Original Research Article

CHILDHOOD HEALTH RISKS ANDVULNERABILITIES ASSOCIATED WITH CLIMATE CHANGE IN THE PHILIPPINES: BASIS FOR CHILDHEALTH VULNERABILITY FRAMEWORK

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ABSTRACT

This study examined the childhood health risks and vulnerabilities associated with climate change in Iligan City, Philippines. The research used a purposive sampling technique, selecting 15 parents and barangay health workers. The findings revealed that climate change-induced calamities are the primary health risks, leading to casualties, trauma, and infectious diseases. These issues require attention from the Local Government Unit (LGU) and child welfare agencies. Vulnerabilities stem from geographic location, children's physiques, and fragile health often caused by poor nutrition. Based on the results of the study, a framework for assessing child health vulnerability was proposed.

Keywords: Climate change; Childhood; Health; Risks; Vulnerabilities.

1. INTRODUCTION

Human-induced climate change ranks as one of the biggest social, environmental, and public health challenges of this century [1]. Children, the elderly, and individuals with low socioeconomic status are particularly vulnerable to its effects [2]. Due to their unique metabolic, behavioral, physiological, and developmental characteristics, children face significant threats to their health from climate change [3]. Many leading causes of childhood death, such as malaria, diarrheal disease, and malnutrition, are highly sensitive to climate change and are expected to worsen. Additionally, changes in the vector-borne disease spectrum and rising air pollution from continued fossil fuel use endanger children's health, quality of life, access to education, and overall development [4].

According to Stern et al. [5], a baseline climate change scenario could result in an additional 40,000 to 160,000 children's deaths per year in South Asia and Sub-Saharan Africa solely due to GDP losses. This projection rises to an additional 60,000 to 250,000 child deaths per year by 2100 under a high-impact climate change scenario [6]. In 2000 alone, the World Health Organization (WHO) projected that climate change caused more than 150,000 deaths and 5.5 million lost years of life with a disability worldwide; over 88% of this burden falls on children under the age of five [7].

Children consume more food per unit of body weight than adults do in terms of air they breathe, water they drink, and food they eat [8]. They frequently play outside and are expected to live longer lives than adults, exposing them to new or worsening environmental hazards in the future. Furthermore, many diseases have a long latency period, sometimes taking decades to manifest [9]. There is growing concern about the impact of climate change on children's health [10]. Although warming in cold regions may benefit kids in some ways (e.g., by lowering some cold-related illnesses and deaths, like viral diarrhea and respiratory infections), the negative effects of climate change on kids may outweigh the good ones by a

wide margin. According to previous reviews, children may be more vulnerable to climate change than adults, but the processes behind this sensitivity have received little attention [11].

Each year, there are an average of 20 typhoons, eight to nine of which make landfall in the Philippines during the peak months of July to October [12]. The nation is regarded as one of the most susceptible to the effects of climate change. Iligan City, situated in the southern Philippines, stands as an industrial hub that, despite its economic significance, grapples with the formidable impacts of climate change. Characterized as a flood-prone region and frequently traversed by tropical cyclones, Iligan City endured the devastating force of Typhoon Washi, locally known as Sendong, in 2011. This catastrophic event tragically resulted in the loss of more than 1,600 lives. Asthma, rhinosinusitis, chronic obstructive pulmonary disease (COPD), and respiratory tract infections are among the respiratory disorders that are becoming more common as a result of rising rainfall, strengthening typhoons, and the resulting floods [13]. Other climate-related health hazards include those caused by droughts and poor water supplies, breathing difficulties from air pollution, possible injuries from extreme weather, and sickness that spreads in shelters during catastrophes. The population most in danger from the health risks posed by climate change is children, especially those with underlying medical issues and those who live in remote places without immediate medical assistance [13].

Children and the elderly are subpopulations that are especially sensitive to the harmful impacts of air pollution on their health [14]. Their exposure to outdoor particulate matter has been associated with respiratory symptoms, decreased lung function, worsening of asthma and chronic bronchitis [15]. Ozone exposure can also cause shortness of breath, wheezing and coughing, temporary decreases in lung function, and lower respiratory tract infections in children [16].

