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Research Article

Survival After Disaster: An Enquiry into Major Public Health Challenges Faced by Flood Affected Areas in Alappuzha District, Kerala, India

Rajendran R[1], Regu K[1], Anusree SB[2], Sayana Bhaskaran K[3]

[1]Consultant, [2]Research Assistant, [3] Medical Officer & Officer in Charge, National Centre for Disease Control, Ministry of Health and Family Welfare, Government of India, Thiruvananthapuram, Kerala, India.
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Corresponding Author:
Rajendran R, National Centre for Disease Control, Ministry of Health and Family Welfare, Government of India, Thiruvananthapuram, Kerala, India.
E-mail Id:
rajendran061@gmail.com
Orcid Id:
https://orcid.org/0000-0003-2080-9723
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A B S T R A C T

The study was carried out in flood-affected 21 rural and 2 urban localities of the Alappuzha district. The aim of the investigation was to assess how far Local Self Governments (LSGs), Local Health Institutions (LHIs), NGOs, Social and Residential Organisations could successfully bring safe drinking water and essential commodities to the flood-affected locality and the role of Health workers in carrying out sanitary activities such as chlorination of Wells and providing essential drugs to the needy people. The assessment of the potability of drinking water sources in the flood-affected areas using the OT test showed adequate residual chlorine was present only in two localities. However, none of the water samples examined from twelve of the flood-affected areas were with adequate residual chlorine. Acute Diarrhoeal Disease (ADD) and Leptospirosis cases were more in 2018 as compared to non-flood years. However, the numbers of dengue fever cases were less in the flood-affected localities.

Keywords: Flood Disaster, Acute Diarrhoeal Diseases, Rapid Disease Risk Assessment

Introduction

Natural disasters are events of nature which overwhelm local resources and threaten the function and safety of the community. Often, natural disasters disrupt populations, destroy existing infrastructure, and fend off developmental activities and economic growth. In addition to this, these have a significant impact on the public health and well-being of the population affected.[1] Over the past two decades, the incidence and enormity of natural disasters have grown in great proportions, resulting in considerable environmental destruction, and loss of establishments, life and economy, all affecting millions of people all over the world.

Flood disaster has been of serious concern since the beginning of human civilisation and has led to extensive morbidity and mortality. Flood is one of the most common disasters which account for about 40% of natural calamities worldwide.[2] Co-morbidities and complications including mortality emerging out of flood can be due to direct and indirect impacts. The direct impact includes drowning, injuries, electrical shocks, snake bites, animal or insect bites,

etc. Indirect impact includes obtrusion of basic public health services, nutritional problems and health-related issues.

The public health repercussions of flooding are disease outbreaks mostly resulting from the movement of people into overcrowded temporary camps and contamination of drinking water sources with faecal materials and other pollutants. The most important public health threats in flooding catastrophe are related to the outbreak of communicable diseases including water-borne diseases such as typhoid fever, cholera, hepatitis A, skin infections, and eye infections, and Zoonotic diseases such as leptospirosis. Flooding can also result in the proliferation of vector breeding habitats and pave the way for the outbreak of vector-borne diseases such as malaria, dengue, chikungunya, Zika, and West Nile fever.[3]

An increase in Acute Diarrhoeal Diseases (ADD) is also a great concern during flooding due to disruption of the water distribution system, contaminated water sources, lack of sanitation, poor hygiene, inadequate shelter homes, overcrowding in stay sheds, inadequate chlorination or other water treatment methods. Many of the inhabitants of the flood-affected areas are facing the problem of non-communicable diseases (NCDs) such as diabetes, hypertension, respiratory illness, cardiovascular diseases, etc. due to poor access to health services.

Kerala is one of the most socio-economically developed among Indian states with a high literacy rate (HLR), human development Indices (HDI) and other welfare indicators. Kerala experienced an abnormally high rainfall from June 1 to August 19, 2018. This resulted in intense flooding in almost all districts in the state including Alappuzha. The district was worst affected being comprised of backwaters, estuaries, canals and lagoons. Most of the inhabitants of Alappuzha depend on the public water supply as a drinking water source. The usage of water from wells and bore wells is not uncommon.

