An Impact of Climatic Change on Water-borne Diseases: A Review

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Abstract: Climatic change has a great impact on the water cycle, impacts on water resources, the frequency and intensity of floods because of high rainfall, the natural environment and human health. In this article, a survey of the effect of climatic change on waterborne diseases.

Materials and Methods: The keywords “climate change”, “waterborne diseases” were used in combination with “or” and “and” by performing electronic searches on Google and Google Scholar. The search was operated with a publication year insulate among January 2019 and October 2020. Results: Of the 34 articles collected, 19 articles were excluded because they had no correlation, while 15 articles were submitted and met the inclusion criteria. The literature reviewed shows that, most of the research has been carried out in wealthy countries, and approximation of the effect of climatic change on waterborne diseases are uncertain for the following reasons: 1) Hesitation about the spread of disease through climate change due to changing rainfall patterns 2) Hesitation about direct and indirect connection among climatic and human health 3) Hesitation about the connection among climatic and waterborne diseases as a consequence of changes in health. Conclusion: The hesitation in this estimate has led to little research in this regard.

1. Introduction

In the 21st century, climatic change is one of the most serious and frightening global problems [1]. The World Health Organization (WHO) predicts rising temperatures and irregular rainfall patterns due to anthropogenic climate change. All of these are burdensome environmental and health determinants [2].

Climatic change negatively impacts overall human health, both at the population and individual stages, by exacerbating common conditions such as respiratory and cardiovascular diseases and the widespread spread of infectious diseases [3]. Principally, climatic change is guessed to evolve waterborne diseases mainly due to increased frequency and intensity of rainfall which can increase the movement of pathogens from environmental reservoirs, eg animal waste [4]. In addition, there is an increase in water-borne disease vectors that transmit infectious diseases from fauna to humans or among humans [5].

At the world level, faintly 2 billion people use sources of drinking water that are soiled by human or animal waste. Most of the population in developing countries particularly in rural areas live in conditions of extreme poverty, inadequate water availability and bad hygiene [6]. Statistically, faintly 884 million people do not have track to basic drinking water and nearly 159 million people depend on
lakes and rivers with nearly 423 million people drawing water from unprotected springs and wells [7].

Waterborne diseases include a wide variety of waterborne infections, and include pathogens in various taxa (bacteria, protozoa, viruses and worms) These pathogens can lead a variety of symptoms, including fever, diarrhea and other flu-like symptoms, liver damage, neurological disorders, etc [8].

In tropical countries, several waterborne diseases, for example lymphatic filariasis, dengue fever, Leishmaniasis, Schistosomiasis and African Trypanosomiasis, Vibrio cholerae and gastrointestinal diseases [9]. There are about 3.9 billion people at risk of developing dengue fever and 96 million cases of dengue fever are reported annually in 128 general countries, 2 percent of all malaria cases and 2.4 percent of all diarrhea cases worldwide[10].

This systematic review aims to provide knowledge of the effect of climatic change on waterborne diseases. This information can be meable for developing and implementing efficient health information systems with public interventions to control the incidence of waterborne disease.

2. Method

1. Search strategy

Electronic search on google and google scholar as the main source, accessed in October 2020 to extract research published in English that discusses the impact of climatic change on waterborne diseases. The search strategy used to find articles with the keywords “climate change”, “waterborne diseases” was developed through a combination of “Or” and “And”. We looked at research articles published among January 2019 and October 2020. Titles, abstracts and keywords were screened for initial steps on articles that were relevant and met the inclusion criteria included in the analysis.

2. Inclusion criteria

- Articles evaluating the impacts of climatic change on waterborne diseases.
- Articles discussing the impacts of climatic change on waterborne diseases with a published year boundary among January 2019 and October 2020

3. Results

3.1 Literature

The initial search identified 34 articles collected from google and google scholar and pubmed. Among them, 19 articles were excluded because they had no correlation, while 15 articles were included and met the inclusion criteria. The research study took place in (New Zealand, Canada, South Korea, United States, India, New Zealand)

Table 1. Characteristics of the Study Discussing the Effect of Climatic Change on Water-borne Diseases

| Authors            | Place and Research | Data Collection | Disease/Vector | Statistics Method | Main Findings                                                                                                                                 |
|--------------------|--------------------|-----------------|----------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Guéladio Cissé (2019) | Africa, America and Asia | Climate change, middle to lower Income | Water | Data collection and analysis literature review results collected through PubMed, WHO and CDC. The data collected is focused on literature review over the last 10 years. | 1. The incidence of diseases related to climate change in water media include: diarrhea, cholera, typhoid, shigella, hepatitis A and E. 2. This disease is susceptible to poor quality drinking water due to weather which makes water a suitable medium for germs to reproduce and poor clean water sanitation. |
1. Extreme climate change and in the long term will have a systemic effect on increasing cases of infectious diseases. 2. One of the infections that can be found is diarrhea, cholera, dengue fever where water is the vector that causes the disease to appear.

