



The Long-Term Mental Health Consequences of Floods and Landslides in Thrissur District, Kerala, India

Citation

Kunnathepeedikayil, Shameer. 2020. The Long-Term Mental Health Consequences of Floods and Landslides in Thrissur District, Kerala, India. Master's thesis, Harvard Medical School.

Link

<https://nrs.harvard.edu/URN-3:HUL.INSTREPOS:37365186>

Terms of use

This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material (LAA), as set forth at

<https://harvardwiki.atlassian.net/wiki/external/NGY5NDE4ZjgzNTc5NDQzMGIzZWZhMGFIOWI2M2EwYTg>

Accessibility

<https://accessibility.huit.harvard.edu/digital-accessibility-policy>

Share Your Story

The Harvard community has made this article openly available.
Please share how this access benefits you. [Submit a story](#)

This Thesis, [THE LONG-TERM MENTAL HEALTH CONSEQUENCES OF FLOODS and LANDSLIDES in THRISSUR DISTRICT, KERALA, INDIA], presented by [SHAMEER KUNNATHPEEDIKAYIL], and Submitted to the Faculty of The Harvard Medical School in Partial Fulfillment of the Requirements for the Master of Medical Sciences in Global Health Delivery in the Department of Global Health and Social Medicine has been read and approved by:



(Vikram Patel MBBS, M.D, PhD)



(Mary Smith Fawzi, ScD)

0

Date: May 11, 2020

**THE LONG-TERM MENTAL HEALTH CONSEQUENCES OF FLOODS and
LANDSLIDES in THRISSUR DISTRICT, KERALA, INDIA**

SHAMEEER KUNNATHPEEDIKAYIL

A Thesis Submitted to the Faculty of

The Harvard Medical School

in Partial Fulfillment of the Requirements

for the Degree of Master of Medical Sciences in Global Health Delivery

in the Department of Global Health and Social Medicine

Harvard University

Boston, Massachusetts.

May, 11 2020

**[THE LONG-TERM MENTAL HEALTH CONSEQUENCES OF FLOODS and
LANDSLIDES in THRISSUR DISTRICT, KERALA, INDIA]**

Abstract

Disasters such as floods and landslides affect humans than ever before. The effects of a catastrophe on humans could result from a simple injury to life-threatening accidents and the emergence of infectious diseases.

I present two research articles as my thesis. Part-1 deals with the social and political background of the study site, where I conducted the primary research for people exposed to landslides and floods in the district of Thrissur in 2018 August. For part 1, I examined the modern social and political history of India since 1750. I analyzed the published literature of disasters that reported under the British India colonial period in India. I focused on two historical calamities, a cyclone that occurred in 1864 in the state of Bengal, which killed over 40000 individuals. Secondly, I analyzed the flood that reported in the state of Kerala in 1924. Because of these incidents, several people lost their lives, and survivors experienced severe hunger and famine. The social response towards these calamities was deficient. The British rulers have marginalized citizens of India by not documenting the loss of property, the value of items possessed before the tragedy, and not providing adequate care to the sick and injured. The public health system under the British colonial era was insufficient and inadequate to provide medical care to the population to the citizen of India. The structural barriers such as collecting payment for services for accessing medical care, imposing various kinds of mandatory tax collection, and limiting access to general education have resulted in the rising structural inequalities

In the second part of this thesis, I conducted a cross-sectional survey among people exposed to floods and landslides that occurred in the district of Thrissur, Kerala, in 2018 August. We measured the mental health morbidity, such as the prevalence of common mental disorders, factors associated with the progression of common mental disorders in the study population.

In summary, the aftermaths of the colonial government tenure still impact the people of Kerala in various ways. The historical governance actions and policy practices still visible, such as deforestation, underfunded health care systems, and inadequate social responses from the government's in power, resulting in increased social suffering of people affected by the disaster. Of those individuals, the poorest of poor are being sidelined from the mainstream social-political developments happening in post-independent India and thereby increasing the structural inequality among citizens.

Table of Contents

<i>Abstract</i>	2
<i>Part 1: Political Economy/Background</i>	7
<i>The Historical Analysis of People Affected by the Floods and Landslides in Kerala, India</i>	8
<i>Background</i>	9
<i>Section 1</i>	10
<i>The Historical Details of Natural Calamities Reported in India and in the State of Kerala.</i>	10
<i>Section 2: Social Health Care Delivery System of India</i>	13
<i>Section-3: Disasters and its Impacts in India</i>	17
<i>Social Determinants of Health and Post Disaster Health and Social Needs of the Community</i>	19
<i>Other long-term unaddressed factors</i>	23
<i>Conclusion:</i>	24
<i>Tables and Figures</i>	25
<i>Table 1: Details of significant disasters occurred in India under the British colonial government period.</i>	25
<i>Table 2: Details of Natural Disaster Reported by the Government of India Since 1978.</i>	26
<i>Figure 1: Political Map of Bengal under British India in 1851</i>	27
<i>Figure 2: Political Map of India under British India in 1851</i>	28
<i>Figure 3: The Political Map of Madras Presidency in 1886</i>	28
<i>References</i>	29
<i>Part 2: Publishable Paper</i>	33
<i>Abstract</i>	33
<i>Background</i>	34
<i>Methods</i>	37
<i>Results</i>	40
<i>Discussion</i>	43
<i>Conclusion</i>	46
<i>Figure-1 Study Area</i>	48
<i>Figure-2 Distribution of Rain Fall Reported in Thrissur District in August 2018</i>	49
<i>Figure-3 Prevalence of Common Mental Disorders in the Study Population</i>	50