The severe flood of August 2018 disrupted water supply in the entire district, especially in the low-lying areas of Kuttanad area, 'the rice bowl' of Kerala. Most of the wells in the flood-affected district become contaminated with bacteria or other contaminants. Waste water from malfunctioning septic tanks or chemicals seeping into the ground contaminated the groundwater. In addition to this, flood water carries large pieces of debris that can dislodge parts of the well and distort or crack the well casing. Flood water may also deposit mud or sediment in the well.

Disruption or contamination in the water distribution system increases acute diarrhoeal diseases (ADD), typhoid, cholera, hepatitis, etc. Floods can potentially increase the transmission of vector-borne diseases and Zoonotic diseases such as leptospirosis. The present study was carried out to assess the post-flood status of the drinking water sources and residual chlorine levels (OT) in the flood-affected households in the Alappuzha district. Unlike the symptomatic treatment and supportive care given for the treatment of most arboviral diseases, prophylactic drugs are available for the treatment of leptospirosis or Weil's disease. Hence, an attempt was made to assess the distribution coverage of chemoprophylaxis drugs for leptospirosis in the flood-affected households of Alappuzha district.

Materials And Methods

The study was carried out in the Alappuzha district of Kerala during the post-flood period from September 1 to September 30, 2018. The study was carried out in 21 rural Panchayaths and two urban (Municipality) areas. Out of the total households available at urban/ rural localities, 1207 households were selected by using simple random sampling method. Out of all indexed households, 50 houses were selected from each area. Disaster data are vital for identifying trends in the enormity of the devastation.

Data was collected by using the standard protocol. Data on types of drinking water sources, activities of health workers regarding the chlorination of wells, distribution of chlorine tablets, issuance of chemoprophylaxis drugs for leptospirosis, etc. was collected using a standardised pretested format. Data on vector-borne diseases such as dengue fever, water-borne diseases such as Acute Diarrhoeal diseases (ADD) and Zoonotic diseases such as leptospirosis was collected from the District Surveillance Unit (DSU), Alappuzha. In order to compare the impact of floods on public health, data from DSU was collected for the preceding (2017) and succeeding years (2019 and 2020).

In order to check the residual chlorine level in the drinking water sources, the test (OT) was done through house visits. The test was carried out by adding 0.1 ml of reagent to 1 ml of water. The colour of the sample changes and the same is compared with the respective colour chart. The reading was taken within 10 seconds; this gives the amount of free chlorine. Free chlorine is the amount of chlorine, measured in parts per million (ppm), that is accessible to get rid of harmful microbes and neutralise contaminants. The minimum recommended free chlorine is 0.5 mg/litre. The presence of free chlorine thus was taken as a measure of the potability of water.

Results

A standard proforma was used for reporting on details regarding the source of drinking water, and chlorination including the performance of OT test for residual chlorine detection and chemoprophylaxis for leptospirosis provided to the eligible house dwellers. Of the total 1207 houses visited, 825 (68.35%) depended on public water supply as drinking water source, 145 (12.01%) had their own

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wells and 98 (8.12%) relied on bore wells as primary drinking water source. The drinking water source of more than 96% of households of Budhannur Panchayath was exclusively through wells. Similarly, 43.1% of households of Veeyapuram Panchayath depended on wells as drinking water sources and an equal number of households in the same locality were also seen using bore well water for drinking purposes. In the present survey, it has been noted that 100 (8.29%) households depended on mobile water tank supply, 30 (2.49%) used RO water, 5 (0.41%) were forced to use river water and the remaining 4 (0.33%) turned to rainwater (filtered through traditional method). In the Chempumpuram area (Ward Nos. IV& V), the local church arranged drinking water for the households through mobile water tanks whereas in Ward No. VI, the Local Self Government (LSG) arranged drinking water through water tank vehicles. In Ward No. 1 of Chempumpuram Panchayath, due to an acute shortage of drinking water, the PHC authorities brought RO water to the local inhabitants. In Veliyanad rural area (Ward Nos. IV, VI, XI) also LSG made adequate arrangements to bring drinking water to the inhabitants through mobile water tanks.

