

Public Health Impact of Natural Disaster: Socio-Ecological Perspective

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ABSTRACT

Background: In explaining the public health impact of disaster, it is insufficient to describe a large occurrence event just at individual level. Socio-ecological approach is able to illustrate the impact of disaster across multiple levels of involvement. The aim of this review is to comprehensively evaluate the impact of natural disaster to public health according to the socio-ecological perspective.

Materials and Methods: Literature search was done using multiple search engines. Socio-ecological theory was used as the framework to guide the search. Articles included are those published within 10 years in English and original articles accessible at full length. Review articles were excluded. Findings from the articles were then mapped according to the layer of the socio-ecological framework.

Result: The multi-dimensional impact of natural disaster to public health is clearly demonstrated through the socio-ecological perspective. Disaster exposes individuals and population to develop different kind of diseases. Individuals who contract the diseases will lose capability to work and unemployment thus will also affect other members of the family. Disaster also causes human migration and resettlement; which may facilitate the spread of infectious diseases. Increase of disease prevalence will then increase burden to the health service system.

Conclusion: Socio-ecological approach allows us to see multiple public health aspect of natural disaster impact towards the population. This approach will allow intervention and policy that will be develops to be more holistic and encompasses several layers within the model itself.

Keywords: natural disaster, public health, socio-ecological approach, socio-ecological, disaster impact

1.0 Introduction

Natural disaster has traditionally been considered the main threat to health security worldwide. Each year around 90 000 people been killed and more than 160 million people were affected by this phenomenon around the world (World Health Organization, 2012). Links between the natural environment and human health have been suggested for centuries. Disasters throughout history have had significant impact on public health. It induce deaths, severe injuries requiring extensive treatments, increased risk of communicable diseases, damage to health facilities, damage to the water systems, food shortage and population movements.

In explaining the public health impact of disaster, it is insufficient to describe a large occurrence of events just under one layer of individual level. An extensive explanation is offered through the application of the socio-ecological approach, which is able to illustrate the impact of disaster across multiple levels of involvement that nested the individuals who were affected to the disaster. This multi-level framework is also able to illustrate the health determinants, health behaviour and interactions between each layer of the framework.

The Social Ecological Model is a theory-based framework for understanding the multifaceted and interactive effects of personal and environmental factors that determine behaviours. It is a useful tool for identifying behavioural and organizational leverage points and intermediaries for health promotion within organizations (Bragin 2014). This model was proposed by McLeroy et al. (1988) and it has five nested, hierarchical levels, namely individual level, interpersonal level, community level, organizational level, and policy/enabling environment. Figure 1 illustrates the socio-ecological model according to the level of involvement in intrapersonal, interpersonal, neighbourhood and societal. All these levels are inter-related with each other which created hierarchical interaction between levels starting from the most inner level affecting the level above till the most outer one. Inversely, it can also affect from the outer to the inner level of the model (UNICEF, n.d.).

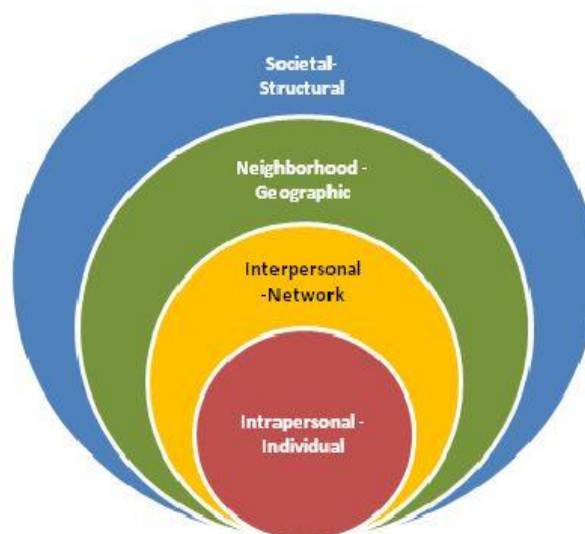


Figure 1: Socio-ecological model adapted from the paper “Impact of Hurricane Katrina on the Louisiana HIV/AIDS Epidemic: A Socio-Ecological Perspective” by Robinson (2003)

Several studies have used this framework to explain the impact of disaster. Robinson (2013), for example, has used this framework to explain the impact of Hurricane Katrina to the HIV/AIDS epidemic in the United States of America (Robinson, 2013). This approach also has been used to describe the rehabilitation process proceeding tsunami and hurricane (Adger et al. 2005), and to illustrate the effect of natural disaster to the Pacific area (Kreimer 2001).

