



Assessing the Impact of Climate Change on Health in South Asia

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Nausheen Zaidi, et al.**Abstract**

South Asia emerges as one of the most susceptible regions to a plethora of direct and indirect repercussions stemming from climate change. These include, but are not limited to, the rising sea levels, heightened cyclonic activity, and shifts in ambient temperature or precipitation patterns. Despite an abundance of publications delving into the associated impacts, our objective is to synthesize pertinent literature with the aim of discerning commonalities in research findings, assessing the most affected areas in terms of health, and delving into potential avenues for mitigating the associated impacts.

Notwithstanding its relatively minor contribution to greenhouse gas emissions, South Asia finds itself exceptionally vulnerable to the perils of climate change due to a confluence of factors, including its geographical and topographical positioning, burgeoning population density, rapid urbanization, deficient health infrastructure, and an economy predominantly reliant on agriculture. This region stands at the forefront of vulnerability to various direct and indirect consequences of climate change, such as sea level rise, extreme weather events encompassing cyclones and droughts, as well as alterations in ambient temperature and precipitation patterns.

Our comprehensive review is centered on an in-depth, country-wise exploration of the available literature pertaining to four South Asian nations: India, Bangladesh, Nepal, and Sri Lanka. Through this analysis, we seek to evaluate the impacts of climate change from both direct and indirect perspectives. A discernible trend emerges, indicating that extreme weather events exert a palpable impact on health and healthcare systems in areas deemed 'climate-sensitive.' However, noteworthy gaps persist in the existing literature, warranting further investigation to substantiate the link between climate events and their health impacts. This void also presents an opportune moment to contextualize strategies for mitigation and adaptation, crafting more sustainable approaches that contribute to the well-being of both the populace and the planet.

Keywords: Climate Change; Global Warming; Health; South Asia**Introduction**

Climate change is a public health emergency. According to the WHO, between 2030 and 2050, climate change-related events are expected to result in 250,000 additional deaths per year globally from malnutrition, malaria, diarrhea, and heat stress [1]. In addition, the 2022 report of the Intergovernmental Panel on Climate Change (IPCC) depicts a dark scenario for the future of life on Earth characterized by ecosystem collapse, species extinction, and climate hazards such as heatwaves and floods [2].

Even though South Asia is not a major contributor to greenhouse emissions, it is particularly at risk of climate change due

to its geographical and topographical location, high population density, rapid urbanization, poor health infrastructure, and agriculture-driven economy. It is the most vulnerable region to several direct and indirect effects of climate change, such as sea level rise, extreme weather events, including cyclones, droughts, changes in ambient temperature, and changes in precipitation patterns.

Evidence from studies indicates that during the current century, the South Asia region will experience some of the highest increases in annual average temperature, thereby aggravating various preexisting diseases, such as cardiovascular and respiratory problems, due to heat exhaustion and increasing the disease burden of vari-

ous endemic vector-borne and waterborne diseases, leading to enormous economic losses [3,4]. To better understand the pervasive effect of climate change on health in South Asia, published literature needs to be reviewed thoroughly, focusing on LMICs such as India, Pakistan, Sri Lanka, and Bangladesh to assess the different morbidity mortality patterns and to align strategically to combat this major challenge.

The purpose of assessing climate crisis impacts on health and humanitarian consequences in South Asia is to better understand climate and health links, forecast kinds of impacts, and look for enhanced preparedness and adapted action to improve health outcomes.

Materials and Methods

A comprehensive literature review was conducted from 1990 to 2020 using the electronic databases PubMed and Google Scholar (in addition to the standard Google search engine) to assess the impact of climate change on human health, directly or indirectly, in four countries (India, Pakistan, Bangladesh, and Sri Lanka) of South Asia. The keywords used were “climate change” or “global warming” AND “health” AND “South Asia”. The search was restricted to free full-text peer-reviewed articles published in the last 10 years in the English language on humans, focusing on four South Asian countries—India, Bangladesh, Sri Lanka, and Pakistan. The findings from these articles have been categorized into direct and indirect health outcomes and presented accordingly.