Floods, droughts, bushfires, and cyclones will become more frequent and intense as a result of climate change [17]. According to several studies, children who encounter the same calamity have more enduring indications of mental health impairment than adults [18]. Natural catastrophe exposure has been shown to make depression, anxiety, and stress worse [19]. Children who experience weather-related catastrophes are more likely to experience sleep problems, unhappiness, and other mental health issues [20]. Moreover, significant stress among parents following weather-related disasters can harm children by limiting their capacity to provide for them and, in some cases, leading to neglect and even abuse [21].

The frequency and intensity of heat waves, defined as intermittent periods of high temperatures outside the typical range of climate fluctuation, are expected to increase [22]. Studies from several nations suggest that children, especially very young children, are particularly vulnerable to these heat waves. Renal damage in children is a serious side effect [23]. Children exposed to extremely hot weather may develop heat-related disorders like hyperthermia and heat stress, experiencing a variety of reflexive circulatory, metabolic, and physiological changes that stress or impair the kidney system [24].

Storms and floods can compromise water resources. As temperatures rise, pathogens such as protozoa, bacteria, and viruses carried by water will replicate more readily [25]. Contaminated water is a primary cause of malnutrition and diarrheal disease, which remain the leading causes of death in children under five [26]. Children, who require three to four times as much food per unit of body weight as adults, are most affected by hunger [27]. Growing food prices and declining production will worsen the world's malnutrition rate,

jeopardizing children's health [64]. Beyond hunger and malnutrition, food supply shortfalls in low- and middle-income nations have additional negative consequences [28].

Existing studies confirm the influence of climate change on children's health, with projections indicating increasingly severe impacts. Despite this, significant information gaps persist regarding the relative risk to children and tailored protective measures. While children are recognized as particularly vulnerable, existing social factors for their protection, and additional proactive measures beyond climate change mitigation, remain poorly understood. Existing studies primarily utilize mortality and morbidity as impact indicators, encompassing total and cause-specific death, hospital admissions, and emergency department visits [29]. However, these metrics likely assign equal weight to child, adult, and elderly deaths. If deaths predominantly occur in the very elderly with limited life expectancy, the public health impact of climate change on life-years lost could be underestimated [30]. This highlights the potential undervaluing of the child-specific impact through mortality and morbidity metrics. While previous studies have quantified the current impact of climate change on children's health and predicted future impacts of specific hazards [31], no study has explicitly estimated the future disease burden in children under various climate change scenarios. Despite inherent uncertainties, initial projections regarding future child mortality and morbidity rates due to climate change might be possible.

The climate has undergone drastic changes over the past few years. As climates shift, environmental hazards may change and potentially increase, disproportionately impacting children. This study aims to not only identify child health risks and vulnerabilities but also propose a framework for potential community-based programs geared towards children's health. Furthermore, it seeks to contribute additional input to existing community endeavors.

2. METHODOLOGY

2.1 Research Design

The researchers used a qualitative descriptive research design for this study. Qualitative research aims to comprehend social phenomena in their natural settings fully. It is a method of naturalistic investigation. It emphasizes the "why" rather than the "what" of social phenomena and depends on the first-hand accounts of people as the agents of meaning creation in their daily lives [32]. On the other hand, descriptive research, according to Williams [33], is a type of inquiry that allows for the analysis of present phenomena. Also, Nassaji[34], adds that descriptive research aims to describe and categorize the phenomenon. In addition, Walliman[35] stated that descriptive research refers to an observation made while gathering data. To combine both would be qualitative descriptive investigations, which aim to thoroughly summarize, in clear terms, particular occurrences that individuals or groups go through [36].

Given the limitations of time and resources, with the need for direct information from those affected by the topic, a qualitative descriptive design is particularly appropriate, according to Atkinson et al. [37]. Therefore, the researchers selected this method to explore into respondents' experiences with climate change-associated childhood health risks and vulnerabilities, aiming to develop a child health vulnerability framework within the given timeframe.

2.2Research Participants

A purposive sampling technique was employed, selecting 15 participants. These included parents of any age and gender residing in Barangay Del Carmen, Iligan City, Philippines,

who happened to be visiting the barangay hall (regardless of their reason) on the day of data collection, and barangay health workers (BHWs) who also reside in Barangay Del Carmen. It is important to note that Barangay Del Carmen serves as the hotspot of climate change-induced calamities in Iligan City. However, the final number of participants in each category (parents/ BHWs) ultimately depended on their availability on the day of data collection. To be eligible for the study, parents needed to have children aged 17 years or below who were still dependent on them and who had been affected by extreme climate change conditions within the past year. Additionally, the children had to live with their parents, the study participants. BHWs were included as participants to share their experiences and insights on child health vulnerability, which was deemed valuable for the study.