<i>Table-1: Characteristics of the Survey Population</i>	<i>51</i>
<i>Table 2a. Sociodemographic characteristics of people exposed to the flood and landslides in Thrissur District, Kerala, India in 2018 and 2019 (n=369).....</i>	<i>52</i>
<i>Table 2b. Experiences of mental trauma, help seeking behavior and, hospitalization of participants exposed to floods or landslides.....</i>	<i>53</i>
<i>Table 3. Association of Common Mental disorders with disaster-related experiences among those exposed to floods and landslides in Thrissur district, India in 2018 and 2019 (n=358)</i>	<i>55</i>
<i>Table 4: Multivariate Logistic Regression Model for factors associated with symptoms comparable with moderate-to-severe common mental disorders</i>	<i>61</i>
<i>References</i>	<i>62</i>
<i>Appendix 1 (Questionnaire for Cross Sectional Study Data Collection)</i>	<i>66</i>

Acknowledgements

First, I am thankful to Almighty Allah.

After Allah, I want to thank my mother, Sainaba. By leading from the front through life's ups and downs, she has continuously shown me the true path to success. Next, I want to thank my wife, Shelsiya, and our three-year-old son, Mohammed Ibrahim. Their constant moral support helped me to stay focused throughout my journey through the Master of Medical Sciences in Global Health Delivery program at Harvard Medical School.

I want to take this opportunity to remember all of the many teachers and advisors who have taught and supported me throughout my career. Their constant feedback helped me to pursue a deeper understanding of human problems through a biosocial lens.

For their unyielding generosity, patience, and support, I am indebted to my Harvard Medical School teachers and advisors: Professor Vikram Patel, Professor Mary Kay Smith-Fawzi, Professor Joia Mukherjee, Dr. Hannah Gilbert, Professor Paul Farmer, and Professor Salmaan Keshavajee, Dr. Hannah Gilber, and Dr. Jason Silverstein whose timely advice, guidance, and inspiration—both from their work and example—has enabled me to become a more motivated learner and focus on the lived realities of people who face challenges from many different settings and parts of the world.

Also, it is with my deepest gratitude that I thank my two mental health professors: Professor Shaji KS, Head of the Department of Psychiatry at the Government Medical College Thrissur in Kerala; and Professor Praveen Lal, Principle at the Jubilee Mission Medical College and Research Institute in Kerala. I benefited from their expertise, inspiration, leadership, and passion for research and service. Their guidance helped me to focus my research on cultivating a broader understanding of the problems experienced by people in India and to complete my research project on time.

Similarly, I am so thankful to my inspiring classmates in the program whose experiences, stories, and actions made me into a more optimistic person. Our time together in the program reemphasized to me the importance of being with and learning from the people around you about their biosocial histories.

Finally, I am grateful to Christina Lively, Bailey Merlin, Nai Kalema, Rebecca Kahn, Dr. Nadeem Kasmani, and Sidney Atwood. Without their continuous support, this thesis would not have been possible.

This work was conducted with support from the Master of Medical Sciences in Global Health Delivery program of Harvard Medical School Department of Global Health and Social Medicine and financial contributions from Harvard University and the Center for Global Health Delivery-Dubai. The content is solely the responsibility of the authors and does not necessarily represent the official views of Harvard University and its affiliated academic health care centers.

Part 1: Political Economy/Background

The Historical Analysis of People Affected by the Floods and Landslides in Kerala, India

“I am uncertain . . .like, how long I would live with these situations.” said Mrs. Geetha* (*the participant's name has been changed to protect her privacy.), a 34-year-old housewife and victim of a recent landslide. Mrs. Geetha had a decent life with her family of six before two unprecedented landslides occurred in the Thrissur district of Kerala, India in August 2018. For Mrs. Geetha*, after the first landslide happened overnight, she and her children evacuated to a safer location, but her husband, the family's primary breadwinner, returned to their home to retrieve some belongings when the second landslide hit. The landslide destroyed their home and killed Mrs. Geetha’s husband. Mrs. Geetha received her husband's body for the funeral while staying in a temporary relief camp for people displaced by the flood and landslides. As a result of the early demise of her beloved husband, relatives, and neighbors within the span of a week Mrs. Geetha began to experience mental and physical health challenges, including involuntary movements of her left hand, unusually increased speech, and change of mood. She said while crying, "We do not have anyone now with us, we are alone now. I do not know how to live forward with these two kids.” While she acknowledged the support she received from her family, relatives, friends, neighbors, and the medical team at the Primary Health Center (PHC), and hospitals, Mrs. Geetha had not yet recovered from the traumatic experiences she had gone through and continues to experience symptoms like fear, anxiety, stress, and tension. When I spoke to her, she lived with her husband's family in a rented home as the government of Kerala has not yet started the process of building new homes for people affected by the landslides.

Background

Studies have shown that climate change has increased the number of storms, which increases the number of weather-related natural disasters.¹ The effects of climate change and natural disasters are directly impacting the lives of humans and other living organisms of the world. The continuing impact of climate change has exacerbated the crisis and suffering among people living in impoverished settings, even in the rural areas of wealthy countries.² The people of Kerala in Southern India experienced a massive rainfall in August 2018 as part of the monsoon season. Over 400 people died due to the unprecedented floods, and landslides, with additional morbidity caused by communicable diseases, like leptospirosis and upper respiratory tract infections.³ The sudden deterioration of the climate resulted in the overflowing of rivers and dams with water having leveled almost half of the state.⁴ This unexpected event disrupted the lives of people in the state which caused massive damages to the social and health institutions. This paper examines the impact of natural disasters in terms of the higher mortality reported as a result of these disasters in India from 1750 to the present time. It explores several questions: who has died from the natural disaster and its related effects? What were the conditions and experiences of people most affected by the natural calamities reported in India? We will explore whether there were adequate health and social supports available to meet the needs of the population from a social medicine perspective. In this paper, we explore the impact that natural disasters have on people in resource-constrained settings.