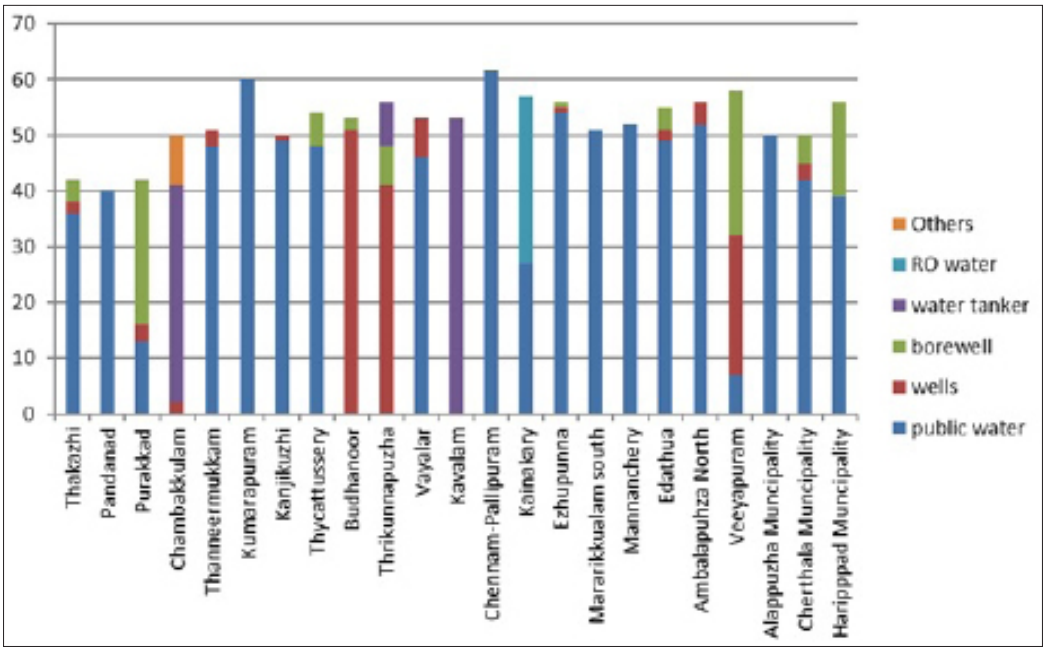
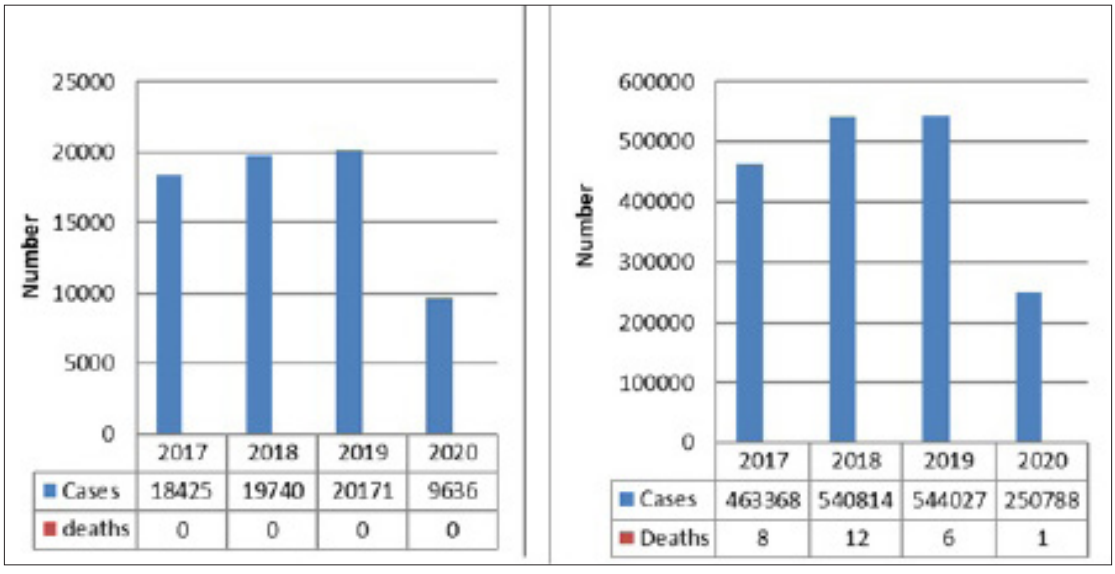