2.3Materials and Instrument

The researchers primarily employed pre-formulated interview questions as their data collection instrument. However, they adopted a semi-structured approach, allowing them to adapt the questions during the interview based on specific sampling criteria(i.e., the participant is a BHW but not a parent, or the participant may not fully understand the established question.) The interview tool was developed based on an extensive literature review. Studies were included if they considered climate change (direct or indirect environmental hazards like heat waves, weather disasters, contaminated water) as the primary exposure and children's health as a major outcome of interest.

2.4Data Gathering

Prior to data collection, the researchers obtained an ethical clearance from the Institutional Ethics Review Committee (IERC) of Iligan Medical Center College. Once granted ethical approval from the IERC, the researchers sought consent from the Chairman of Barangay Del Carmen, Iligan City.

With permission secured, the researchers proceeded with data collection. Participants signed informed consent forms provided by the researchers. To gain a comprehensive understanding of the individuals' experiences, the researchers conducted individual interviews. Repeatedly listening to the audio recordings helped capture the participants' thoughts, processes, and feelings.The researchers meticulously reviewed and reread each transcript, identifying and examining key statements in each record. For each participant, these statements were individually coded with the corresponding transcript page and line numbers.

2.5 Data Analysis

The researchers conducted a thematic analysis of the collected data. They began by reviewing and familiarizing themselves with the data, noting important points and discarding irrelevant material. Next, they documented observed meanings and patterns in the data through analysis coding, which they recorded in a dedicated code book. In this study, the codes captured relevant data related to child health risks and vulnerabilities associated with climate change. Subsequently, the researchers collated these codes with supporting data from relevant literature. This collation allowed them to identify potential frameworks that could be proposed. Following that, they grouped the identified child health vulnerability frameworks. Finally, using the sorted codes, the researchers constructed a narrative that proposes an appropriate framework for understanding child health vulnerability.

3. RESULTS AND DISCUSSION

3.1 Childhood Health Risks Associated with Climate Change

Three themes have emerged from the responses on childhood health risks associated with climate change. These include extreme heat and heavy rain,landslides and floods.

3.1.1 Extreme Heat and Heavy Rain

The respondents identified unpredictable extreme heat and heavy rain as the most common childhood health risks associated with climate change. Participants specifically mentioned increased risks from heavy rain, including floods, waterborne diseases, and common colds/fevers.

The long-standing belief that getting wet in the rain causes illness persists, especially among younger individuals who associate colds with changing seasons. However, while rain exposure can contribute to illness, it primarily facilitates faster viral transmission due to sudden weather shifts. The rhinovirus, responsible for common colds, thrives in cooler temperatures and attaches to cooler areas like the nasal cavity. The immune system's response to this invasion, particularly against unfamiliar strains, can lead to fatigue and illness [38].

Studies have shown that children in dry and wet areas exposed to heavy rain are more likely to experience their first hospitalization for enteric bacterial or viral infections [38, 39]. Hospital admissions increase by 60% within two days of heavy downpours, likely due to increased surface runoff mobilizing and carrying germs into the water supply [39].

Extreme heat events also have potentially concerning, yet understudied, consequences. While reduced productivity and functioning are evident impacts, the research quantifying the cognitive impact of increased heat on student learning in non-climate-controlled classrooms remains limited [40].

3.1.2 Landslides

Participants identified landslides as the second key theme concerning childhood health risks linked to climate change. They attributed this primarily to the combined impact of geographic location and extreme weather events in the area, which, according to parents, increased children's risk of accidents and psychological trauma.

Disasters significantly impact children's lives. For example, unforeseen landslides can put them at significant risk, leading to behavioral changes in daily life, emotional disturbances,

and functional difficulties in home or school environments. Additionally, landslides inflict severe damage on the ecosystem and leave children traumatized [41].