Section 1

The Historical Details of Natural Calamities Reported in India and in the State of Kerala.

In this section, (Table 1) the article will examine how the people of India were treated under the British rule when the previous natural calamities occurred. Formerly, India was divided by major provinces and local states under local rulers. In 1757, the British East India Company was set up in the province of Bengal. Initially, it provided medical services that were limited to serving the needs of the civil servants of the British Army in India. The first medical services that were made available to the civil population of India was in 1796 by the British East India Company. In 1919, the British government accepted the constitutional reform measures suggested by the commission under the leadership of Mr. Edwin Montagu, secretary of state for India (1917–22), and Lord Chelmsford viceroy of India (1916–21)⁵. This committee consulted with the Indian people, those whom were the loyal of the British government even though they were working on the public health system of India. This committee recommended decentralizing the healthcare delivery system of India to the state and provincial government levels to improve the public health system of the country.⁶

The Bengal Cyclone

On 5th of October 1864, the people of Calcutta in the state of Bengal in India (Figure 1), under the British administration, witnessed a heavy rainfall, speedy wind, and fluctuating air pressure with barometer readings ranging from 28 to 85. On October 5th, the atmospheric humidity in Calcutta rose to ninety percent and was accompanied by a massive rainfall of 7.1 inches, and massive lightning. In the east, Calcutta bordered Bangladesh. Bihar and Jharkhand bordered Nepal in the west and to the north, bordered Sikkim. Orissa and the Bay of Bengal lay in the south.

The cyclone caused an estimated 42,000 deaths. The British government appointed a committee to examine matters related to the progression of the cyclone and its impact on the people and properties in the Presidency of Bengal. The committee extensively researched the progression of wind before and during the October 5th event. The committee observed that there was not enough time to warn people about the cyclone in advance to prevent this loss of life. The state of Bengal underwent great economic depression in 1842 and 1852. Previous storms had not caused as much destruction as the cyclone that hit in 1864. In a small town called Tumlook, the storm caused massive destruction in which water levels rose up to 13 feet above normal levels of the land that caused a substantial destruction of almost 1,400 houses. Only twenty-seven houses out of 1,400 remained standing after the storm and the strong winds ended. A statement from the “Report on the Calcutta Cyclone of the 5th October 1864. The government of Bengal Calcutta: Calcutta 1866” describes the aftermath.⁷

It appears from what I gathered from the survivors, that the deluge came upon them almost instantaneously, not by any gradual rising of the tide; consequently, the women and children had no time to escape, but were drowned in their houses.⁷

The most important losses as a result of the storm were human lives. The water level on average increased from 6 feet to 12 feet in the state. About 388,400 hectares of land were affected. Of this estimate, half of the mainland was submerged with water up to 6 to feet high from the ground level. Over 48,000 people died due to the calamity, which lasted for more than 18 hours in a single day. The flooding caused diseases such as cholera, diarrhea, and smallpox. The estimated loss and cost of the private property losses were around Rs. three lakh thirty-two thousand and seven hundred and twenty-seven (Rs.332727) \$6,654,540 as of 2020. According to an inquiry committee, an accurate measure of the value of the public sector’s loss of property and belongings due to the calamity were immeasurable.

At this time, the state of Bengal was under British colonial rule. The committee did not collect post-disaster needs assessment information from the citizens of Bengal, India (Figure-2). The British government again marginalized the poor people of India by not documenting their voices in the commission report. The people who lost their lives due to the calamity were mostly villagers who lived near the city of Calcutta in Bengal. The most impoverished people lived very close to the inland rivers and harbors. The sudden unexplained weather event stopped people's income and led to the flooding of their homes, huts, and working spaces .

2. South Indian Floods in 1871

The Madras Presidency (or “province”) was established by the British East India Company in Madrasapattinam in 1639 with treaty support from the local ruler of Rajah Chandragiri and existing trade partners from Portugal. Madras is a city located on the Bay of Bengal, which is along the coast of the Indian ocean. Since it was established, the Madras Presidency's borders have expanded to include Southern Indian locations such as Travancore and Malabar, in Kerala; Hyderabad (the de jure capital of Andhra Pradesh), in Telangana; Arcot, in Tamilnadu, and other parts of the Carnatic region.⁸ The British East India Company had to compete with European trading partners, like the Dutch, Portuguese, and French, and local provincial Indian leaders to secure their monopoly on trade and commerce in the region. Under the rule of Queen Elizabeth I of Great Britain, the British East India Company gradually conquered territory in Southern and Northern India and started imposing colonial rules on an increasing number of Indian people.⁶ In 1871, the Madras Presidency had 18 districts across Southern India. A significant storm followed by floods. In the region, particularly in the state of Tamilnadu, hundreds of thousands of people were killed due to a devastating storm and the subsequent flooding. The floods were more severe in the North Arcot, Salem, Tiruchirappalli, and Vellore

areas. One hundred thousand cattle also died as a result of these natural floods. Forty thousand people died due to fever and other illnesses. The most affected people were stranded in their huts and other similar temporary housing. The people living under the Madras Presidency also suffered a great famine due to the loss of key crops, such as rice. Farmers lost their farmland due to the overflowing of water onto their land.⁹