Generally, the impacts of tremendous disaster events can be classified into various categories; the first one is individual impacts such as physical, mental, emotional and behavioural problems. Secondly, is the impact to the family and community including family resettlement, household income loss, community displacement and migration. Besides that, society and population impacts such as disease epidemiology, environmental issues and also food and water safety are also involved. Finally, there are organization and policy impacts including issues related to health infrastructures and economic impacts. Comprehensively, all the impacts will be discussed based on Socio Ecological Model.

The aim of this review is to evaluate the public health impact of natural disaster based on adapted Social Ecological Model to the intrapersonal-individual, interpersonal-network, neighbourhood-geographic and also to the societal-structural.

2.0 Materials and Methods

Literature search was done using multiple search engines namely; Pubmed, Google Scholar and Mednar. Socio-ecological theory was used as the framework to guide the search. Keywords include “public health impact”, “natural disaster”, “individual impact”, “family impact”, “population impact”, “organizational impact”. Articles included were those published within 10 years, in English and original articles with accessible full length. Review articles were excluded. Any reports and literatures relevant to the articles found through snowballing search from the articles’ reference were also included. Findings from the articles were then mapped according to the layer of the socio-ecological theory framework. Figure 2 displayed the public health impact of natural disaster mapped according to socio-ecological perspective.

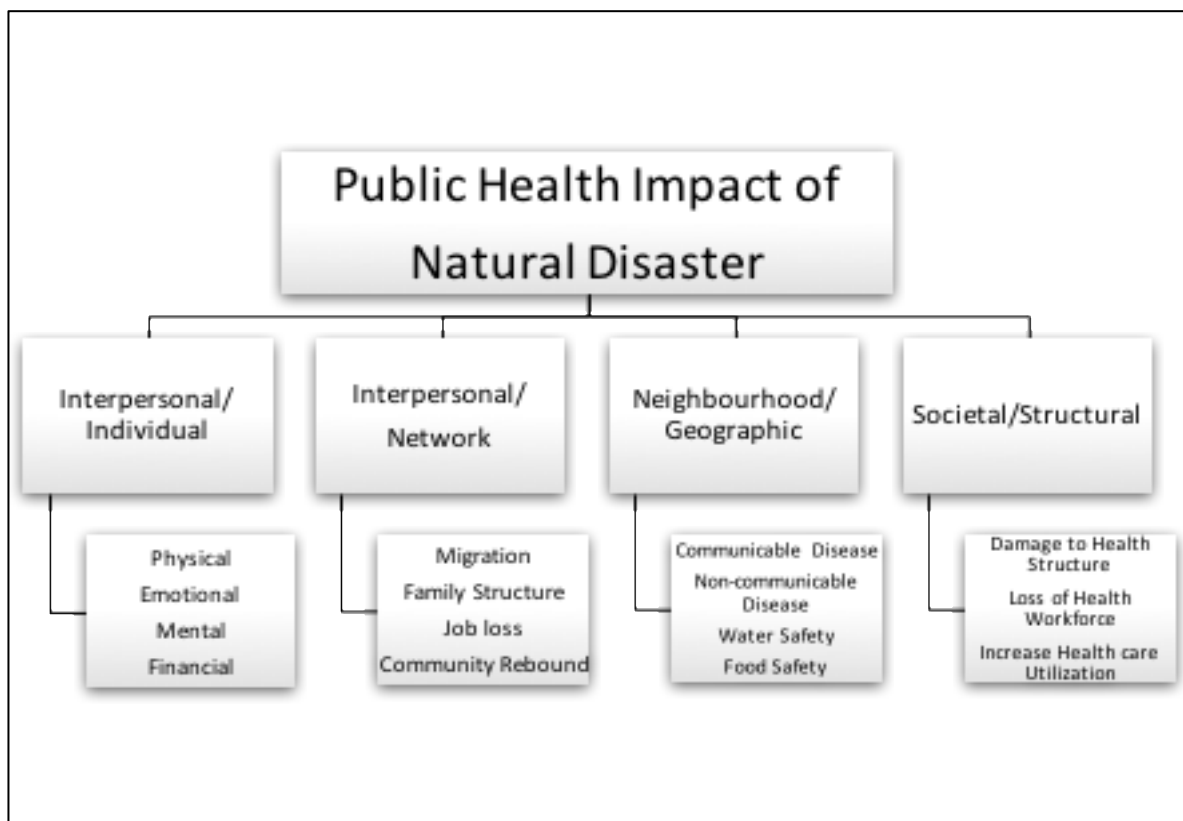


Figure 2: Mapping of Public Health Impact of Natural Disaster to Socio-ecological Perspective