1. The impact of climatic change on the increase in disease cases cannot be avoided so that there needs to be awareness by the public to always pay attention to the cleanliness of the food and drink consumed.

1. Incidence of campylobacter spp. Increasingly increasing according to changes in temperature to become warmer due to global warming that occurs throughout mainland northern Europe.

1. There is growing evidence to suggest that climatic change can modify the incidence of waterborne disease, and diarrheal disease in particular. Much of the existing work examines the historical connection among weather and diarrhea incidence, with a limited number of studies projecting future rates of disease.

Several literature take ecological and social factors into account in historical connection, but few do so in forecasted prospective conditions.
4. Discussion

It is estimated that patterns of rainfall and temperature around the world will change due to climate change affecting various waterborne diseases. The results show that the connection among climatic and campylobacteriosis in Norway, Finland, Denmark and Sweden and predict the effect of climatic change that the incidence of Campylobacter is associated with an increase in temperature and most important rainfall in the week before illness. There are as many cases of Campylobacter as in the late 2080s, about 6,000 more cases per year only caused by climatic change [5]. Based on the of model LOAEL 94th, the percentile from 10.5 (90th percentile), to 16.3 (94th), 18.6 (95), 21.4 (96), and 43.8 (99). The maximum value is 274.7 mm in a day as many as 5,469 children aged five years, of which there are 796 children aged five years suffering from enteric disease which is transmitted through water and who are hospitalized for the first time. High rainfall for 2 days prior to entry date (hazard ratio 1.727 (1.103 to 2.703)) was associated with waterborne disease. New Zealand (Auckland, Counties-Manukau and Waikato), climate change has a negative impact on health [16].

Meanwhile, changes in population behavior, migration, drug resistance, resistance to depletion, urbanization, population density, improvement in health status and health services, and various community behaviors are various factors of waterborne disease due to the role of climate change. The different climates are very complicated and difficult due to the presence of water-borne pathogens from human and animal waste including large numbers of viruses, bacteria, protozoa, and parasites [20]. In addition, microorganisms such as vibrio (gastroenteritis, diarrhea and septicemia), Pseudomonas aerogenesis (skin infection) are pathogenic to humans [6]. Pathogens that are transmitted through water to humans will be problematic if they have unsanitary environmental conditions. Humans and animals, have low infectivity, such as pathogens, which can last for a long time in the environment, and are resistant to purification systems. Several types of pathogens can grow and reproduce outside the host body under certain environmental conditions such as vibrio cholera, hepatitis A virus, and schistosoma, also resistant to tropical areas [17].

Increased amount of rainfall and severe flooding have led to an increase in the number of pathogens in natural waters. This is due to increased refinery hydraulic loads, the spread of human and animal waste, and the displacement and release of pollutants. Transition, survival, and pathogen release also depend on surface hydrodynamics, and it can be argued that increased water release surface prevents pathogens from being depleted by UV and solar temperature [18]. Studies on cryptosporidiosis show that with increasing rainfall, the number of oocytes increases which also increases the risk of pathogenicity of this pathogen [19].

The World Health Organization (WHO) has published guidelines for calculating Disability Adjusted Life Years (DALYs) for the Disability Adjusted Life Year after Global Burden of Disease (GBD). This scale provides the ability to calculate the effect that causes disability [15]. To conduct this study, climate change scenarios are derived from global climate change models derived from future greenhouse gas emission scenarios [20]. In this way, the burden of climate change can be estimated under three different scenarios from 1960 to 1991, where the artificial effects of climate change are negligible. Epidemiological models are used to estimate the rate of these changes that may affect various diseases (malaria, diarrhea, malnutrition, flood mortality, drought, and the immediate effects of cold and heat). And with this scale, we can estimate the future burden of climate-related diseases [4].

In addition, climate change also provides benefits for human health, such as fewer deaths from flu in some areas, agricultural products in warmer areas have increased, but in developing countries the positive effects on other diseases can be neglected (infectious diseases, malnutrition). At the same time, cardiovascular disease is likely to increase slightly in mortality from high temperatures in the tropics. There is evidence that temperature causes slight changes in some deaths and no accurate assessment of the disease-related temperature load [19]. It is estimated that the burden of diarrhea will increase by 2.5% due to climate change in developing countries. However, the risk of diarrhea is low or insignificant in rich countries with a GDP of more than 6,000 US $ / year.
5. Conclusion

Climatic change has an uncertain effect on the spread of waterborne diseases. Approximation of the effect of climatic change on waterborne diseases are uncertain for the following reasons: 1) Hesitation about the spread of disease through climatic change due to changing rainfall patterns. 2) Hesitation about the direct and indirect connection among climatic and human health. 3) Hesitation about the relationship among climatic and waterborne diseases as a consequence of changes in health. Conclusion: The uncertainty in this estimate has led to little research in this regard.

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