3. The 1924 Kerala Floods

The unified current state of Kerala was not formed until 1947. The Madras Presidency included three local provinces: Cochin, Travancore, and Malabar from the state of Kerala. Local state rulers and the British East India Company jointly governed these three provinces under the close guidance of the Madras Presidency located in Madras (now known as Chennai). In July 1924, massive torrential rainfall, over 3,000 millimeters, for a short period of time resulted in overflowing rivers, dams, and swamp lands. This caused massive damage in the region of Malabar, Cochin, and Travancore. Over 1,000 people died and hundreds of cattle were diseased due to this calamity. The Mullaperiyar dam, one of the largest reservoirs of water in the provinces, overflowed which resulted in the overflowing of rivers in the mainland's located downstream. The torrential downpour affected the state's road connectivity and rail transportation.¹⁰

Section 2: Social Health Care Delivery System of India

This section deals with the social, political, and health care delivery systems of India under the British government between 1757 and 1947. During this period, India underwent many structural

and administrative reforms. The country engaged in a lot of foreign trade and commerce. However, the country later sacrificed its fundamental freedom to the British government. As mentioned above, the British government failed to protect the citizens of India during and after natural calamities. From 1757 to 1924, over 110,000 people died due to natural disasters. The loss of livestock was six times higher than the loss of human life.^{7,9,11,12,13}

Before the arrival of modern medicine to India, Indian people practiced Ayurvedic and various other forms of traditional medicine. Modern western-based medicine was brought into the state of Bengal by the British East India Company to take care of their army stationed in Bengal. In 1831, the Calcutta Medical College, based in Calcutta, opened its doors to the native Indian population so they could receive medical care there. The British East India Company provided primary medical care to the population of India through the widespread network of dispensaries it'd built across the country. Initially, dispensary services were only available in cities like Calcutta, Bombay, and Delhi. The Madras Presidency also adopted the dispensary model of care and later established centers in each of the provinces. The Indian government allocated Rs 250 per month to the dispensaries and the dispensaries were encouraged to accept private charity to cover additional monthly expenses. During the mid-eighteenth century, the British East India Company's Court of Directors advised the company not to invest further in the health sector as the sector was not deemed profitable. This resulted in an underinvestment of public funds in health care. The British East India Company later required public dispensaries to fund more than half their budget through private charity rather than government funds.¹⁴ Starting in 1864, the British East India Company increased barriers to health care and social services for sick and poor people. For example, the company focused instead on providing care to people who could afford to pay for treatment at dispensaries and hospitals, including wealthy individuals who could also be private charity donors. This approach to healthcare delivery increased the social suffering of poor

people who lived in the state of Bengal and its adjacent areas when the Bengal Cyclone struck in 1864.^{7,12,14}

Similarly, the Madras Presidency, under the British East India Company, had established a few dispensaries in a few districts. However, the government started providing medical care to India's indigenous population in 1838. By 1894, the British government had 2,121 health establishments, either as a hospital or dispensary, across the country. However, since most of the hospital were urban-centric, rural and poor patients had to walk a longer distance to consult a doctor, and the system was often mostly inaccessible to the marginalized sections of the community. Since then, the number of medical facilities providing care to the Indian population increased and continued to increase with an annual growth rate of 2.2 percent. However, the steady rate of growth did not benefit the majority of the Indian community due to the lack of human resources in the health care system. From 1897 to 1910, for every 100,000 people, there was only one medical facility available.¹⁴ The health care system was publicly and privately supported. For instance, Christian missionary organizations and similar types of faith-based organizations were often crowded with sick and poor Indian due to the poor living conditions of socially marginalized people under British India. During the Madras Presidency, the Cochin and Kerala provinces had a few hospitals located in several district.¹⁵ Rulers were interested in the development of those hospitals under the British administration. In the province of Travancore, hospitals were available in the Alleppey, Quilon, and Thiruvananthapuram districts. The state of Travancore had a historical relationship with the Rockefeller Foundation, a well-known public health organization, which advocated to the rulers of Travancore about the need for vaccination and encouraged them to set up a specialized women and child hospital in the city of Travancore.¹⁶

The public healthcare system under British India did not focus on the needs of the most vulnerable people and many died. Most people became diseased mostly because of natural calamities,

famines and preventable communicable diseases, such as smallpox, diarrhea, fever, and plague. Poverty and hunger were the most significant public health issues for people in India under the colonial British administration's rulership. The environmental factors, such as floods during monsoon season, caused less crop production that increased the suffering of millions of people from various Indian states living under British rule. ⁹

Utsa Patnaik, an Indian economist, recently said that the “scars of colonialism still remain in India.”¹⁷ The next part of this analysis measures the economic performance of the British East India Company in India between 1757 and 1947. The state of Bengal was the primary income generating state under the British East India Company until 1854. During its period of influence in India, the British East India Company taxed Indian consumers on essential commodities like salt, tea, opium, and land use.¹⁸ The company's annual expenditure in India was around INR 23 million in 1824 whereas its annual expenditure in Great Britain was around INR 50 million. The income from the state of Bengal was used to cover the expenditures of Indian presidencies, like Mumbai and Madras. It is still unclear how much revenue the British East India Company brought to Britain during their two hundred years in India. However, a new research paper published by the economist Utsa Patnaik estimates that the income extracted from India over that time period would today amount to USD 45 trillion.¹⁷

Section-3: Disasters and its Impacts in India

This section deals with natural disasters and their secondary impacts (e.g., severe famine) that have occurred in India since its independence in 1947 (Table-2). Due to its geographical location and local climate and weather patterns, in India, one is very vulnerable to floods.¹⁹ In the past forty years, the country experienced over 480 natural disasters that resulted in the loss of life and property. These natural disaster events include cyclones, severe cloudbursts, earthquakes, and floods.¹³ The National Disaster Management Authority reports that since 1978 over 563,000 people have been killed in various natural calamities that occurred in Indian states. To date, the largest calamity in India was the 2004 tsunami, which killed almost 11,000 people in a single day.²⁰ The Latur and Kutch earthquakes also caused significant destruction to people's lives and property. The super cyclone of Andhra Pradesh and Orissa impacted the lives of thousands of people in 1999.¹³

