

# The Impact of Flood-Related Malnutrition in Guyanese Lokono-Arawak Coastal Communities

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## Abstract

This paper explores the critical health impact of flood-related malnutrition, contending that it poses a significant concern due to its pervasive influence on the global population and enduring consequences across the life course. The analysis delves into the intricate disease pathways forged by malnutrition, emphasizing its role in elevating susceptibility to waterborne and vector-borne diseases. Through this investigation, the understanding of the interconnected nature of malnutrition and its intricate relationship with adverse health outcomes is strengthened, particularly in the context of climate change, environmental justice, and health. This research sheds light on the resilience of indigenous and coastal communities, showcasing their ability to mitigate the effects of flood-related malnutrition through alternative livelihoods.

**Keywords:** climate change, flooding, malnutrition, Indigenous health, Sustainable Development Goals (SDGs), climate adaptation

## Introduction

Climate change is one of the most serious challenges posed to humanity in the present time (1). As global temperatures continue to rise, many cities around the world are suffering the consequences that climate change poses to infrastructure, communities, and populations (1). This includes an increased frequency and severity of natural hazards, such as flooding, that affect over 38% of the world's population (2). While some cities are well-equipped to cope with flooding, many are not, particularly those in low-and-middle-income countries (1). There is a shortage of international studies that examine the link between increased precipitation, flood-related malnutrition, and climate change adaptation in Indigenous South American communities. This paper will explore the Lokono-Arawak community's vulnerability to flooding and related health impacts in Guyana.

This paper will focus on the health impacts of flood-related malnutrition, which results from inadequate access to sufficient and nutritious food during or after flooding events. This health concern is considered to be the most serious repercussion of flooding because it exacerbates the socio-economic inequities already experienced by impoverished coastal communities, including food insecurity, unemployment, and financial hardship (1). Malnutrition is a

primary pathway to other health challenges and is related to multiple intersections of physical, social, and developmental issues across the life course (3). Due to the nature of this deficiency, malnutrition can lead to a greater risk of injury, displacement, morbidity, and mortality in the Guyanese Lokono-Arawak coastal community (4). Following flood events, coastal farmland and crops are often destroyed, leading to a scarcity in food and other basic necessities (1). This disproportionately affects the Lokono-Arawak people who rely on sustenance farming to survive (2). The resulting scarcity of food can exacerbate tensions within this community, leading to violence and injuries over land, water, and resources (4). These socioeconomic conditions can push individuals to seek refuge in neighboring communities in hopes of safety and a better life (4). To fully understand the complexity of flood-related malnutrition, we must first examine increased precipitation, the specific climate driver that leads to this environmental condition.

## Flooding in Guyana

### *Direct Impacts*

Anthropological climate change over the past millennia has intensified the Earth's hydrological cycle (5). As water temperatures of oceans have risen over time, there has been a subsequent increase in sea levels and the amount of water

evaporating into the air (6). Once humid air moves over cooler land or converges with storm systems, it produces more intense precipitation in South America (6). Such environmental changes have exposed millions of people to an increased risk of flooding (6). These effects are particularly pronounced in Guyana, a country located on the low Coastal Plain, approximately 1.5 meters below sea level (1). Flooding is among the most prevalent natural hazards worldwide and can have a devastating impact on infrastructure and individuals' livelihoods and health (1). Heavy rainfall and storm surges can lead to extensive weather-related morbidity and mortality, especially in lower-income countries where infrastructure systems, such as drainage and flood protection, tend to be less developed (5). During floods, heavy and sharp objects can move at high velocities through floodwater (7). The forces associated with hydrological pressure can uproot trees, electric power lines, wild animals, and buildings, leading to a range of injuries (5). Contaminants found within flood water such as sewage, industrial hazardous waste, and carcinogenic compounds can lead to complications such as injury, infections, poisoning, and a rise in communicable diseases (7). The combination of these hazards can lead to immediate health impacts such as drowning and a loss of human life (5). However, they can also lead to a multitude of indirect health impacts contributing to food insecurity. These consequences will be explored in the remainder of the paper.

#### *Indirect Impacts Leading to Food Insecurity*

Malnutrition is a consequence of food insecurity, which refers to the lack of availability and/or ability of populations to access food of adequate quality and sufficient quantity. Rainfall-induced flooding and waterlogging can have a significant impact on communities that rely on agriculture as a primary source of food and income (8). In Guyana, most coastal populations live below the country's poverty line (1). Since the majority of these communities are located in remote areas, far from the national capital of Georgetown, many do not have access to grocery stores or fresh produce (9). In the rare cases where produce is available, it is sold at unaffordable prices due to the cost of transportation and importation (9). As a result, individuals living in these areas are forced to rely on their own production of fruits, crops, meat, eggs, and dairy to feed their families, known as subsistence farming (4). However, increases in the frequency and intensity of flooding have led to increased rates of crop loss, contamination, soil erosion, debris deposition, and invasive species, impacting the communities' ability to grow their own food (6). In addition to the direct rushing effect of floodwater, the submergence of crops creates complex abiotic stress in

plants, including oxygen depletion, reduced light availability, and altered chemical and nutrient characteristics of soil (8). The combination of these physical and chemical alterations can substantially reduce farm stand as well as the yield and growth of crops (8). Under current climate conditions, there has been a significant reduction in crop yields due to excessive rainfall, which has negatively impacted Guyana's rice supply and created food insecurity (4). While this environmental hazard is prevalent in South America, it is also a global issue that affects much of the world's population that lives in coastal regions. There is a high proportion of individuals who participate in subsistence farming (8). The loss of farmers' livelihoods, as well as a lack of alternative food options, can exacerbate conditions of poverty within these populations (9). This can reduce coastal communities' ability to financially mitigate the damage caused by flooding (1).

