Health Risks of Climate Change and Variability to Maternal Health

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ABSTRACT

Climate change has emerged as a significant global challenge with far-reaching implications to human health. Through a comprehensive review of scholarly articles, the study examines the complex interplay between climate change and maternal health and highlights the role of religion in climate change mitigation. Mothers *play an integral role in creating and sustaining healthy* households. Furthermore, improving maternal health is essential to achieving global sustainable development goals, particularly goal 3 (Good Health and Well-being). The paper sought to examine the physical and psychosocial effects of climate change on expectant mothers. The study explored the following objectives: the direct impacts of climate change on maternal health; Indirect impacts of climate change on maternal; and mitigation strategies. The study revealed that, rising temperatures and heatwaves increase maternal heat-related illnesses, potentially affecting birth outcomes. Vector-borne diseases, influenced by climate shifts, pose additional threats to maternal well-being. Environmental stressors, including natural disasters and climate-related migration, contribute to maternal stress, anxiety and depression affecting maternal care. Christian teachings acknowledge human life as precious and sacred. It should be protected and valued from conception until death. Religious beliefs and values lay emphasis on stewardship of the environment, social justice, compassion, and community support. Religious institutions and leaders can play pivotal roles in advocating for climate action, promoting sustainable practices, and providing psychosocial support to individuals and families affected by climate-related health issues. To effectively combat climate change effects, the study recommends that it is imperative to embrace integrated approaches that prioritize healthcare access, environmental resilience, mental health support, and community-based initiatives that integrate religious perspectives with scientific knowledge and best practices.

Keywords: Climate-change; Climate-variability, Maternal-health, Mitigation, Religion, Psycho-social.

INTRODUCTION

Climate change affects human health in many ways directly or indirectly. The effects may also be short term or long term. The direct effects of extreme weather leading to injury and loss of life include floods, drought, hurricane, wildfires, heat waves, etc. On the other hand the indirect effects include malnutrition brought on by crop failures, lack of access to safe water for drinking which consequently may result to outbreak of water-borne diseases, vector-borne diseases, and destroyed infrastructure as a result of flooding rendering some roads impassable. The health risks posed by climate change include: (i) direct-acting effects e.g. heat wave, extreme weather events; (ii) impacts mediated via climate-related changes in ecological systems and relationships (e.g. crop yields, mosquito ecology, marine productivity), and (iii) the more diffuse (indirect) consequences relating to impoverishment, displacement, and mental health problems.

The figure below summarizes the effects of climate change on human health.

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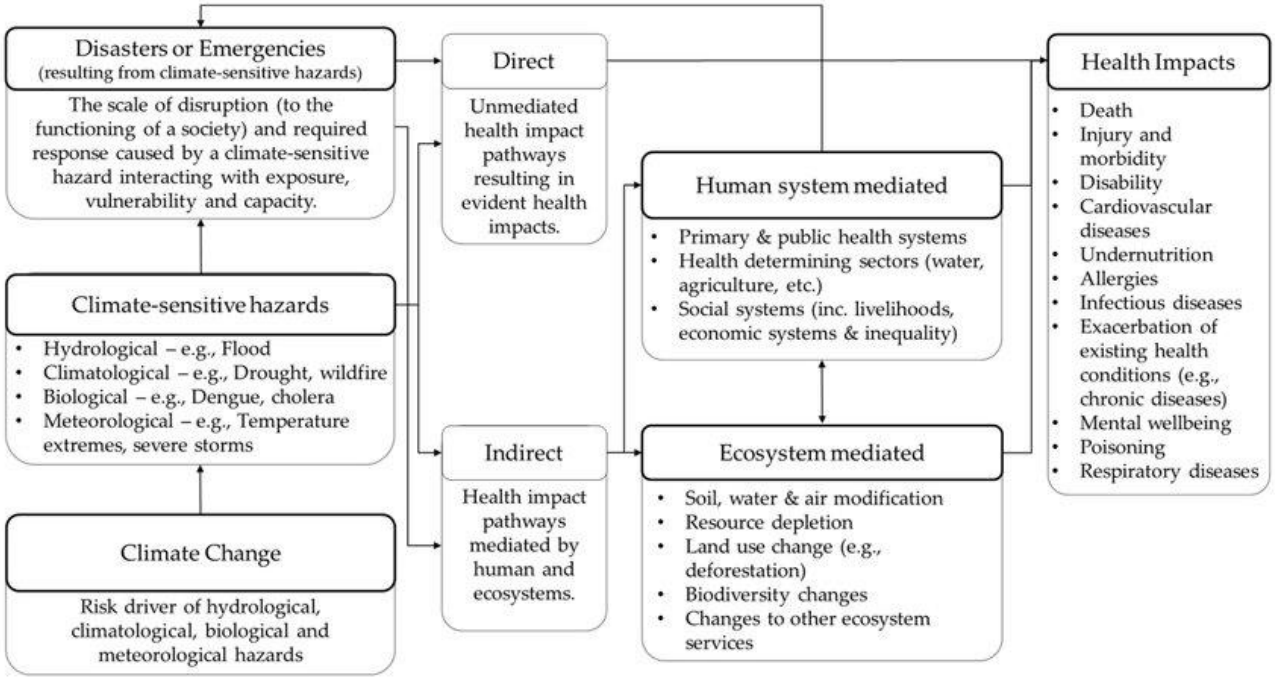