Government Approach to the Disaster Management

Though India is a country historically vulnerable to various forms of natural hazards and floods, the nation has not had a stipulated policy to coordinate the mechanisms between affected local settings and the central government. After the Gujarat earthquake in 1999, the government of India appointed a high powered committee that includes various cabinet ministers of the national government who study the preparedness of local and government systems to effectively manage future natural disasters that might affect the country. In 2005, the government of India created a disaster management policy that was implemented by Prime Minister Manmohan Singh to manage the various types of disasters in the country. The 2005 National Disaster Management Act was passed by the parliament to deal with disaster crises in local settings with the help of the district, state, and national administrations. This act provides a provision for creating the National Disaster Mitigation Fund, a separate fund that provides immediate relief measures and financial

assistance to people in affected places, with the help of central government.²¹ The National Disaster Management team has a separate wing under the chairmanship of India's Prime Minister that coordinates crisis response; it has a decentralized administration system in place. At the village level, it has a ward member from the local government that leads disaster management activities. The National Disaster Response team works closely with the district administration during a crisis moment. Between 2005 and 2014, the National Disaster Response team rescued 147,000 victims and identified 343 diseased victims from disaster site.²²

Social Determinants of Health and Post Disaster Health and Social Needs of the Community

Due to the country's geographical location, some of the states in India are more prone to natural floods and other calamities. The social and human suffering of people who are exposed to small and large-scale disasters have not been well studied. However, research evidence indicates that vulnerable populations, such as children and women, who are exposed to natural calamities have an increased risk of serious medical problems like diarrhea, fever, and acute respiratory tract infections;²³ in fact they are 2-3% more likely to experience that adverse outcomes than people who have not faced a disaster. This was evident in the states of central northern India which had witnessed natural disasters in the past.²⁴ A study conducted on the annual health district survey data in India on places exposed to small and massive natural disasters found that there was a 7% increased risk of stunting and underweighted among children who'd been impacted by natural disasters than the control group (i.e., children who had not been exposed to a natural disaster event). There was also a decrease in the rate of vaccination among impacted beneficiaries who'd been exposed to a natural disaster in the previous year.²³

Another study conducted on the post-disaster needs of the displaced people in the Uttaranchal state found that around 83 villages needed to have its people totally resettled and provided with socially equitable rehabilitation delivery packages with sheltering provisions that included a new housing requirement. In India, only seven territories and three out of 30 states had state-owned housing and specific rehabilitation and resettlement policies in place directed at the needs of people affected by disasters. This shows the policy gap and lack of effective delivery of interventions to people in need of those services.^{24,25}

In 2001, another study was done by researchers to understand the role of NGOs in providing service delivery to the post-disaster victims of the massive earthquake in the Kutch district of

the state of Gujarat. This study's learning showed that people's involvement and decision-making capabilities for a successful disaster rehabilitation program are key. People who participated in a co-production approach to reconstruct their homes that was led by the government and NGOs had a higher satisfaction rating ($r=.69$) than the people who did not participate with the government.²⁶ Disaster response should assist all people regardless of their age, color, sex and other social backgrounds. Unfortunately, in India caste and gender play a crucial role in society and also in how people access programs like disaster relief. A study conducted on women's experiences during the 2004 Tsunami revealed that women were forced to refuse the aid assistance offered by rescue workers when the Tsunami waves hit their premises. One account by male rescue workers in the state of Tamilnadu indicated

Some [women] refused to climb naked into the rescue boats because of an internalized sense of shame and honor. Although many women reported that men asked them to give up their sense of shame and offered their shirts to cover their bodies, women refused the offer due to the underlying issues of gender-based violence and post-survival consequences.

These social norms increased the number of women who died after the 2004 tsunami in the state of Tamilnadu.^{27,28} The resettlement programs put in place by the local government led to the early resettlement of people into unorganized relief camps as a temporary setting for people recently displaced by the floods in Kerala. This resettlement process eventually became an issue for the local government and humanitarian aid workers as it led to psychosocial and interpersonal disputes between the survivors of the tsunami and aid workers.²⁹

To answer this question, one has to understand the social context of a setting where I did my master's thesis. I conducted field-based research in the Thrissur district of Kerala, India, one of the area's most severely affected by landslides and floods. Thrissur has a population of 3.1 million people as per the census of 2011.³⁰ In August 2018, the state of Kerala had received 42% excess rainfall from the first week of June to August in 2018 as compared to the same time period for the previous year. That increase resulted in the overflowing of rivers and water resources across the state.⁴

One of our study settings in rural Thrissur was Desamangalam—as described in the vignette on Mrs. Geetha where the study participant lives. Mrs. Geetha and her family belong to a lower class community according to the Hindu religion. They do not have a permanent source of income—their primary family income came from their manual labor. Her husband's house was located near forest land. This land was allotted to their ancestors by the Government of Kerala in 1970. Unfortunately, the location was subject to landslides, and during the 2018 floods, four individuals died and several more sustained grave injuries.

Around 36 families had shifted to safer locations soon after the incident. At the time of this writing, many people were still living in the temporary relief camps arranged for by the government of Kerala. In our study, we found that people who live in poverty tended to have poor housing conditions, sought medical assistance, been hospitalized, and a higher likelihood of developing common mental health disorders in comparison to people who were less affected by the floods and landslides in the Thrissur district.