Figure 1.Types of Drinking Water Sources in the Study Areas in Alappuzha District (N = 1207)



(a) **(b)**

Figure 2.ADD (Diarrhoea) Cases in (a) Alappuzha and (b) Kerala

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The major health threat associated with flooding is the contamination of drinking water sources resulting in water-borne diseases such as typhoid, acute diarrhoeal diseases, cholera, hepatitis A, etc. As per the Integrated Disease Surveillance Project (IDSP) report available in the District Surveillance Unit (DSU), Alappuzha, a total of 19740 acute diarrhoeal diseases (ADD) were reported from Alappuzha district in 2018. During the year 2017, the number of reported cases of ADD was 18425. As the 2018 flood affected almost all districts of Kerala, a similar trend of ADD was seen in the state-level report also. It is interesting to note that though it was not that fierce, in August 2019 also, most of the districts of Kerala, especially northern and central parts were worst affected by flood. The severity of the flood was from 8th to 29th August 2019. The trend of ADD cases reported in the Alappuzha district and from the whole State in 2019 is alike which is comparable with the 2018 report (Figures 2a and 2b). However, the outbreak of ADD could not be noted in any of the flood-affected localities.

The assessment of the potability of drinking water sources in the flood-affected areas using the OT test showed none of the water samples examined from twelve areas in flood-affected localities of Alappuzha district had adequate residual chlorine. However, residual chlorine was found adequate in all the water samples (100%) tested from two areas i.e., from Pandanad and Thycattusserry Panchayath areas. 95.5% of water samples examined from Edathua Panchayath also showed inadequate residual chlorine. Of the total 51 water samples tested from the Thanneermukkom area, only 2.27% showed inadequate residual chlorine. Area-wise houses showing inadequate residual chlorine in drinking water sources are given in Figure 3.

Another epidemic infection which can be transmitted directly from contaminated water is leptospirosis, a Zoonotic bacterial disease. This is transmitted through contact of the skin or mucous membrane with water, damp soil or mud contaminated with rodent urine. It was observed that a total of 254 leptospirosis cases and 6 deaths were reported from Alappuzha district in 2018, the flood year whereas in 2017, there were only 204 cases and 2 deaths due to leptospirosis. In 2019 and 2020, the number of leptospirosis cases reported from Alappuzha was 184 and 131 respectively (Figure 4a). A similar tendency was observed with regard to leptospirosis cases and deaths reported from Kerala during 2017-2020. In 2017, the number of leptospirosis cases reported was only 1408 with 80 deaths whereas in 2018 (flood year), the number of leptospirosis cases rose to 2079 and 99 deaths. A decline in the number of leptospirosis cases was noted in 2019 and 2020 as has been observed in Alappuzha district. The number of leptospirosis cases and deaths reported in Kerala in 2019 were 1211 and 57 respectively. However, in 2020 the reported cases and deaths were 1039 and 48 respectively (Figure 4b).

Floods may indirectly lead to an increase in mosquito-borne diseases such as dengue fever through the expansion in the number and diversity of vector habitats. In the flood year of 2018, the number of dengue fever cases reported in Alappuzha was 149 with one death. But in 2017, 1375 DF cases and 8 deaths were reported from the district. In 2019 and 2020, the reported DF cases in Alappuzha were 355 and 221 respectively (Figure 5a). Evaluation of the data pertaining to DF cases reported in Kerala state from 2017 to 2020 showed a similar proclivity as that of Alappuzha district (Figure 5b).