3.0 Results

3.1 Interpersonal-Individual Impact

Tremendous disastrous event can lead to significant impacts at intrapersonal-individual level such as physical, mental, emotional and behavioural problems. Physical problems can be classified into four categories. Firstly, acute injuries which contributed about one fourth of the problem such as cuts, abrasions, sprains, fractures which include routine procedures such as medication refills, wound checks, and splinting (Centre For Disease Control And Prevention, 2005). Other than that, acute physical problems can also affect the survivors such as self-limited viral syndromes, gastroenteritis and respiratory problems which contributed about more than half of the problems (Ahern, Kovats, Wilkinson, Few, & Matthies, 2005). The existing chronic physical problems such as hypertension, diabetes and bronchial asthma can also deteriorate during these events and adequate provision of medication and medical supplies must be provided (Freedy & Simpson, 2007). Finally, medically unexplained physical symptoms such as fatigue and headache without clear organic aetiology or is commonly called psychosomatic disease are also commonly affecting the victims of a disastrous event (Freedy & Simpson, 2007). Figure 3 summarizes the impact of natural disaster towards intrapersonal and individual.

Disastrous events can also affect the victim's mental health such in the case of post-traumatic stress disorder (PTSD). An individual will experience intense fear, helplessness, and horror in response to a stressful event. They keep re-experiencing the pronounced symptoms of the traumatic event over and over again in the form of nightmares, intrusive thoughts, avoidance of trauma-reminiscent cues, emotional numbing, and symptoms of exaggerated startle response or hyper vigilance. The severity of these symptoms may impair the social and occupational functions of an individual. On average, 8-9% of trauma victims develop chronic PTSD (American Psychiatric Association, 1994). A study done in Canterbury, New Zealand had reported that the participants who were exposed to multiple earthquakes were 1.4 (95%CI, 1.1-1.7) times higher in rates of mental disorder including major depression, PTSD, anxiety disorders, and nicotine dependence than those who were not exposed. The attributable fraction contributed by exposure to the earthquakes accounted for 10.8- 13.3% of the overall rate of mental disorder in the cohort at age 35 years (Fergusson, Horwood, Boden, & Mulder, 2014).

The survivors of disastrous events always experience a significant emotional and psychological aftermath effects other than physical impacts as a result of loss of life, physical injuries, and property damage to an individual. The victims generally experience symptoms like intense fear, anxiety, despair, terrified, shock, disbelief, grief and insecurity. Concerns on the safety, adequacy of the shelter, and significant financial consequences of the event are among the possible reasons of victims developing such emotions. In addressing these problems, safety planning and emergency stabilization such as housing, medical attention, financial assistance should be prioritized (Gray et al., 2004).

Apart from physical, mental and emotional impact of disaster, behavioural problems also affect the victims especially children and teenagers which include internalizing and externalizing symptoms. A study among youth at the elementary school aged children who survived Hurricane Katrina has found that the disaster-related stressors were associated with higher child internalizing and externalizing symptoms three years post-disaster as a result of increased maternal psychological distress and school mobility in the first year post disaster (Lowe, Godoy, Rhodes, & Carter, 2014). Instead of expressing their negative emotions or responses to life pressures in a healthy or productive way, children and teenagers with externalizing behaviours direct their feelings outward to other people or things while others expressing internalizing behaviour such that are focused inward such as fearfulness, social withdrawal, and somatic complaints (Self-Brown, Lai, Patterson, & Glasheen, 2017).