This is notable considering the social history of the location we studied, particularly concerning land and labor policy reforms. The research investigates the causal association between these policy reforms and the level of poverty reported in the study population. Since 1970, the state of

Kerala has achieved tremendous progress in its social and economic development. However, in our study area, Desamangalam, we found that for people who had been severely affected by the landslide and living in the area before 1970, and they did not have ownership of either their homes or land they'd been living on. In 1959, the government of Kerala passed a land reform act, which required excess land be handed over to the government for it to equally redistribute those properties to peasants, agriculturalists, and landless individuals. However, before implementing this law, the government of Kerala lost its power. In 1969, with the support of peasants and their associations, the government was forced to enact land reform law through the 1969 Kerala Land Reform Amendment Act (KLRAA). The KLRAA gave poor farmers working under landlords the right to have 10% (i.e., 100 % = 1 Acre) of each acre of land. This is a remarkable law that was passed by the legislative assembly as it promotes the rights of citizen's living at the "bottom of the pyramid". This law protected the rights poor farmers and agricultural laborers had demanded. However, the vast majority of landlords suffered, and they lost a significant portion of land to the government. Since then, the relationship between peasants and agricultural laborers was broken. To protect the rights of laborers, the Kerala Agricultural Workers Act was enacted in 1974.^{31,32} This law allowed people to earn decent wages for the work they performed for their landlords. Despite the provision of these two laws and other subsequent governmental development schemes, the visible amelioration of poverty—in terms of achieving higher social and economic status in the community—has not been seen for the Dalit (a group made especially vulnerable due to it being positioned as low caste and deemed "Untouchable"). This observation is evident from our study population in terms of possession of materials and objects in the households, similarly, historical findings support the observations we noted during our study.^{33,34}

Other long-term unaddressed factors

Deforestation is a known risk factor for both floods and the loss of rainfall in an area. When I analyzed the facts related to the availability of forest resources before the colonial government, the intra-colonial government in India, the research revealed that the princely rulers and kings of various parts of the subcontinent had no official policies on forest conservation. However, after the arrival of the British, British India had its first forest conservation policy in 1865, and it went into enforcement in 1878. This conservation policy was introduced to exploit India's forest resources. A significant portion (65%) of dryland was categorized as a forest land, and subsequently, local communities were banned from handling and entering the demarcated forest land. The British India started extracting and exporting its natural resources abroad. The wood and timber (e.g., teakwood, sandal, etcetera) were taken out of India, and as a result of that extraction, naturally, secondary deforestation began.³⁵ The unintended consequences of the British India forest conservation policy still affects millions of people in the state of Kerala. For example, in Nilambur, a semi-urban place located in the district of Malappuram in Kerala, India, a teak museum was established by the British administration and through rail connectivity British India transported the famous Nilamber teakwood all over the world.³⁶ Unfortunately, most of India's forest resources were used during World War I to kill the innocent people on the other side. In August 2019, Nilambur received a record rainfall for a single day, 106 millimeter, which resulted in minor landslides and the overflowing of inland water resources, like ponds and small rivers.³⁷ These unprecedented climatic events led to several reported deaths and over 22,000 people being shifted into district administration controlled relief camps.³⁸ I strongly believe that

deforestation, secondary deforestation, and record rainfall might have accelerated the sudden climatic events to turn into a disaster.

The other long-term issues in dealing with the victims of disasters are rehabilitation and permanent resettlement of such people. To provide adequate assistance to the victims of disasters, government and international development agencies contribute a large amount of aid-in money to local settings. However, the proper utilization of money to the targeted beneficiaries had not happened in the most time in a resource-constrained setting like Kerala.³⁹In Kerala, after the initial stabilization of people, the responsible government diverted the money into other politically-aimed projects to maintain its power. The poor relationship between state and central government on key policy areas like disaster rescue services, disaster management, and resettlement of survivors of disasters resulted in the suffering of people whose wait kept getting extended, year by year, due to the lack of governance and political will.^{19,40,41}

Conclusion:

It is evident that the aftermaths of colonial rule still exist in India. The public health system was poorly designed to meet the needs of the population before India's independence. Yet, the gap in care delivery has continued to exist after 1947, including the underfunding of the various governments' health care systems during the post-independence era. Additionally, the increased climatic conditions over the years has exacerbated the suffering of people. For families like Mrs. Geetha's, the poorest of the poor, they are the real victims of natural disasters such as floods and landslides. In the case of her family, the poverty trap is being formed silently over the years with social and environmental forces.

Tables and Figures

Table 1: Details of significant disasters occurred in India under the British colonial government period.

Description	Year	Approximate Number of People's Lives Lost	Ruling Government
Bengal Cyclone	On October 5th in 1864	Over 48,000 people died in Bengal.	The British Government during the Bengal Presidency
South Indian Floods in	1871	Over 37,949 individuals lost their lives. 100 people died in the Vellore district, and 50,000 died in Salem district, in Tamilnadu.	The British Government during the Madras Presidency
Kerala	1924	Over 400 people died.	The British Government during the Madras Presidency

Table 2: Details of Natural Disaster Reported by the Government of India Since 1978.

