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Climate change: Its importance to global health and its solutions

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Author Note

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Abstract

Recently, the WHO described climate change as the most important human health issue of the 21st century, and with good reason. Climate change has many human health impacts including increased risk of disease, increased flooding, more frequent and intense storms and hurricanes, increased temperature, more frequent and intense heat waves, food insecurity, water scarcity, rising sea level, and ocean acidification. Not everyone will be equally impacted by climate change; the most vulnerable populations will be most at risk of the effects of climate change. Moving forward, climate change must be combatted by a combination of mitigation and adaptation strategies. Mitigation is decreasing climate change itself, usually through lowering CO₂ and other greenhouse gas emissions. Adaptation is learning to live with the effects of climate change, such as how to monitor and control climate-sensitive diseases. Some places more impacted by climate change have already implemented mitigation and adaptation policies to varying degrees of success.

Keywords: climate change, global health, mitigation, adaptation, environmental health, disease, human health, public health

Climate change: Its importance to global health and its solutions

Ever since the beginning of human civilization, people have been altering the environment. However, it was not until the late nineteenth century during the Industrial Revolution that people were having a profound impact on the climate on a global level. Climate change has had many effects on the environment and especially on human health. Climate change is the most crucial issue to human health globally, and the world must create both mitigation and adaptation strategies to solve it.

According to the EPA, climate change is a period, usually decades or longer, of major change in climate, including but not limited to temperature, rainfall, or wind (“What is climate change?” 2018). Throughout the history of Earth, the climate has changed many times, such as during the ice ages, but these changes have occurred over thousands of years or longer. Today, however, human activities are accelerating climate change through the emissions of greenhouse gases. Faulkner, 2016 outlines the most compelling evidence of human-caused climate change: CO₂ levels continue to rise, the average yearly global temperature is the highest it has ever been, and for the past four decades the average temperature has continually risen. The cost of climate change is staggering; the Climate Vulnerability Monitor concluded in 2012 that the climate change impacts on the environment and human health will cost trillions of dollars annually by 2030 (Kjellstrom & McMichael, 2013). The scientific evidence supporting the existence of climate change at this point is undeniable, and those who ignore or manipulate that evidence will negatively impact future generations who will be most affected by climate change (Faulkner, 2016). At this point, no one can deny the reality of manmade climate change, and those who do deny it do not understand climate change, its causes, or its impacts.

One of the reasons that climate change is the most crucial health issue is because of increased risk for disease, especially with certain vector-borne diseases. The Intergovernmental Panel on Climate Change (IPCC) stated that climate change will be responsible for increased threats to human health while already adding to the global burden of disease (Preet, Nilsson, Schumann, & Evengård, 2010). The increased risk of vector-borne diseases, such as malaria and dengue fever, is especially prevalent. According to model predictions, the number of people affected and the severity of malaria will be increased because of climate change (Gething, Smith, Patil, Tatem, Snow, & Hay, 2010). In 2010, Mweya, Sharadhuli, Stanley, Misinzo, and Mboera conducted an experiment to observe how climate change could alter the distribution of *Aedes aegypti*, a type of mosquito that carries dengue fever, Zika fever, and other diseases, in dengue fever risk areas in Tanzania. The results of their experiment “show that changing climate will expand the range of *Ae. aegypti* and potentially intensify risks and expand current distributions of dengue” (Mweya, Sharadhuli, Stanley, Misinzo, & Mboera, 2010). Climate change will also increase the risk of vector-borne, food-borne, and water-borne diseases in affluent countries (Baylis, 2017). For example, a rise in sea surface temperature (SST) triggered by climate change is causing an increase in *Vibrio* bacteria, which are found in marine environments and can infect wounds and cause foodborne outbreaks, infections particularly in the Baltic Sea in northern Europe (Ebi, Odgen, Semenza, & Woodward, 2017). Another example is the increase in risk of Lyme disease in Canada; originally, the ticks that carry Lyme disease could not live in Canada because of the country’s cold climate, but tick populations are now thriving in the warmest areas of Canada due to warmer temperatures caused by climate change (Ebi, Odgen, Semenza, & Woodward, 2017). The worsening of vector-borne diseases and other illnesses shows how climate change is the most important human health issue.