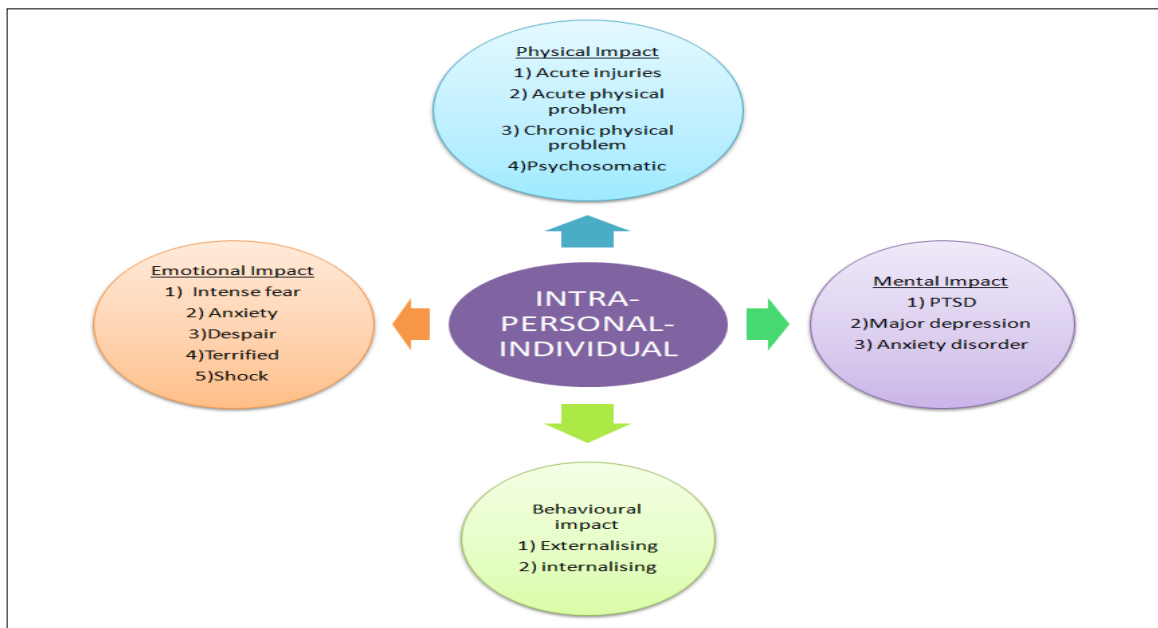


Figure 3: The Intrapersonal-Individual Impact of Natural Disaster

3.2 Interpersonal-Network Impact

Emerging evidence suggests that natural disasters such as storm, landslides and flood adversely affect livelihoods by destroying agricultural land or by damaging critical infrastructure, and can ultimately lead to displacement and migration in several parts of the world (Bogardi & Warner, 2008).

Feasibility for a places to be liveable maybe affected if the impact of disaster is badly enough thus pressured the affected population to seek shelter elsewhere. Current disaster such as Hurricane Katrina in 2005 and Russian drought in 2010 showed the impact of disaster to the human daily living therefore on the resettlement pattern. Although the environment condition alone is not the main cause for resettlement but it can exacerbate the socio-economic condition that emerge as the result of natural disaster (Krishnamurthy, 2012).

Natural disasters also could cause structural damage to buildings or destroy crops. These causes job loss or unemployment, where the businesses are not operational due to the damage caused by the natural disaster. It is estimated that about 11,800 jobs were lost following the catastrophe in Hurricane Sandy in 2013 (Friedmann, 2013).

3.3 Neighbourhood-Geographic Impact

Natural disaster influences the disease epidemiology in various ways. The impact of natural disasters varies according the nature of the disease, whether it is communicable or non-communicable diseases. The major causes of communicable disease in disasters can be categorized into four areas: waterborne diseases, diseases associated with overcrowding, vector and insect borne diseases, and infections due to wounds and injuries (Ligon, 2006). Figure 4 summarizes the outline of neighbourhood-geographic impact from natural disaster.