3.1.3 Flood

Another emerging theme of childhood health risks associated with climate change is flooding. Residents of Barangay Del Carmen, the study's locale, identified constant unwanted flooding as a major threat to childhood health. The area's geographical location makes it prone to flooding and landslides, further exacerbated by climate change.

Flooding also contributes to the spread of infectious diseases, such as dengue fever from stagnant water and diarrhea from contaminated water sources. The impact of floods on health varies depending on a population's vulnerability and the type of flood event. Notably, flooding significantly impairs quality of life and disproportionately affects the health of pregnant women and children.

Studies have shown detrimental psychological and physiological consequences for children's health and reproductive systems [43, 44]. For example, Delfin [44] reported that children are the frequent victims of water-borne illnesses, particularly diarrhea.

3.2 Childhood Health Vulnerabilities Associated with Climate Change

When asked about the childhood health vulnerabilities associated with climate change, the participants pointed out geographic location, frail childhood health, children’s physical, physiological and cognitive immaturity, and psychological trauma.

3.2.1 Geographic location

The majority of participants identified their barangay's geographical location as a key theme impacting children's health vulnerability. Situated in an area susceptible to landslides and flooding due to extreme weather events, this location significantly endangers the safety and well-being of local children.

The Philippines' archipelagic geography, with many small and remote islands, inherently presents challenges to children and families accessing social services. In areas with inadequate transportation infrastructure, children face difficulties reaching healthcare facilities, schools, police, and social welfare support. Similarly, families in geographically isolated communities often struggle to participate in social protection programs [45].

3.2.2 Frail childhood health

Participants frequently highlight the theme of frail childhood health linked to climate change. Children's already fragile health makes them even more susceptible to climate-induced risks. Their developing bodies require greater nutritional support to build a strong immune system. Additionally, the environment they live in further impacts their health.

Numerous climate-sensitive exposures can affect health outcomes at the immune system level. Understanding the diverse impacts of climate change on immune function, particularly for children, is crucial but remains largely unexplored. We propose various mechanisms by which climate exposures and conditions can gradually weaken specific components of the immune response, altering the susceptibility of populations - especially children - to infections and diseases. Undernutrition, psychological stress, and exposure to ambient UV radiation, all significantly impacted by climate change, influence susceptibility to infections, allergies, and autoimmune illnesses. Environmental UV radiation, for example, plays a role in autoimmune, allergic, and infectious susceptibility [46].

In developed environments, climate change poses a significant threat to the nutritional status and eating patterns of socially disadvantaged individuals. The urban poor are particularly vulnerable as they already spend a large portion of their income on food, with non-agricultural households relying heavily on purchased food [47].

3.2.3 Children's physical, physiological and cognitive immaturity

Another recurring theme in participants' responses centers on the heightened vulnerability of children to climate change risks. This vulnerability stems from their ongoing physical, physiological, and cognitive development, which leaves them less equipped to handle threats. Younger children are particularly susceptible.

Climate change's health impacts disproportionately affect children due to their physical, physiological, and cognitive immaturity. The World Health Organization reports that 88% of the current global disease burden linked to climate change falls on children under five [48]. Children's inherent curiosity driven by their developing minds and bodies can significantly increase their risk of accidents. This underscores the critical role of adults in taking appropriate measures to ensure the safety and well-being of this age group by closely monitoring their behavior.

The home environment is a primary setting where children's inherent inquisitiveness manifests, especially for young toddlers aged zero to five who spend most of their time there. While commonly perceived as the safest space for this population, statistics reveal that most accidents involving young children occur within the home or its immediate surroundings. The frequency of these incidents increases with younger age [49].

3.2.4 Psychological trauma

This theme of children's vulnerability to psychological trauma due to climate change risks also emerges in the participants' responses. The study reveals multifaceted impacts on the well-being of children in Barangay Del Carmen, affecting their physical safety, psychological distress, and ultimately, their quality of life.

Landslides and other natural disasters pose a direct threat to children's physical health. Not only can they suffer from food shortages caused by supply disruptions or diarrhea due to contaminated water, but they also face the risk of injury or death.

The psychological toll of natural disasters is equally concerning. Disasters are inherently stressful and frightening, and children can experience further trauma from the destruction of their homes and belongings, displacement, grief over losing loved ones, witnessing stressed caregivers, neglect or abuse, and the disruption of social networks, communities, and local economies [50].