Some research has been done on more specific diseases and how they are impacted by climate change, namely ophthalmic, or eye, diseases and allergic diseases. Climate change will increase ozone depletion and ultra-violet radiation (UVR) which will affect human eyes because the eye is almost always directly exposed to the sun (Qassim, Viki, Ng, Jersmann, & Casson, 2017). Specifically, increased UVR exposure increases frequencies of eyelid diseases, such as basal cell carcinoma (BCC), squamous cell carcinoma (SCC) and cutaneous melanoma (Qassim, Viki, Ng, Jersmann, & Casson, 2017). Other factors that can impact eye diseases are changes in temperature and rainfall; for example, according to a study done in Pakistan, development of lens opacities is more likely in hotter and drier areas (Qassim, Viki, Ng, Jersmann, & Casson, 2017). In order to create prevention strategies for eye diseases, public health awareness of the impact of climate change must be increased (Qassim, Viki, Ng, Jersmann, & Casson, 2017). Climate change also has an impact on allergic diseases. Increased temperatures and CO₂ levels impacts plant and pollen production, which impacts allergens and allergic diseases, including asthma and allergic rhinosinusitis (Katelaris & Beggs, 2018). Another effect of climate change is increased flooding which leads to fungal growth in residential areas and homes; exposure to fungal growth can lead to allergy, infection, and toxicity (Katelaris & Beggs). In 2000-2011, California witnessed an enormous increase in Valley Fever, which is a disease caused by a fungus in soil, due to heat waves, frequent dust storms, and shifting weather patterns (Ganesh & Smith, 2018). These examples showcase some of the effects that climate change has on disease and the risk of disease on different parts of the world.

Another way that climate change is the biggest threat to human health is through heat-related adverse health effects and heat-related deaths. By the end of the 21st century, climate change is expected to increase the global mean temperature from between 1.8°C and 4°C

(Mweya, Sharadhuli, Stanley, Misinzo, & Mboera, 2010). While this increase does not seem significant, it has wide-ranging effects on regional climates, which includes warmer summers and prolonged and more frequent heat waves. Research indicates that heat-related deaths in the UK from climate change will increase from a baseline of 1974 deaths per year in the 2000s, to 3281 deaths per year (66% increase) in the 2020s, 7040 deaths per year (257% increase) in the 2050s and 12,538 deaths (535% increase) in the 2080s (Arbuthnott & Hajat, 2017). A study in Stockholm, Sweden concluded that deaths due to heat extremes in the years 1980-2009 could have been half the number if not for the impacts of climate change (Ebi, Odgen, Semenza, & Woodward, 2017). Additionally, climate change also impacted the number of deaths during the 2003 heatwave throughout Europe, specifically, heat-related deaths increased by about 70% for central Paris and about 20% for London (Ebi, Odgen, Semenza, & Woodward, 2017). Increased heat caused by climate change can also impact everyday activities. Even though research on this subject has been limited, women in low- and middle-income countries have been affected by increased heat exposure through reduced speed of daily activities and spending more time collecting water, food, and firewood (Preet, Nilsson, Schumann, & Evengård, 2010). Increased heat waves can also affect cognitive abilities (Patz & Thompson, 2018). All of these issues may not seem important to the U.S., but many people in low- and middle-income countries that must work outside and do not have air conditioning will be feeling the heat. The wide-ranging effects of increased heat and temperature show how climate change is the most important issue to human health.

The environmental effects of climate change will also impact human health and financial security. Climate change causes prolonged and frequent periods of drought which financially impacts individuals that economically rely on rainfall, such as those working in agriculturally

fields (Ganesh & Smith, 2018). Climate change is projected to decrease agricultural yields, which will increase food prices, especially with increasing food demands from a growing global population (Bowen & Friel, 2012). Climate change is also expected to impact crops, livestock, and fish through factors such as ocean acidification, sea level rise, and rising temperatures (Bowen & Friel). Another effect of climate change is extreme weather events, such as storms, hurricanes, and floods, and the frequency of these events will increase because of warmer average temperature and water vapor (Kjellstrom & McMichael, 2013). These events will be especially harmful to the health of people living in urban areas with poor human settlements and shelter structures (Bowen & Friel, 2012). People living in urban settings are additionally at risk for poorer health because extreme increases in rainfall could intensify sewage contamination (Patz and Thompson, 2018). In addition to all of these issues, climate change is also expected to affect the ozone layer of the atmosphere and ultraviolet radiation (UVR), as well as cause more frequent and intense heatwaves and monsoons (Patz and Thompson, 2018). Climate change is the most important human health issue because of the long-term environmental effects, which will impact the food security and infrastructure of people for many years.