Year	Type of Incident	States Affected	Mortality
1970	Bhola Cyclone	West Bengal and (East Pakistan) now Bangladesh	500,000
1977- 1999	Cyclone	Andhra Pradesh	10,967
2004	Tsunami	Tamilnadu, Kerala, Andhra Pradesh, Orissa, Puducherry and Andaman Nicobar	10,022
2004- 2010	Floods, Cyclone and Earthquake	Orissa, Bihar, Andhra Pradesh, Gujarat and Maharashtra	18,114
2011- 2018	Cyclone, Cloudburst, Earthquake and Floods	Uttarakhand, Kashmir, Maharashtra, Tamilnadu, Puducherry, Assam, West Bengal, Orissa, Kerala and Himachal Pradesh	4,565

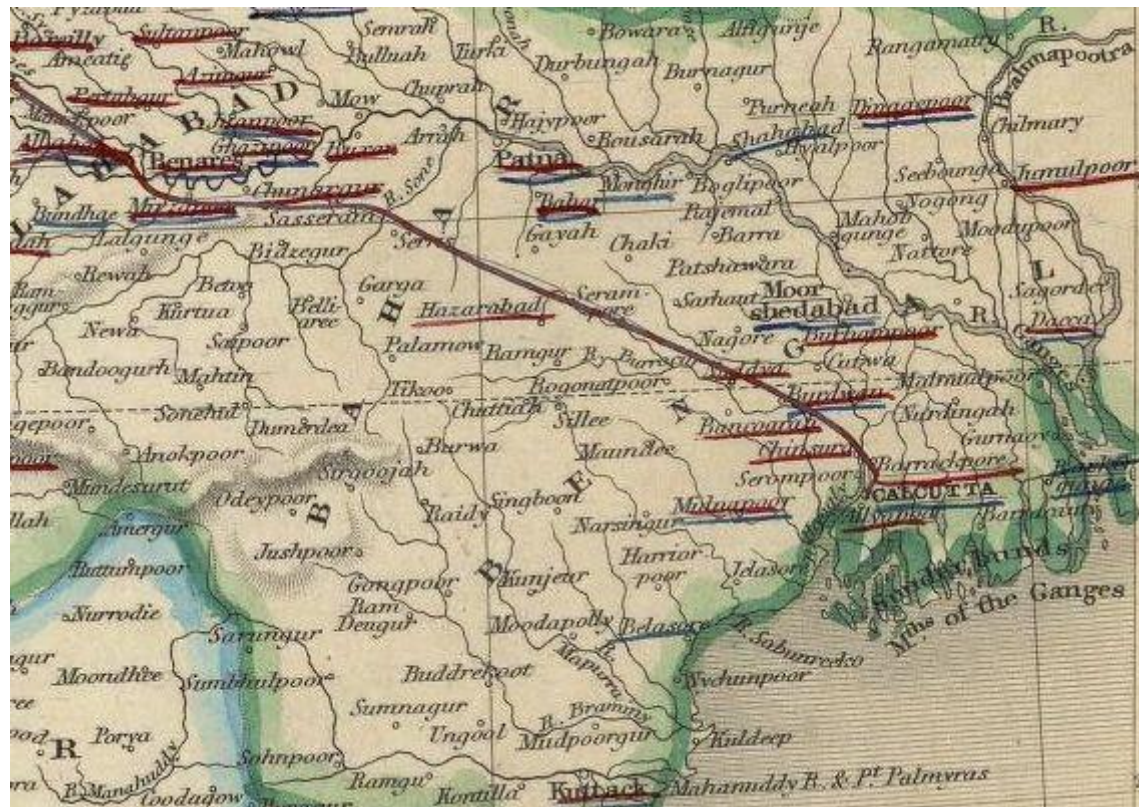


Figure 1: Political Map of Bengal under British India in 1851



Figure 2: Political Map of India under British India in 1851



Figure 3: The Political Map of Madras Presidency in 1886

Source: adapted from the website of David R Rumsey⁷

<https://www.davidrumsey.com/luna/servlet/detail/RUMSEY>

References

1. Hallegatte S, Bangalore M, Vogt-Schilb A. *Assessing Socioeconomic Resilience to Floods in 90 Countries*. The World Bank; 2016. doi:10.1596/1813-9450-7663
2. Seán Nolan KS. Poorer countries are more vulnerable to climate change – here’s how they can prepare. World Economic Forum. <https://www.weforum.org/agenda/2019/07/when-disaster-strikes-preparing-for-climate-change/>.
3. Post Disaster Needs Assessment_Kerala.pdf.
4. Sudheer KP, Murty Bhallamudi S, Narasimhan B, et al. Role of Dams on the Floods of August 2018 in Periyar River Basin, Kerala. *Curr Sci*. 2019;116(5):780. doi:10.18520/cs/v116/i5/780-794
5. Danzig R. The Many-Layered Cake: A Case Study in the Reform of the Indian Empire. *Mod Asian Stud*. 1969;3(1):57-74. doi:10.1017/S0026749X00002055
6. Public health in British India: A brief account of the history of medical services and disease prevention in colonial India. <http://www.ijcm.org.in/article.asp?issn=0970-0218;year=2009;volume=34;issue=1;spage=6;epage=14;aulast=Mushtaq>.
7. James Eardley Gastrell, Henry Francis Blanford. *Report on the Calcutta Cyclone of the 5th October 1864. Government of Bengal Calcutta: Calcutta 1866*. Bengal <https://babel.hathitrust.org/cgi/pt?id=nyp.33433090738703;view=1up;seq=4>.
8. 9. Madras in the Olden Time, A history of St George Fort in Madrasapattanam, Now in Chennai. [https://babel.hathitrust.org/cgi/pt?id=uc1.\\$b53960;view=1up;seq=9](https://babel.hathitrust.org/cgi/pt?id=uc1.$b53960;view=1up;seq=9). Accessed December 9, 2018.
9. *Famines and Floods in India. Macmillan’s Magazine, 1859-1907, Jan 1878, Vol.37(219),.;* :236-256. https://search-proquest-com.ezp-prod1.hul.harvard.edu/docview/5973082?accountid=11311&rfr_id=info%3Axri%2Fsid%3Aprimo. Accessed December 8, 2018.
10. Adrija Roychowdhury. Kerala floods: The deluge of 1924 was smaller, but impact was similar. <https://indianexpress.com/article/research/year-1099-keralas-great-flood-of-1924-too-affected-same-areas-5317677/>. Published August 22, 2018.
11. 1864 Bengal Floods.pdf.
12. Kingsbury B. *An Imperial Disaster: The Bengal Cyclone of 1876*. 1st ed. Oxford University Press; 2018. doi:10.1093/oso/9780190876098.001.0001