Figure 1: Direct and indirect health impact pathways of climate change and climate-sensitive disasters

Source: Banwell, N., et. al (2018)

While everyone stands to be affected by climate change effects, the vulnerable populations groups will be affected disproportionately. Although effects of climate change on human health has been greatly documented, there is little focus on the impact of climate change on vulnerable population groups. Pregnant women are increasingly being recognized as vulnerable populations in the context of climate change. This paper attempted to bring forth the direct and indirect impacts of climate change on maternal health as well as mitigation strategies that can be adapted in order to improve maternal health outcomes and ensure progressive attainment of sustainable development goals (SDGs) 3.1 and 13.1. SDG 3.1 seeks to reduce the global maternal mortality ratio to less than 70 per 100 000 live births while SDG 13.1 seeks to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

DIRECT EFFECTS OF CLIMATE CHANGE ON MATERNAL HEALTH

These are the immediate impacts that environmental changes have on pregnant women and their health outcomes. These effects can be attributed directly to variations in climate patterns, extreme weather events, and increased exposure to environmental hazards.

Extreme Heat

Climate change impacts human health in varied ways and degrees with vulnerable populations including expectant mothers, infants and neonates being worst hit. Studies conducted within climate change and maternal health have shown an association between heat exposures and the risk of pre-term birth, pre-mature rapture of membrane, low birth weight and still births. Pregnant women are susceptible to increasing ambient temperatures and heat waves since their ability to thermoregulate is compromised (Well, J.C., 2002). Increased sweating as a result of thermoregulation, causes dehydration which may consequently prompt early and prolonged labor (Chersich, M. et. al, 2020; Bekkar B, et. al, 2020).

Pregnancies are susceptible to complications at all stages of gestation. Such complications may affect

maternal health, fetal health, perinatal health, or postnatal health of the mother and/or child (Rylander C., et. al 2011) and are complex in both etiology and outcome. Extreme heat may cause high blood pressure and possible pre-eclampsia in pregnancy. The consequence of heat exposure on developing fetuses are not yet completely understood since the epidemiology behind many adverse fetal outcomes, including preterm delivery, is diverse (Blencowe H., et. al, 2012) Low birth weight was previously hypothesized as a consequence of sustained heat exposure and maternal heat stress (Well, J.C., 2002). Extreme weather events increase the risk of postpartum depression and post-traumatic stress disorder as well as occurrence of pre-term birth and low- birth weight infants (Harville, E.W.,et. al, 2009).