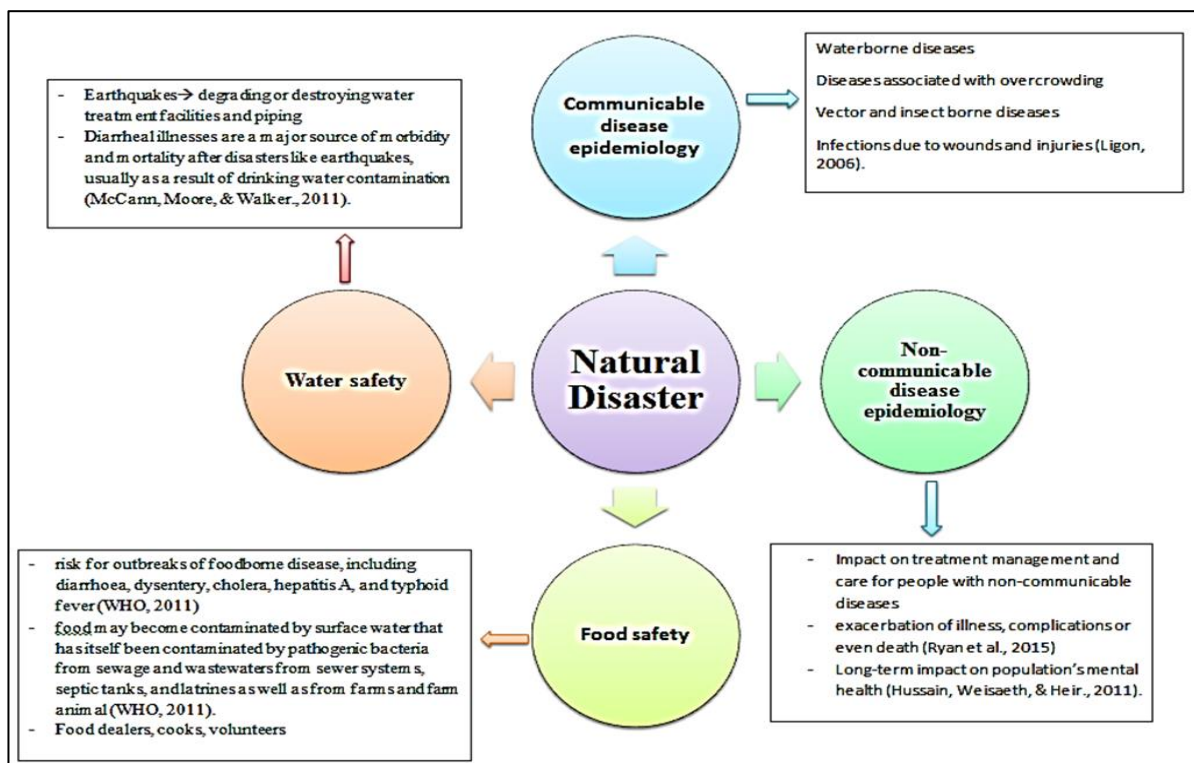


Figure 4: Neighbourhood-geographic impact

Several waterborne diseases like diarrheal diseases are usually at rise, especially during the hydro meteorological disasters, such as floods. Waterborne disease outbreaks of diarrheal illness after floods are thought to result primarily from the contamination of water. This occurs due to the disruption of purification, sewage disposal systems and breach in food security. However, secondary effects of flooding, including crowding and subsequent faecal-oral spread of gastrointestinal pathogens, may also contribute to the spread of diarrheal diseases (Baqir et al., 2012). Unexpectedly high rate of isolation of *E. coli* patho-types during flood periods is suggestive of shift of disease pattern during natural disaster (Bokhari, Shah, Asad, Akhtar, Akram, & Wren, 2013).

Cyclone, flood and storm related disasters impact on treatment management and care for people with non-communicable diseases with the possibilities of exacerbation of illness, complications or even death (Ryan et al., 2015). Disasters tend to leave a long-term impact on population's mental health in the form of depressive disorders and Post-traumatic Stress Disorders (PTSD) (Hussain, Weisaeth, & Heir., 2011).

Following natural disasters, such as the recent earthquake and tsunami in South East Asia, food in affected areas may become contaminated and consequently be at risk for outbreaks of foodborne disease, including diarrhoea, dysentery, cholera, hepatitis A, and typhoid fever (WHO, 2011). Foods which were consumed during and after disaster period need no safe especially for vulnerable population such as infants, pregnant mother and elderly which are more prone towards foodborne diseases. Food maybe contaminated by surface water that maybe contaminated by micro-bacteria from waste water (WHO, 2011). During emergency response operations, large-scale distributions of imported or locally-purchased food items as

well as mass preparation of cooked food frequently occur, and these may cause a breach in food safety.

Water contamination is a common occurrence after disasters, including natural disasters such as earthquakes and floods as well as human-made disasters. Whether it is in life-threatening short supply (drought), overabundance (floods, tsunamis and storm surges) or contaminated as a result of a disaster, water can have highly significant health effects on already distressed populations. For instance, earthquakes affect water quality in other ways, particularly through degrading or destroying water treatment facilities and piping. It is well known that diarrheal illnesses are a major source of morbidity and mortality after disasters like earthquakes, usually as a result of drinking water contamination (McCann, Moore, & Walker., 2011).