Results and Discussion

Human health can be affected directly by extreme weather conditions such as floods, droughts, cyclones, and heatwaves or indirectly through exposure to air pollution, poor water quality, lack of access to clean water, food insecurity due to droughts and saltwater intrusion, and the establishment of new disease-carrying vectors and varied patterns of distribution of infectious diseases [3,5]. In addition, the vulnerability of women and children, noncommunicable diseases, mental health, and climate-induced migration are areas that are also indirectly affected by climate change but are less explored.

Indirect health outcomes

In 2022, Asia recorded an average increase in land surface air temperature of approximately $1.42 \pm 0.13^\circ\text{C}$ above the 1981–2010 average [6]. Extreme climatic events such as droughts, floods, and salt intrusion due to rising sea levels tend to aggravate food insecurity in this region, which is already facing malnourishment

among children. According to the sixth assessment report of the IPCC, Asia has the highest prevalence of undernourishment in the world, approximately 11% in 2017, accounting for more than 515 million people [2]. Along with increased temperatures, erratic and unpredictable rainfalls are creating havoc on the agricultural sector due to crop failures, thereby impacting the already burdened economies of these South Asian countries even more.

A recent example is the Pakistan floods, which the World Weather Attribution clearly describes as a direct consequence of extreme monsoon rainfall, which was 243% more than usual during this period [7]. This catastrophic flood affected more than 33 million people, destroyed 1.7 million homes, and caused nearly 1500 people to die [8].

People living in LMICs are more vulnerable to such climatic events due to poverty; inequality, including gender inequity and exclusion from healthcare; dependence on underfunded public health systems; and malnutrition. Displacement or migration of people due to climate emergencies, livelihood loss, and multiple poor health outcomes are areas that need immediate global attention. Further research is essential to strengthen the evidence concerning these major anthropogenic challenges.

Direct health outcomes

The climate change crisis is directly related to various negative health outcomes. These adverse events act as precursors to multiple vector-borne diseases, such as dengue and malaria, as well as waterborne diseases, such as diarrhea and cholera. Various studies suggest that a 1°C increase in temperature increases the incidence of diarrhea by 5.6% [9]. The table below summarizes the distribution of various health outcomes in the four South Asian countries.

As mentioned above, South Asia covers diversified topologies responsible for varied climatic zones that could result in multiple climate change-related challenges across the entire subcontinent. While South Asia constitutes approximately 3-4% of the total global land mass, it houses approximately 24% of the world's population [41]. As a result, slight changes in climatic conditions can have a major impact on a significant and vulnerable population segment.

For example, the Himalayan mountain ranges across India and Pakistan are experiencing water shortages and associated food and livestock security issues due to the recession of glaciers and decreased snowfall (directly associated with a rise in temperature across the region). In contrast, coastal regions across South Asia

Country	Health impact due to climate change
India	<p>Increased burden of Vector-borne diseases like Dengue, Malaria, Chikungunya, and kala-azar [10-12].</p> <p>Incidence of Diarrheal diseases influenced by precipitation, humidity, and temperature [11-13]. It is estimated to increase approx. 13.1% in North India by 2040 [14].</p> <p>Increased Mortality and Morbidity due to heat stress/heat [15-20].</p> <p>Food insecurity caused by floods and droughts leads to a higher prevalence of child undernutrition [21-23].</p> <p>Eco-stress affects mental health in Sundarbans regions [24]. Other challenges include violence against women and children, sexual abuse, neglect, and trafficking [25].</p>
Bangladesh	<p>Higher risk of Hypertension and other health effects caused by the increasing trend of coastal salinity [26,27]. Additionally, evidence of an association between an increased risk of preeclampsia and gestational hypertension with salinity in drinking water documented [28].</p> <p>Maternal deaths occurring during the floods season due to a lack of proper care and treatment [29].</p> <p>Increased Incidences of Vector-borne diseases like Dengue, Malaria, and Leishmaniasis. With a 3.3 °C temperature rise, an increase of approximately 16,030 dengue cases is estimated in the city of Dhaka by the end of this century [30].</p> <p>Diarrheal diseases due to extreme weather changes 7 [31,32].</p> <p>According to the WHO Country Profile 2015, Climate change aggravates food insecurity, further burdening child malnutrition under age 5 prevalence of 31.9%</p> <p>Climate change impacting mental health [33].</p>
Pakistan	<p>Air pollution is among the leading contributor to illness and Death, attributing to approx. 135,000 deaths per year [34]. Also reducing the life expectancy by 5 years.</p> <p>Diarrheal and waterborne showed an increasing trend as a result of floods [34,35].</p> <p>Higher incidences of vector-borne diseases resulting from extreme weather conditions.</p> <p>Livestock production to reduce to approx. 20-30% as a result of increasing temperature [36].</p>
Sri Lanka	<p>Increased incidence of Dengue with the rise in temperature and humidity [37,38].</p> <p>Higher snake bite burden with climate change [39].</p> <p>Cutaneous Leishmaniasis positively related to climate change [40].</p> <p>Ecosystem degradation increasing frequency and duration of droughts, the intensity of rains, and storm surges [41].</p>