A systematic review by Kuehn, L. & McCormick, S. (2017) demonstrated that heat worsens maternal and neonatal health outcomes. That extreme heat exposure affects foetal outcomes, ranging from stillbirth rates to birth weight and gestational age, with the trend being evident in research regarding reduced gestational age and preterm birth. Their reviews showed that an increase in 1^0 C in the week before delivery, corresponding with a 6% greater likelihood of still birth. The Intergovernmental Panel on Climate Change (IPCC) has concluded that to avert catastrophic health impacts and prevent millions of climate change-related deaths, the world must limit temperature rise to 1.5°C. Past emissions have already made a certain level of global temperature rise and other changes to the climate inevitable.

Respiratory Health

During pregnancy, hormonal and physical changes occur due to the growing fetus. This consequently affects the respiratory tract and cardiovascular systems causing stuffy or runny nose, reduced lung capacity, and increased oxygen use among others. With these alterations many expectant mothers experience difficulty in breathing as pregnancy progresses. These changes can be exacerbated by air pollution e.g. dust, smoke and increased temperatures attributed to climate change. The presence of particulates in our lungs also harms our cardiovascular system in three main ways: (i) by causing oxidative stress and inflammation; (ii) by shifting the balance of our autonomic nervous system to a fight-or-flight state; and (iii) by these toxins being transmitted into the bloodstream. This can lead to high blood pressure, heart attack, heart failure, stroke, high cholesterol, arrhythmia, and insulin resistance (Miller, M. R. et al. 2012)

Climate change may increase outdoor air pollutants, such as smoke from wildfire, dust and underground ozone level. Some communities and vulnerable groups including pregnant women bear more burden of unhealthy air. Mendola, P et. al, (2019) assessed the effects of common pollutants, such as ozone, sulfur dioxide, nitrogen oxide, and nitrogen dioxide and found a correlation between air pollution and preterm labor. Area-level changes in air pollution exposure appear to have important consequences in consecutive pregnancies with increasing exposure associated with higher risk.

Vector-Borne Diseases

Vector-borne infections cause a significant proportion of world-wide morbidity and mortality and many are increasing in incidence. This is due to a combination of factors, primarily environmental change, and encroachment of human habitats from urban to peri-urban areas and rural to previously uninhabited areas, persistence of poverty, malnutrition and resource limitation in geographical areas where these diseases are endemic.

There is no doubt that a suitable climate is responsible for the emergence and persistence of a vector-borne disease. Changes in climate may affect the transmission dynamics and geographical spread of vector-borne diseases by affecting the pathogen, the vector, non-human hosts, and humans. For example, warmer temperatures associated with climate change can also increase mosquito development and survival and feeding activity. These changes may increase the prevalence of mosquitoes that transmit viruses, such as the Zika virus and dengue fever (Ebi, K.L., et al. 2018). Zika can be transmitted from the mother to the fetus

during pregnancy. This can consequently cause certain brain defects, including microcephaly, where a baby's head is much smaller than expected due to lack of brain development (CDC, 2021), consequently causing economic and psychosocial stress on the family.

Mosquito-borne diseases predominately affect the southern hemisphere and cause by far the largest burden on mortality, quality of life, social, financial and economic burden globally (Franklinos LHV, Jones KE, Redding DW, et al. 2019). Hard-shell tick-borne illnesses like Lyme disease which affect temperate areas of the northern hemisphere, are less well defined but are a growing cause of morbidity internationally (Mead PS. 2015; Vandekerckhove O, De Buck E, Van Wijngaerden E. 2019). Soft shell ticks are present on all continents globally, relapsing fever borreliosis has been shown to be associated with fetal loss as high as 475 per 1000 in some sub-Saharan countries. (Jongen VH, van Roosmalen J, Tiems J, et al. 1997).

The main adverse events of infections in pregnancy include pre-eclampsia and HELLP (haemolytic anaemia, low platelets, and elevated liver enzymes) syndrome, low fetal birth weight, congenital deformities, mother-to-child transmission of infection, preterm labor and delivery, spontaneous abortion and miscarriage, as well as peri-partum mortality of the mother or child.