3.4 Societal Structural Impact

Healthcare facilities were affected greatly as a result of disaster aftermath especially if the facilities were built not to be disaster resistance. Many services were interrupted due to the damage. The damage of the facilities will further hamper the recovering and rehabilitation of the population post disaster. Retrospective survey done in Iran, after 10 years being exposed to multiple natural disasters revealed 697 primary care facilities suffered structural damage and 1378 primary care facilities had functional failure (Ardalan, Mowafi, & Khoshshabedhe, 2013). Flood disaster that happened in 2007 has damaged a total of 40 Indonesian health facilities (World Health Organization, 2015). Similarly, the tsunami that happened in Aceh during 2004 destroyed 34 healthcare facilities and 77 others were severely damaged (Carballo, Daita, & Hernandez, 2005).

While the disaster had caused morbidity and mortality to the population, it had also affected the health personnel and rescue workforce. This impact further deteriorates the interruption of public services delivery. Tsunami that happened in December 2004 affected healthcare facilities along the coastline of Ranong and Phang-Nga and killed seven public health officers and 25 public health volunteers (Carballo et al., 2005). Over the past 10 years, natural disaster has injured 644 healthcare workers and caused death to 127 healthcare workers (Ardalan et al., 2013).

The system also need to overcome the rate of higher turnover. Just after Hurricane Katrina, 40 of 600 physicians and 1500 of its 7400 other employees resigned after the disaster as their spouses no longer has local employment, schools were closed or housing no longer available (Berggren & Tyler, 2006). Disaster also could give long term health effect as postulated in a longitudinal study after a disaster that occurs in Enschede, Canada that sick leave absence been increasing 18 months after the disaster and only return to the baseline after 36 months post disaster. This result however needs to be interpreted with caution as the association couldn't be concluded purely due to disaster (Morren, Dirkzwager, Kessels, & Yzermans, 2007).

Disaster also inevitably will increase health service utilization which in turn increase the burden happens to the systems. These effects depend on the severity and the nature of disaster. Severe injuries which require acute attention to trauma management are mainly during the time of the disaster while traumatic event which involve mental health might persist for a longer duration(Dorn, Yzermans, Kerssens, Spreeuwenberg, & van der Zee,

2006). This is also agreeing with a study that shows that in every four times increase of number of lifetime traumas, there was about a 50% increased risk for having hospitalization and emergency medicine visit (Leserman et al., 2005).

3.5 Inter-hierarchical impact of natural disaster

Disaster exposes individual and population to develops different kind of diseases whether acute diseases, non-communicable disease or mental illness (Ahern et al, 2005). Individual that contract the diseases be it either acute illness or chronic illness would later lose their capabilities to work (Friedman 2013). Lose of working capabilities on one person will affect other person in the family and thus lead to higher turnover in all organisations (Berggren & Tyler 2006).

Disaster will force a lot of victims to be homeless and aggregate into an area of resettlement. Resettlement area can lead to overcrowding problem and overburden of local water and sewage area and thus make waterborne and other communicable disease more easily transmitted within the population (Bokhari et al, 2013).

Increase of disease epidemiology post disaster then will add further burden to already malfunction health system. A study done to determine health care utilization after tornado event in Minnesota, United States during March 1998 showed that there was an increase of average health care utilization from 5.92 visits per year to 7.11 visit per year (Polusny et al., 2008).

When look from macro to micro level, due to significantly impaired of health system, adequate health provision cannot be provided and the existing health system cannot cope with the increase of health utilization (Dorn et al., 2006). Subsequently, individual and population with existing chronic illness will have their health condition deteriorate due inadequate medication and health care (Freedy & Simpson, 2007). Significantly reduced of livelihood of disaster area then will force population to migrate to seek for better healthcare services (Bogardi & Warner, 2008).

In addition, population will be devoid of safe food and water during natural disaster. Unsafe food and water supply will then make population more easily to contract food and water borne diseases (McCann, Moore, & Walker., 2011).

4.0 Conclusion

Devastating effects can be seen post natural disaster occurrence worldwide. Socio-ecological approach allows us to see multiple public health aspect of natural disaster impact towards the population. This approach will allow intervention and policy that will be develops to be more holistic and encompasses several layers within the model itself. This review however have several limitation which is it does not taking into account different adaptive capability of each country facing the disaster and also this approach have tendency to generalize the impact and might overlook other impact which is out of the scope of the model.

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Declaration

Author(s) declare that there is no conflict of interest with the publication of this article.

Authors contribution

Author 1: literature finding, draft manuscript
Author 2: literature finding, draft manuscript
Author 3: literature finding, manuscript editing
Author 4: literature finding, manuscript editing
Author 5: manuscript review and editing
Author 6: manuscript review and final editing

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