Table 1: Country wise distribution of the negative health impacts of climate change.

suffer from an increase in sea level, which results in an increased risk of floods, heat waves, and changes in the intensity and frequency of precipitation patterns, among others [5].

Another major health impact noted across the region is the increased burden of vector-borne diseases such as dengue, malaria, and filariasis. There is also a reported increase in morbidity and mortality associated with neglected tropical diseases such as cutaneous leishmaniasis (CL), snakebites and rabies, among others, that are correlated with climate change. Factors such as a rise in temperature and changing rain patterns are responsible for favor-

able breeding grounds for vectors, faster viral/parasitic amplification rates, and greater human-animal interactions, all of which contribute to the disease burden in vulnerable population groups [42].

Recent evidence from India and Bangladesh has also suggested that climate change and associated environmental impacts are also associated with increasing trends of domestic abuse, internal displacement and sexual and gender-based violence (SGBV) in vulnerable population groups that live in urban slums, underserved rural communities, and conflict settings, among others. Although further

research is needed in this space, initial findings indicate that unstable living conditions, financial constraints from unemployment due to natural calamities and environmental stress all contribute to an increased incidence of domestic violence and physical abuse in low-income households [43].

Existing efforts in public health responses around communicable/noncommunicable diseases and disaster management would be inadequate if climate resilience were not included as an integral part of the strategic response. A robust 'Climate Smart' model would require taking a multipronged approach that includes the following steps.

- **Climate Mitigation:** Healthcare systems globally contribute approximately 4.4% of the total greenhouse gas emissions [44]. In such a scenario, it becomes important to evaluate the contribution of health programs to climate change burdens. This involves investing in a multisectoral approach that includes ecoefficient waste management, sustainable waste procurement, renewable energy adoption, etc.
- **Climate adaptation:** Adaptation includes exploring ways to improve health system preparedness in response to the impacts of climate change. Better vulnerability mapping and outbreak forecasting for climate-sensitive diseases, robust disaster response surveillance systems, and remodeling of urban/rural settlements to prevent potential extreme weather events, among other issues, are some of the opportunities that need to be explored and implemented [5,45].

All of the above intervention strategies, however, first require the recognition of climate change as a major public health challenge by existing governments, intergovernmental organizations, NGOs, etc.

Conclusion

The extent of damage from climate change is unfeasible. However, the recent IPCC report makes a compelling case for "rapid and far-reaching" energy, land, industry, transportation, construction, and city use, with the goal of limiting global warming to 1.5°C by reducing global emissions (related to humans) of carbon dioxide by approximately 45% from 2010 levels by 2030. If this goal is achieved, this feat would reduce the burden on natural systems and provide more time for adaptation. While countries such as India and Bangladesh have acknowledged the impact of climate change on health and have integrated the same into national action plans (NAPS), there needs to be greater investment in decentralizing/contextualizing 'mitigation' and 'adaptation' strategies to combat

this major health emergency. This permeating threat to health due to climate change demands immediate action from all the relevant stakeholders, policymakers, and Govt agencies, NGOs and community organizations to protect current and future generations.

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Conflicts of Interest

This research received no external funding. The authors declare no conflicts of interest.

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