Quality Water

Access to water is a necessity to human life. Climate change however continually affects the quality of water. For instance, warmer weather increases evaporation enabling the air to hold more water consequently leading to heavier rainfall and flooding. The resultant effect will be decrease in water quality and increased health risks. Warmer temperatures make the surface water temperatures to rise. This then creates a conducive environment some harmful algae and other microbes to grow. Some algae produce toxins that are harmful when ingested. Vulnerable populations like expectant women are more susceptible to waterborne illness because their immune system is weaker. Children take in more water per body weight than adults, and their organ systems are still developing. Elderly people may be less resilient because many have pre-existing chronic diseases that cause their immune system to be weakened. The aging infrastructure of our water system leaves low-income communities at higher risk of exposure as those communities may not have resources available to fix the problem.

INDIRECT IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH

Food Security and Nutrition:

"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Food Summit, 1996).

For a healthy society, every human being must have an access to adequate food in terms of proper nutrition and safe diet. Women too have unique nutritional requirements especially before and during pregnancy and while breastfeeding. Their diet must contain fruits, vegetables, dairy, fish, and meat to cater for important minerals like iodine, iron, folate, zinc and calcium. These minerals are vital in nourishing the mother and the unborn baby. It is therefore important that expectant women access proper nutrition for their well-being, that of their unborn babies and their children after birth. Women and under five children in most developing countries have challenges accessing proper nutrition. The challenges range from socio-economic, cultural, political and environmental factors particularly climate change related effects.

According to World Health Organization (WHO), 75% of the neonatal deaths occur during the first week of life, and in 2019, about 1 million newborns died within the first 24 hours. Preterm birth, childbirth-related complications (birth asphyxia or lack of breathing at birth), infections and birth defects caused most

neonatal deaths in 2019. From the end of the neonatal period and through the first 5 years of life, the main causes of death are pneumonia, diarrhoea, birth defects and malaria. Malnutrition is the underlying contributing factor, making children even more vulnerable to severe diseases.

A report by the Intergovernmental Panel on Climate change (IPCC, climate change augments and intensifies risks to food security for the most vulnerable countries and populations. The report highlighted four out of the eight key risks induced by climate change to having direct consequences for food security. They include: i) Loss of rural livelihoods and income, ii) Loss of marine and coastal ecosystems and livelihoods, iii) Loss of terrestrial and inland water ecosystems, and livelihoods iv) Food insecurity and breakdown of food systems (IPCC 2014). The earliest and the more impacted are the most vulnerable countries and populations including expectant mother and children, landlocked countries, small island developing states and arid and semi-arid areas where food supplies are particularly volatile and reliant on local weather conditions.

Climate change is expected to threaten food production, food quality, food prices and distribution systems. Many crop yields are predicted to decline because of the combined effects of change in precipitation, more frequent and severe weather events and increasing competition from weeds and pests on crop plants. Livestock and fish production are also projected to decline. Prices are expected to rise in response to declining food production and such trends as costlier pesticides, fertilizers and the petroleum used for agricultural machinery and the distribution of food. Rising temperatures, variable climates and higher carbon dioxide levels in the air decrease the amount of zinc, iron, protein and other nutrients in the crops much of the world's poor depend upon. Those crops include rice, maize and wheat.

Studies point to potential changes in the nutritional quality of some foods (e.g. reduced concentration in proteins and in some vitamins and minerals), due to elevated CO2, particularly for flour from major cereals and cassava. Climate change can have a variety of impacts on the quality of drinking water, which is key to the good absorption of nutrients. Climate change has been found to have an impact on food safety, particularly on incidence and prevalence of food-borne diseases. Increased climate variability, increased frequency and intensity of extreme events as well as slow ongoing changes will affect the stability of food supply, access and utilization. (FAO 2015). Malnourished women are more vulnerable to diseases, encounter miscarriages and pre-term labor and give birth to underweight children whose survival is at risk.

Psychosocial effect of climate change.