3.3 Framework

3.3.1 Geographic Location

Barangay del Carmen, Iligan City, is situated near the coast, making it highly susceptible to flooding, storm surges, and other water-related hazards due to climate change.The community's proximity to mountains increases the risk of landslides and mudslides during heavy rainfall events.Limited access to safe water sources and sanitation facilities due to geographic challenges can exacerbate health problems.

3.3.2 Frail Childhood Health

Children under five are more vulnerable to health problems due to their developing immune systems.Malnutrition, a prevalent issue in many Philippine communities, weakens children's resilience to diseases and environmental stressors.Existing health burdens, like respiratory illnesses and waterborne diseases, can be worsened by climate-related events.

3.3.3 Children's Physical, Physiological, and Cognitive Immaturity

Children have limited physical strength and stamina, making them more susceptible to injuries and exhaustion during disasters.Their physiological systems are still developing, increasing their vulnerability to heat stress, waterborne diseases, and respiratory problems associated with climate change.Children's cognitive development can be hampered by psychological trauma and disruptions to education caused by climate events.

3.3.4 Psychological Trauma

Witnessing or experiencing climate disasters can cause significant psychological distress in children, leading to anxiety, depression, and post-traumatic stress disorder (PTSD).Displacement due to floods or landslides can disrupt children's sense of security and belonging, further impacting their mental well-being.Loss of loved ones or property due to climate events can exacerbate feelings of grief and trauma.

Table 1 :Proposed Programs to Reduce Vulnerabilities

Program	Action Plan
Early Warning Systems and Evacuation Drills	Implement effective early warning systems to alert communities about impending disasters and conduct regular evacuation drills to ensure preparedness
Climate-Resilient Infrastructure	Invest in infrastructure like seawalls, drainage systems, and early flood detection systems to mitigate the impact of floods and landslides
Improved Water, Sanitation, and Hygiene (WASH) Access	Ensure access to safe drinking water and sanitation facilities to prevent waterborne diseases, especially during and after disasters.
Nutrition Programs	Implement nutrition programs for pregnant women, lactating mothers, and young children to address malnutrition and improve their immune systems.
Child-Friendly Health Services	Establish child-friendly health facilities within the community, equipped with trained personnel and essential medications to address children's specific health needs.
Mental Health and Psychosocial Support (MHPSS)	Provide MHPSS services to children who have experienced trauma, including individual counseling, group therapy, and community-based support groups.
Climate Change Education	Integrate climate change education into school curriculums to raise awareness, promote risk reduction behaviors, and empower children to adapt to changing environmental conditions
Community-Based Adaptation Strategies	Collaborate with community members to identify and implement context-specific adaptation strategies, such as diversifying livelihoods, developing drought-resistant crops, and promoting sustainable resource

	management.

5. CONCLUSION

This research concluded that childhood health risks in Barangay Del Carmen, Iligan City, Philippineswere solely climate-induced calamities leading to casualties, psychological trauma, and infectious diseases among children. These issues demand immediate attention from the LGU and child welfare agencies.

Furthermore, the study identified childhood health vulnerabilities associated with climate change as a combination of naturally occurring circumstances such as geographic location, children's natural physique and frail health caused primarily by poor nutrition.

These findings illustrate the significant challenges related to childhood health risks and vulnerabilities in the local community, potentially extending to a larger scale. Parents reported inconsistencies in child health assistance from the LGU. While beneficial programs exist, parents emphasize the need for consistent support. Additionally, monitoring children's well-being should be a top priority for barangay health workers, considering their high vulnerability to diseases. This study can serve as a basis for improvement for the city's city health office, Iligan city nutrition committee, barangay health workers, and even non-governmental organizations.

Regular checks are crucial to ensure children's safety and well-being during extreme weather conditions, preventing injuries and calamities. Furthermore, illegal activities significantly impacting children's health within the vicinity should be monitored and addressed.

Existing seminars cover topics like childhood health, family planning, and maintaining a sanitary environment. However, barangay health workers report that many mothers do notimplement these practices, jeopardizing children's health. More effective educational strategies are needed to bridge this gap.

This study, due to its limitations, did not highlight climate-induced diseases. Future research can build upon this work to identify further risks to childhood health related to such diseases.

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