All of the effects of climate change discussed so far affect people's physical health; however, climate change has profound consequences for people's mental health as well. As discussed above, ongoing drought has financial effects on individuals, which then leads to psychological distress in worrying about how these conditions affect one's livelihood (Ganesh & Smith, 2018). Solastalgia, which is a loss of identity after one's home environment negatively changes, is another impact of climate change (Ganesh & Smith, 2018). The extreme weather events discussed above can also cause anxiety, stress, and depression because of the risk of homelessness, conflict, and migration through the destruction of communities (Bowen & Friel,

2012). Forced migration from homes, workplaces, and communities can be especially devastating because of their tendency to cause mental health disorders and tensions that can easily lead to conflict within an already vulnerable population (Kjellstrom & McMichael, 2013). The importance of climate change as a human health issue is compounded by its physical and mental effects on human health.

Even though climate change is the most crucial human health issue, climate change will not impact everyone equally. Climate change usually does not create new health issues, but rather exacerbate a population's current health risks or issues (Kjellstrom & McMichael, 2013). However, who will be most impacted by climate change depends on region, the populations' ability to adapt, and income and poverty level (Smith, Vargo, & Hoverter, 2017). However, the groups of people most likely to be most impacted by climate change are the ones who are least responsible for it, namely poor people and especially poor women (Preet, Nilsson, Schumann, & Evengård, 2010). Climate change will amplify the already prominent health inequalities, and it will most affect those with social and economic vulnerabilities (Buse, 2013). People in low- and middle-income countries often have poor infrastructure, making them more at risk for climate-sensitive diseases such as dysentery and malaria (Bowen & Friel, 2012). The dehydration associated with dysentery that plagues many developing countries is connected to blinding cataracts (Qassim, Viki, Ng, Jersmann, & Casson, 2017). WHO also found that between the years 2030 and 2050, climate change will contribute to 20,000-86,000 deaths of children due to diarrheal diseases (Baylis, 2017). Many cities in low- and middle-income countries have a hot and humid climate, making them more susceptible to frequent heat waves and increased temperature (Bowen & Friel, 2012). In addition, these countries cannot afford to mitigate or adapt to the effects of climate change, unlike higher income countries, making the consequences

even worse. For example, air conditioning is common in homes, workplaces, and hospitals in high-income countries, but this is not the case in low-income countries, where people have increased heat exposure at home and have more difficulty in treating patients in hospitals and other health service establishments (Kjellstrom & McMichael, 2013). Because of these inequities, more affluent countries must assist developing countries in alleviating and adjusting to the effects of climate change, especially since high-income countries are much more responsible for the current state of climate change (Katelaris & Beggs, 2018). However, high-income countries are experiencing health hazards such as certain diseases which primarily impact low-income countries because of climate change (West-Oram & Buyx, 2017). Because climate change affects everyone, though some much more than others, high-income countries have more motivation to create international health policies to combat climate change and its health effects (West-Oram & Buyx, 2017). However, the priority of climate change public health policy should be low- and middle-income countries because they are the most vulnerable to the effects of climate change. Climate change is the most crucial human health issue because it has the most impact on those who do not have the resources to adapt to the effects of climate change.

In order to combat climate change, the world must implement both mitigation and adaptation strategies. The goals of mitigation are to reduce and eventually eliminate greenhouse gas emissions, which are the main cause of climate change. Mitigation strategies mostly involve the reduction of all environmental pollutants, which includes anything that uses fossil fuels such as transportation vehicles (Katelaris & Beggs, 2018). The shift to renewable energy sources is important as well. Not to say that these mitigation efforts, especially the reduction of carbon emissions, are not important, but adapting to climate change is crucial if we are to maintain any successes in global health (Patz & Thomson, 2018). Adaptation seeks to respond to the health

and environmental changes already triggered by climate change. Both types of strategies are crucial. Mitigation strategies alone cannot prevent the effects of climate change because we have already altered the climate too much, so adaptation strategies to climate changes are now being seen as crucial (Bowen & Friel, 2012). However, the people responsible for creating and implementing climate change policy must be careful with applying adaptation strategies. Adaptation policy should not only focus on extreme periodic events such as storms or hurricanes because little attention will then be paid to long-term challenges such as food insecurity (Smith, Vargo, & Hoverter, 2017).