The mass destruction and degradation of wildlife habitats by flooding can also have detrimental effects on Indigenous communities' livelihoods (8). In the case of the Lokono-Arawak Amerindians, the destruction of aquatic and terrestrial ecosystems can affect their ability to continue traditional ways of life, including hunting and fishing (10). Wild meat is an important source of protein, fat, and micronutrients for Indigenous people (10). Prolonged flooding and high-water depths can impact animals' ability to migrate from submerged areas, most seriously affecting mammals that have a limited ability to swim, such as deer, wild boar, and pacas (11). The short-term variation in seawater salinity due to the mixing of salt and fresh water can create physiological challenges for aquatic organisms, leading to the mortality of many important fish species like the gillbacker sea catfish, dorado, and Atlantic tarpon (6). These events can force families to rely on highly processed, non-perishable foods (4). This can result in a loss of traditional activities, languages, and place-based ontology that is intricately connected to the land (9). These environmental changes thus lead to culture stress, a loss of culture, and community identity (9).

## **Malnutrition**

### *Impacts of Malnutrition on the Lokono-Arawak Community*

The collapse of traditional food systems significantly increases the risk of malnutrition in the Lokono-Arawak community, disproportionately affecting pregnant women, children, and youth (12). Malnutrition occurs when individuals do not consume enough essential nutrients or when nutrients are excreted more rapidly than they can be replaced (13). A lack of access to traditional foods can contribute to a progressive decline in health, reduced cognitive and physical function

status, and increased mortality (14). Energy and nutritional vulnerability are most pronounced during pregnancy and lactation (13). The consumption of highly processed diets lacking in key nutrients such as iron, calcium, folate, or zinc can lead to adverse pregnancy outcomes such as pre-eclampsia, eclampsia, anaemia, hemorrhaging, preterm delivery, and death in mothers (15). These conditions can increase infants' risk of fetal growth restrictions, low birthweight, wasting, and developmental delays, having profound impacts on their lifelong health (16). Furthermore, maternal malnutrition can lead to a reduced production of breastmilk, preventing infants from receiving lifesaving antibodies from their mothers (15). Malnutrition is particularly important in young children, as they require more frequent and high-quality meals (16). Young bodies absorb nutrients from food at a faster pace than older bodies, especially during puberty when large growth spurts and bodily changes occur (15). Growth failure and micronutrient inadequacy during childhood and adolescence can cause stunting and create a higher risk of chronic diseases such as diabetes mellitus, coronary artery disease, and hypertension (13). Long-term, malnutrition in children can increase their susceptibility to infectious diseases, morbidity, and mortality, negatively impacting the Lokono-Arawak's population demographic.

The repercussions of stunting and micronutrient inadequacy extend beyond immediate health concerns, impacting the Lokono-Arawak community's collective well-being (17). These nutritional deficiencies can hinder the intergenerational transmission of cultural knowledge and practices essential to the Amerindian identity. An example of this is the nine-day Lokono-Arawak puberty rite of passage, where youth engage in a variety of practices including fasting and the receipt of traditional body tattoos (17). These rituals symbolize youth's physical and mental fortitude, marking their transition into adulthood (17). The completion of this ritual is essential for youth to earn the right to learn and be involved in cultural, traditional, and spiritual ceremonies (17). Thus, flood-related malnutrition can impact the continuity of Lokono-Arawak culture and heritage, as well as impacting affected individuals' status and acceptance in society.

#### *Waterborne Diseases*

In Guyana, the Lokono-Arawak people rely on local rivers, wells, and ground aquifers to access cooking, drinking, and bathing water (10). Similar to other coastal communities, the Lokono-Arawak people lack access to potable water, heightening their vulnerability to waterborne diseases (10). During periods of severe flooding, disruptions to nearby communities' wastewater treatment and water filtration can contaminate

Amerindian's supply of drinking water. The contamination of water created by floating debris, chemicals, and sewage can expose the Lokono-Arawak to dangerous pathogens (4). Such exposure, compounded with flood-related malnutrition, can further increase the Lokono-Arawak's susceptibility to diarrheal and gastrointestinal illnesses (18).

Under strenuous environmental conditions, malnourished bodies have a reduced ability to mount adequate protective responses against infectious agents, particularly among young children (19). According to the Guyana Ministry of Health, nearly 30% of deaths among children under five are attributed to diarrheal diseases, due to their small stature, high metabolic needs, and area-to-weight ratio (20). During the first few years of life, infants undergo critical periods of immune development, heightening their vulnerability to infections and mortality (19). Consequently, Lokono-Arawak children, particularly those suffering from flood-related malnutrition, are at an elevated risk of contracting cholera (20). Left untreated, this waterborne illness can be fatal within a few hours in previously healthy people (21).