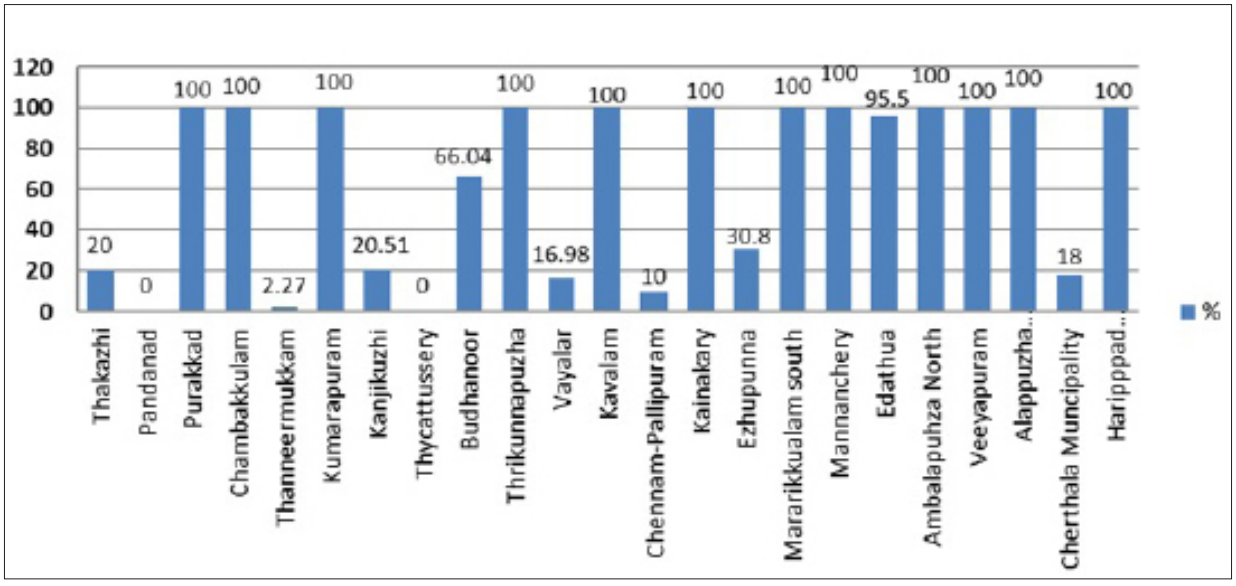

Figure 3.Houses showing Inadequate Residual Chlorine in Water (%)

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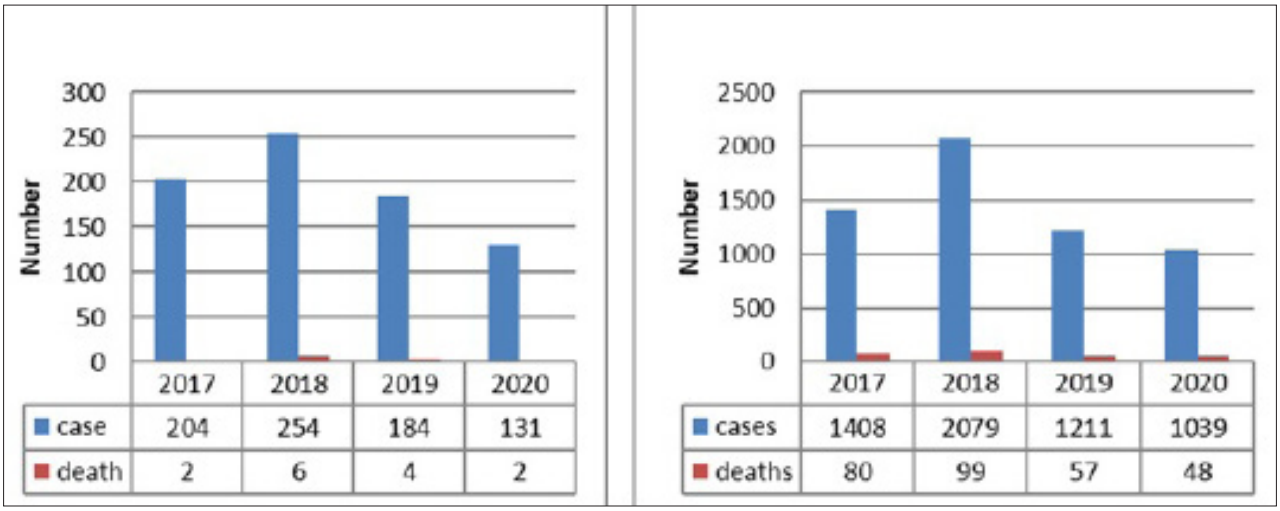