Many strategies also exist for more general adaptation and mitigation of factors affecting human health caused by climate change. The first step in planning strategies to increase public health in a world profoundly affected by climate change is to increase people's general understanding of how climate change affects human health (Cardwell & Elliott, 2013). In order to increase the quality of the public health response in regards to the health impacts of climate change, one must understand the environmental, economic, political, and social impacts of climate change, which include changes in agricultural production and water availability, the debate between fossil fuels and renewable energy, and the treatment of marginalized communities (Buse, 2013). For example, air conditioning is often seen as the solution for indoor heat exposure, but the electricity required to power air conditioners uses fossil fuels which emit greenhouse gases; therefore, using renewable energy for air conditioning is crucial in the near-future (Kjellstrom & McMichael, 2013). Another way to mitigate the impacts of climate change is to improve the public health of the most vulnerable populations (Kjellstrom & McMichael, 2013). Currently, many non-governmental organizations (NGOs) are attempting to raise awareness of the importance of climate change at a local level because of the lack of

development of climate change policy at the national and international level (Buse, 2013). Indeed, mitigation strategies are negatively impacted by political debates and slow decision-making processes, as well as the self-centered motivations of corporation that heavily influence global economies (Kjellstrom & McMichael, 2013). However, the efforts of NGOs face major obstacles without the money and resources from government institutions, such as public health agencies (Buse, 2013). But what is most important for developing strategies for the mitigation and adaptation of climate change is communication between businesses, policymakers, and the community. Some solutions that can be developed from this increased communication are the localization of food production which reduces the urban heat island effect and the risk of heat-related deaths, and using the same energy source for multiple buildings can reduce CO₂ emissions, reduce energy costs, and reduce risk of respiratory illnesses (Buse, 2013). Monitoring coastal flooding areas and restricting building new infrastructure in risk areas are two long-term adaptation strategies (Kjellstrom & McMichael, 2013). When creating any mitigation or adaptation strategy to combat climate change and its effects, communication and understanding the impact of the strategies on all parties involved is incredibly important.

Many ideas for mitigation and adaptation strategies exist and have been discussed, and some are already being implemented. One of the most important adaptation strategies is adapting to the increased risk of disease, especially vector-borne diseases, brought about by climate change. According to Baylis 2017, adaptation to the increased risk of disease requires three main actions: higher quality surveillance of disease for earlier detection of periodic cases and outbreaks; conducting regularly-updated assessments of the likelihood of a disease, taking into consideration vector, climate, the disease itself, and transporting the data; and increased readiness for outbreaks. An important facet of any mitigation strategy regarding the management

of disease is to improve the medical workforce in recognizing and handling climate-sensitive illnesses (Katelaris & Beggs, 2018). In order for both mitigation and adaptation strategies to be successful in all areas of climate change and their health impacts, perfected and ongoing measurements of the factors of climate change that impact human health must be taken (Katelaris & Beggs, 2018). Both mitigation and adaptation strategies of reducing the risk of vector-borne diseases must be thorough and take many different factors into consideration, such as the disease itself and who it is impacting.

Climate change mitigation and adaptation policies have already been implemented in certain places highly affected by climate change. One of these places is California's San Joaquin Valley. Public health policies in San Joaquin Valley were created to specifically address the impact climate change has on the mental health of its residents. San Joaquin is unique in regards to the impact of climate change because of its frequent droughts, multiple vulnerable populations, such as Hispanics, people with lower levels of education, people living in poverty, and people with limit proficiency of English; and its reliance on agriculture (Ganesh & Smith, 2018). Policymakers in California used both mitigation and adaptation policies to address the effects of climate change in San Joaquin Valley. When making policy about public health and mental health services, policymakers always took into account climate change and its effects (Ganesh & Smith, 2018). Another strategy is increased and continued communication between those that control funding and policymaking for mental health services with mitigation and adaptation agencies and institutions (Ganesh & Smith, 2018). A mitigation strategy incorporated into San Joaquin Valley's climate change policy is reducing greenhouse gas emissions through increasing affordable housing; however, this strategy may increase exposure to particulate matter and other pollutants (Ganesh & Smith, 2018). These strategies have been working, but California

needs better linkage between mitigation and adaptation in order for their policies to be fully effective.

The most crucial issue to human health today is climate change, and climate change must be solved by a combination of mitigation and adaptation strategies. Very recently, researchers have put forward that this generation is the last chance for reversing the current trend of climate change before it is too late. Even though the current generation is the least at fault for the present conditions of climate change, this generation still has a responsibility to future generations to not only to adapt to the effects of climate change but to start to prevent it altogether.

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