Although we are all at risk, certain groups are more susceptible to distress and other mental health problems linked to climate change-related exposures. Human beings react to disasters differently based on their demographic, socio-economic and environmental conditions. Populations directly exposed to climate change related disasters, the most vulnerable lack of resources and information as well as protection tend to suffer most from mental health. The exposure pathways to mental health could be environmental (air pollution, insufficient water quantity and quality, food insecurity, ecological changes); socio-economic (e.g. loss of livelihood, property loss or damage, loss of autonomy, conflict, inequalities, forced migration). The possible mental outcomes include stress reaction, strained social relationships, mental health conditions e.g. anxiety, depression; helplessness; suicidal behavior; alcohol and substance use; etc. Children, the elderly, women (particularly pregnant women and mothers of newborns), minorities, the poor, the homeless, people with preexisting mental illness and first responders are more vulnerable to negative mental health outcomes.

Traumatic stress can also result from extreme weather events or changing ecosystems which end up disrupting food and water sources, cause displacement or forced migrations. Increasing wildfires may intensify local contributions to air pollution hence causing respiratory complications to pregnant women. Studies have shown an association between second trimester nitrogen dioxide and particulate matter exposures with depression at 12 months postpartum. In addition, psychological stress before and during pregnancy can influence the susceptibility to chemical environmental exposures and impact birth outcomes.

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Climate change effects are cyclic. For instance, when pregnant women are stressed, their mental disorders spill to both the prenatal and post-partum periods consequently affecting child development (Bastain TM, et al. 2021; Vesterinen HM, et al. 2027; Schmeer KK, et al., 2020)

Climate change causes extreme weather events that adversely affects people's psychosocial lives directly and indirectly. Reviewed studies indicate that the impact range from disruption of social family set up to very severe mental disorders. Increased temperatures, rainfall and atmospheric pressure variations consequently results to heatwaves, floods, hurricanes and prolonged droughts. In order to cope with the climate change, people relocate or change land use practices as well as other economic activities. This leads to mental stress and increase intergroup conflicts. Extreme weather events lead to the loss of livability which does not affect only the social economic life but also the mental well -being. Burke et el (2018).

Destruction of infrastructure, loss of landscape, loss of lives and other consequences of extreme weather events adversely affect the family and society set up. This creates a sense of helpless ness as actions to address the problem are insignificant as compared to the magnitude of climate change threat. Studies also report that challenges like disruption of food and water resources can lead to financial and relationship stress which increases risks of violence, aggression and displacement of entire community. On a positive note, such disastrous events may inspire people to band together as they rebuild, salvage and console amongst the chaos fostering a sense of personal growth a situation known as post traumatic growth Hayes (2018).

According to Walinski et el (2023), direct effects of extreme weather events like floods, storms, and indirect effects of climate change like food insecurity and migrations are reported to lead to mental disorders by various studies. Climate change instigated stressors are very traumatizing resulting to Post traumatic stress disorder (PTSD), anxiety disorder, and depression among other mental disorders. Survivors are reported to suffer from completed grief, survivor guilt, vicarious trauma, recovery fatigue, substance abuse, and suicidal ideation.

Climate change disrupts the social economic structures that people depend on (Atwoli et el. 2022). Uncertain weather conditions cause a lot of anxiety among farmers. A study carried out on small scale farmers in Embu and Meru revealed that 35.2% of the respondents portrayed symptoms of anxiety, psychosomatic discomfort and depression which are indicators of common mental disorder (Njeru et el 2022.) According to the studies carried out in India and Australia, increased heat reduces the working hours as the workers shelter to avoid heat stroke. This reduces the income, disrupt daily social activities and create psychological distress (Berry et el 2010). Further, studies have proved that there is a correlation between extreme heat and aggressive and suicidal cases (Atwoli et el. 2022). Most people preserve the climate change phenomena catastrophic due to the negative publicity or experience. Climate change elicit self-defeating emotions, which affects the mental health. A study conducted by Ndetei, et el (2024) on high school students in Kenya revealed that majority of the respondents were worried 69.9% (1654/2366) about climate change. In addition, 35.4% (828/2342), 25.5% (588/2305), 36.4% (846/2322), and 22% (507/2302) of the respondents felt anxious, angry, afraid and powerless respectively in response climate change.