(a) (b)

Figure 4.Leptospirosis Cases and Deaths in (a) Alappuzha and (b) Kerala

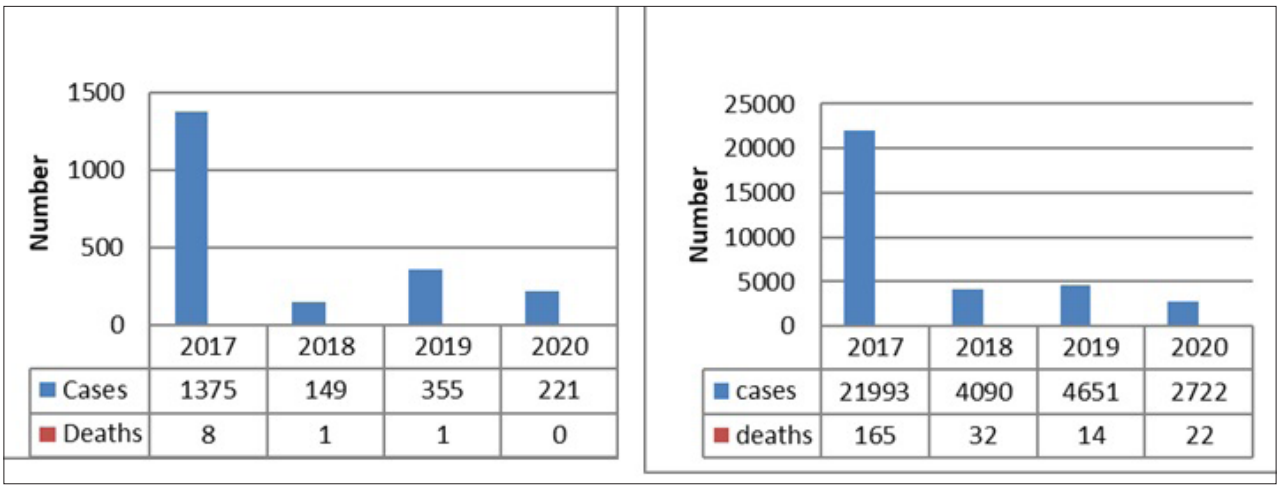

Figure 5.Dengue Cases and Deaths in (a) Alappuzha and (b) Kerala

Discussion

Kerala experienced an abnormally high rainfall and received an excess of 37.43% rainfall during the period from June 1 to August 22, 2018. During this period, Alappuzha district of Kerala received 1648.1 mm rainfall which is 20.54% more than the normal rainfall (1309.5 mm). The average cumulative rainfall of 3 days from 15th to 17th August 2018 was about 414 mm. This was almost of the same order as that of rainfall of Devikulam which occurred from 16th to 18th July 1924. Hence, the Government of India had declared it a Level 3 calamity or calamity of a severe nature.

Flooding is the foremost natural catastrophe in the world. It also causes significant environmental changes faced by many nations in the 21st century.[4,5] The changes in precipitation affect the ecology, behaviour, diversity, growth and mobility of arthropod vectors, their pathogens and hosts, especially the non-human vertebrates.[6] In addition to drowning, injuries and disability, floods can cause outbreaks of gastroenteritis, communicable diseases especially vector-borne diseases, epidemic diseases, etc. This leads to significant morbidity and mortality in the affected locality. Flooding can also affect the physical and mental health of the individuals residing in the worst affected areas.[2,3] It has been noted that heavy rainfall is usually associated with a significant increase in rodent-borne diseases such as leptospirosis because of altered patterns of human-pathogen-rodent contact.[7] Number of leptospirosis cases reported in Alappuzha district during 2018, the flood year was higher than that reported in 2017 and 2019 indicating a close association between leptospirosis outbreak and heavy rainfall.[8]