Flood-related malnutrition also plays a role in exacerbating the prevalence of leptospirosis cases, colloquially known in the Guyanese community as the "flood disease" (22). Guyana is particularly susceptible to leptospirosis epidemics, witnessing numerous outbreaks during each rainy season (20). While the majority of infections are mild or subclinical, leptospirosis can result in life-threatening symptoms and even death, with mortality rates ranging from five to fifty percent (20). The persistence of leptospires in wild and domestic animals further complicates the situation, significantly impacting the health of the Lokono-Arawak people who rely heavily on subsistence hunting and fishing for survival (22).

#### *Infectious Diseases*

Malnutrition can increase individuals' vulnerability to a variety of vector-borne diseases, including yellow fever, West Nile virus, dengue fever, Zika virus, and malaria (16). In Guyana, the combination of malnutrition and flooding conditions can have an additive effect on the prevalence and severity of malaria in the Lokono-Arawak community (4). Recent studies have found that the burden of malaria is disproportionately related to nutrient deficiencies in zinc, folate, vitamin A, and iron, as well as an underweight status in children ages 0 to 4 years old (13). Malnutrition has also been linked to recurrent infections of malaria which can lead to permanent tissue damage, central nervous system damage, dysregulated immune responses, disruptions to the blood-brain-barrier, and persistent health complications following the clearance of Plasmodium parasites

(3). In situations when malaria is not treated promptly, it can lead to seizures, kidney failure, respiratory distress, coma, and death (16). Malnutrition and infections often act synergistically to increase morbidity and mortality (3). Infections such as malaria can intensify the deficiency state of malnourished individuals, disproportionately affecting children, pregnant women, and immunocompromised individuals (19). An increase in stagnant pools of water after floods can expand the habitat availability of disease vectors such as mosquitoes, increasing their geographic and seasonal distribution (7). Coastal Guyanese communities' practice of collecting bathing water in buckets can increase transmission rates of malaria, allowing disease carrying *Aedes aegypti* mosquitos to infect a larger number of people (10). Collectively, these changes in coastal communities can contribute to an increased risk of zoonotic transmissions and epidemics.

## Sustainable Solutions

In upcoming years, the impact of flooding and flood-related malnutrition is likely to play a role in the displacement of vulnerable populations locally and internationally (4). However, there are proactive and sustainable mitigation strategies that can increase coastal communities' resilience and preparedness to deal with this climate challenge. The government of Guyana can develop a climate-friendly national plan to fund green coastal defense projects, such as investing in the implementation and management of mangrove forests (23). Mangroves play a crucial role in mitigating flood impacts by slowing water flows, reducing erosion, and encouraging sediment deposition (24). Strategically positioning mangrove belts around coastal areas, farmland, and wastewater facilities can markedly diminish the risks of flooding-related crop damage, malnutrition, and disease proliferation (23). Further, another mitigation strategy involves developing community-based flood preparedness and response plans with local stakeholders, such as the Lokono-Arawak people (25). These plans should include early warning systems, evacuation routes, and emergency shelters to minimize the impact of flooding on vulnerable populations (25). Looking forward, it is imperative for the Guyanese government to seek collaborative partnerships with international organizations to support climate adaptability and resilience efforts in coastal regions, including knowledge exchange, technical assistance, and financial support (26). By adopting a multi-faceted approach that combines ecosystem-based solutions, infrastructure development, community engagement, and capacity building, coastal communities can mitigate the adverse impacts of flood-related malnutrition.

## Conclusion

This paper has argued that flood-related malnutrition is the most concerning health impact of flooding because it impacts much of the world's population and can have significant impacts across the life course. Throughout this review, special attention was paid to the disease pathways created and exacerbated by malnutrition, highlighting its ability to increase individuals' susceptibility to waterborne and vector-borne diseases. The exploration of this subject has addressed existing gaps within the literature on the Lokono-Arawak community in Guyana, providing a more holistic understanding of how climate change, environmental justice, and health are interrelated through geographic, historical, and political factors. This study demonstrates the resilience of Indigenous and coastal communities to mitigate the impact of flood-related malnutrition by engaging in alternative livelihoods such as flood recession farming, dry season farming, and petty trading. Despite common misconceptions, impoverished populations are far from powerless. They are resourceful and capable of making significant lifestyle changes to adapt to their environment conditions. This paper aimed to address how climate drivers such as increased precipitation can impact the socio-economic conditions of communities to widen existing health inequities between the Global South and Global North. Vulnerable populations in low- to middle-income countries are disproportionately faced with the consequences of climate change, despite being the least responsible for it. Future humanitarian and government initiatives addressing malnutrition will need to consider the interrelated relationship between climate change, environmental justice, and health in order to effectively address the needs of minority populations. A greater understanding of these three topics will help countries and communities better prepare for the climate changes predicted in the upcoming century.

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