Transport Infrastructure

WHO revised guidelines on antenatal care and intrapartum care such that ANC visits have been increased from the earlier minimum of four to eight visits. Andersen's 1973 in his model puts forward a combination of three factors that work together in order to yield health care utilization. The three categories of factors include: i) Predisposing factors (for example age, sex, education, e.t.c); ii) enabling factors (includes transport; income; medical insurance) and iii) need factors (chronic illness, perceived general health, etc.).

Transport being one of the enabling factors can be affected by climate change through various ways. For example through heat waves (thermal expansion of piers, pavement integrity and softening, deformation of

rail tracks); rising sea levels (more frequent flooding and potential damage in low lying areas, erosion on infrastructure support, changes in harbour facilities) increasing hurricane intensity (greater mobility of infrastructure failure, greater damage to port infrastructure and more significant flooding on hinterland infrastructures) increase in arctic temperatures (damage to infrastructure because of permafrost).

Religion as an opportunity for Climate Change Mitigation

Religion, climate change, and maternal health are interconnected in complex ways. This literature explores how religious beliefs and practices influence resilience and coping mechanisms in the face of climate change and maternal health challenges. It examines both the positive roles religious organizations play and the barriers that religious norms can create. This section was prompted by the fact that since most people belong to a religious institution, climate change awareness and mitigation messages is likely to reach to a wider audience.

The Role of Religion in Promoting Resilience to Climate Change

According to Bhargava (2019), religious narratives often promote environmental stewardship, encouraging followers to protect and sustain the environment. For example, the Christian concept of "caring for the creation" and the Islamic principle of "khalifah" both emphasize human responsibility to preserve the natural world. These teachings can inspire environmental activism and sustainable practices that mitigate the impacts of climate change. Greer and Kayser (2017) observes that religious communities provide strong social networks that can be mobilized during crises. These networks offer emotional support, material assistance, and a sense of belonging, which are crucial for resilience. Religious organizations often act as first responders in natural disasters, providing essential services such as shelter, food, and medical care.

Leathers and Van Pelt (2016) posits that spiritual practices like prayer, meditation, and ritual help individuals manage stress and anxiety associated with climate change. These practices can promote mental health by providing a sense of control, hope, and meaning. Therefore, spirituality can buffer against the psychological impacts of climate-related events, helping individuals maintain a positive outlook and proactive stance toward adaptation.

Levin (2009) postulates that religious organizations play a significant role in health care delivery, particularly in underserved regions. Faith-based health interventions improve maternal health outcomes by providing essential services such as prenatal care, childbirth assistance, and postnatal support. These interventions are often more accessible due to the trust and cultural alignment between religious organizations and communities. According to Gauri and Lieberman (2006), religious teachings influence attitudes and behaviors related to maternal health. Many religions advocate for the protection of women and children, promoting practices that enhance maternal well-being. Therefore, ethical guidelines derived from religious beliefs can shape health policies and programs, ensuring they respect cultural values and address women's needs effectively.

Ammerman (2005) state that religious leaders and institutions are powerful advocates for maternal health. They educate communities about the importance of maternal care, dispel myths and misconceptions, and encourage health-seeking behaviors. Religious advocacy can influence policymakers to prioritize maternal health, leading to improved services and outcomes.

CONCLUSION

It is irrefutable that climate change impacts human population with extreme effects affecting the vulnerable groups including expectant mothers, the inborn and infants. The effects can be direct or indirect. Direct effects include: extreme heat, respiratory health, vector borne diseases and access to quality water. Indirect

effects include: food security and nutrition, mental health and transport infrastructure. It is also important to acknowledge the fact that the vulnerability of these population groups vary geographically, socially and economically.

While religious conservatism can pose barriers to services like contraception and skilled birth attendance, religious organizations have significant potential to promote maternal health positively. By advocating for supportive policies, educating communities, and providing essential health services, religious organizations can utilize their influence and networks to improve maternal health outcomes, particularly for marginalized populations.

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