The main reasons for floods are high-intensity rainfall in short duration, poor or inadequate drainage capacity of rivers, unplanned reservoir regulation and failure of flood control structures. Floods may indirectly lead to an increase in mosquito-borne diseases through expansion in the number and range of vector habitats. Standing

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water caused by heavy rainfall can act as breeding sites for mosquitoes, and therefore enhance the potential for exposure of the disaster-affected population and emergency workers to infections such as dengue, malaria and other mosquito-borne diseases. Hence one can expect more vector-borne diseases especially, Dengue Fever cases and deaths in the post-flood period. However, the number of dengue fever cases reported in Alappuzha district in 2018 was much lower than that of 2017. This is possible because the devastating flood had obliterated most of the breeding habitats of vector mosquitoes. This further led to significant depletion in the emergence of adult vector mosquitoes. The lower number of DF cases reported in Alappuzha during the flood period substantiates the phenomenon that occurred in nature that curtailed the breeding and proliferation of vector mosquitoes. This was evidenced in the post-flood vector surveillance carried out in 2018 in the flood-affected areas of Alappuzha district.[9]

In the present study, an outbreak of ADD could not be noted in any of the flood-affected localities in the Alappuzha district. It is mainly because of the habit of the people in using only boiled water for drinking purposes. The state health department has a significant role in creating positive health habits in the population.

During and after flooding, surveillance plays an indispensable role in the early identification and subsequent control of contagious disease outbreaks as well as timely management of other public health issues.[10] Epidemiological surveillance can bring forth accurate information on incidence rates of infectious diseases arising from flooding across populations and geographic regions. The data regarding frequency, trend, affected population and location will help in the management and control of diseases in the flood-affected areas.

Public health interventions are very important in reducing vulnerability to infections as a result of flooding.[5] One of the most effective health interventions to avoid disease outbreaks arising out of flooding is to develop Early Warning Systems (EWSs). This allows either timely evacuation of the population residing in high-risk areas or implementation of precautionary measures by the concerned authorities to sufficiently prepare for the eventualities.[11] Emergency Response Planning (ERP) is an important health intervention strategy. It brings about well-planned emergency procedures designated and established well in advance of the flooding hazard. This will provide strong support for health care during and after flooding.[12] Another intervention is the Rapid Disease Risk Assessment (RDRA). The main purpose of this is to assess the health needs and risks aroused due to flooding.[13] A recent study on post-flood morbidity patterns in flood affected population of Alappuzha district showed respiratory infection accounted for a majority of cases both among adults and children followed by generalised weakness and musculoskeletal pain.[14]

In post-flood situations, the immediate intervention targets mainly water, sanitation and hygiene (WASH). The availability of safe drinking water during and after flooding helps to reduce many public health issues. An adequate supply of clean water to the affected population is very important as most of the infectious diseases are spread through contaminated water. One of the most affordable and widely used disinfectants is chlorine. It is known to be effective against nearly all waterborne pathogens and is convenient where no alternative supply of safe drinking water facilities exists. The effort made by the LSGs, Local Health Institutions, and Residence/ welfare associations to provide safe drinking water to the flood-affected individuals of Alappuzha district during the 2018 flood was witnessed by the study team.

Health awareness campaigns are required to reduce health vulnerability to floods and protect public health. The main purpose of an awareness campaign is to motivate action to protect the health and well-being of the public. This should be one of the priorities of the public health fraternity in the event of impending floods, during floods, and in flood-prone areas.[15] Keeping this in mind, the National Centre for Disease Control (NCDC), Kerala branch prepared a leaflet in the local language on “Precautions during and after Flood & Survival” and distributed it to the affected localities.

Proper and enhanced coordination and collaboration among stakeholders such as between the Department of Public Health and Livestock, emergency relief providers and public health, researchers, and the local community creates a condition for better handling of outbreaks of infectious diseases that follow flooding disasters.

Conclusion

The efforts done by LSGs, LHIs, etc. in bringing safe drinking water to the flood-affected locality of the Alappuzha district is a classic example of post-flood management. The activities done by various departments in association with many social organisations to take care of the affected people were observed during this study.

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