framework and the observed data. This reinforces the reliability and validity of the structural model in explaining the relationships among the variables under investigation.

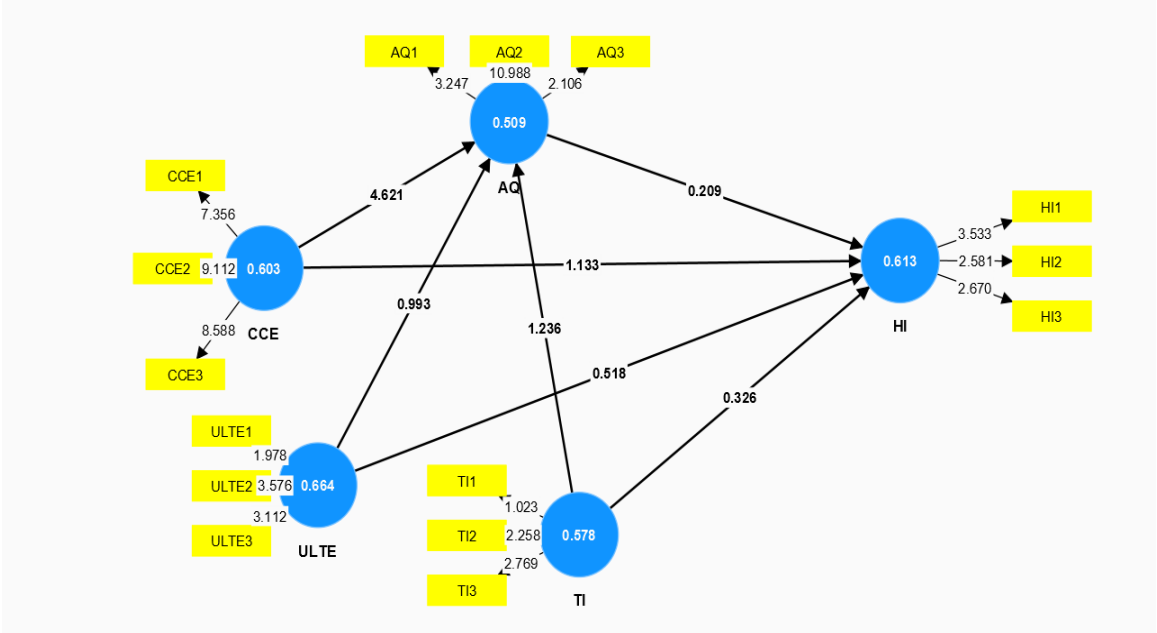

Figure 2: Bootstrapped model

Conclusion: The amalgamation of research findings provides a comprehensive insight into the intricate relationship between climate change and public health. The exploration of diverse dimensions, including infectious diseases, cardiovascular health, mental well-being, and urban health challenges, underscores the multifaceted impacts of climate change on human well-being. The accumulated knowledge not only emphasizes the urgency of addressing these health implications but also contributes to a deeper understanding of potential co-benefits and ethical considerations associated with climate change and health. This collective understanding serves as a foundational resource for shaping future research directions and informing holistic approaches to mitigate the health risks posed by ongoing environmental changes.

Managerial Implications: The research findings carry significant implications for decision-makers and public health professionals. Understanding the intricate links between climate change and various health aspects provides a foundation for developing targeted interventions and policies. Decision-makers can use these insights to formulate adaptive strategies that not only address the direct health impacts of climate change but also consider potential co-benefits in different sectors. Public health professionals can leverage this knowledge to enhance preparedness and response measures, ensuring that health systems are resilient in the face of evolving environmental challenges. By incorporating these findings into managerial decisions and strategies, policymakers and public health practitioners can contribute to building a more sustainable and health-conscious future.

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