13. disaster_management_in_india.pdf.
http://www.undp.org/content/dam/india/docs/disaster_management_in_india.pdf. Accessed December 11, 2018.
14. 4. Colonial Medical Care in North India: Gender, State, and Society, c. 1830-1920.
<http://www.oxfordscholarship.com.ezp-prod1.hul.harvard.edu/view/10.1093/acprof:oso/9780198096603.001.0001/acprof-9780198096603-chapter-1>. Accessed December 9, 2018.
15. 7. *Report on the Administration of Madras Presidency*. 8.
https://play.google.com/store/books/details?id=_oAZAAAYAAJ&rdid=book-_oAZAAAYAAJ&rdot=1. Accessed December 9, 2018.
16. Kutty VR. Historical analysis of the development of health care facilities in Kerala State, India. *Health Policy Plan*. 2000;15(1):103-109. doi:10.1093/heapol/15.1.103
17. Ajai Sreevatsan. British Raj siphoned out \$45 trillion from India: Utsa Patnaik, <https://www.livemint.com/Companies/HNZA71LNVNNVXQ1eaIKu6M/British-Raj-siphoned-out-45-trillion-from-India-Utsa-Patna.html>. <https://www.livemint.com/Companies/HNZA71LNVNNVXQ1eaIKu6M/British-Raj-siphoned-out-45-trillion-from-India-Utsa-Patna.html>.
18. Banerjee A, Iyer L. History, Institutions, and Economic Performance: The Legacy of Colonial Land Tenure Systems in India. *Am Econ Rev*. 2005;95(4):37.
19. Winchester P. Cyclone Mitigation, Resource Allocation and Post-disaster Reconstruction in South India: Lessons from Two Decades of Research. *Disasters*. 2000;24(1):18-37. doi:10.1111/1467-7717.00129
20. Tsunami: India situation update.
https://www.who.int/hac/crises/international/asia_tsunami/ind/2005_01_09/en/.
21. Disaster Management Act 2005_India.pdf.
22. ndmp-2019.pdf.
23. Datar A, Liu J, Linnemayr S, Stecher C. The impact of natural disasters on child health and investments in rural India. *Soc Sci Med*. 2013;76:83-91. doi:10.1016/j.socscimed.2012.10.008
24. Flood induced vulnerability to poverty_ Evidence from Brahmaputra Valley, Assam, India Elsevier En.pdf.
25. Pande RK, Pande R. Resettlement and rehabilitation issues in Uttaranchal (India) with reference to natural disasters. *Disaster Prev Manag Int J*. 2007;16(3):361-369. doi:10.1108/09653560710758314

26. Thomas T, Ott JS, Liese H. Coproduction, participation and satisfaction with rehabilitation services following the 2001 earthquake in Gujarat, India. *Int Soc Work*. 2011;54(6):751-766. doi:10.1177/0020872811400717
27. Juran L. The Gendered Nature of Disasters: Women Survivors in Post-Tsunami Tamil Nadu. *Indian J Gend Stud*. 2012;19(1):1-29. doi:10.1177/097152151101900101
28. Rao S. A natural disaster and intimate partner violence: Evidence over time. *Soc Sci Med*. 2020;247:112804. doi:10.1016/j.socscimed.2020.112804
29. Mulligan M, Nadarajah Y. Rebuilding community in the wake of disaster: lessons from the recovery from the 2004 tsunami in Sri Lanka and India. *Community Dev J*. 2012;47(3):353-368. doi:10.1093/cdj/bsr025
30. Thrissur Population. <https://www.censusindia2011.com/kerala/thrissur/thrissur-population.html>. Accessed April 30, 2020.
31. Parayil G. The “Kerala model” of development: Development and sustainability in the Third World. *Third World Q*. 1996;17(5):941-958. doi:10.1080/01436599615191
32. Mannathukkaren N. Redistribution and recognition: land reforms in Kerala and the limits of culturalism. *J Peasant Stud*. 2011;38(2):379-411. doi:10.1080/03066150.2011.559014
33. Gee Imaan Semmalar. How caste discrimination during and after Kerala floods has affected dalits, adivasis. The news minute. <https://www.thenewsminute.com/article/how-caste-discrimination-during-and-after-kerala-floods-has-affected-dalits-adivasis-90804>. Published October 30, 2018. Accessed May 1, 2020.
34. Nöhrind R, Aid C, Kumar M, Ghosh A. National Dalit Watch-NCDHR (SWADHIKAR). :80.
35. Bhat DM, Murali KS, Ravindranath NH. FORMATION AND RECOVERY OF SECONDARY FORESTS IN INDIA: A PARTICULAR REFERENCE TO WESTERN GHATS IN SOUTH INDIA. :21.
36. Deforestation_Nilambur PGT.pdf.
37. Deluge in Mallapuram villages worse than 2018 flood.<https://www.newindianexpress.com/states/kerala/2019/aug/09/deluge-in-mallapuram-villages-worse-than-2018-flood-2016179.html>.
38. Nilambur Flood Camp.pdf.
39. Charles Starmer-Smith. Kerala tsunami funds 'diverted to tourism'.<https://www.telegraph.co.uk/travel/travelnews/3171804/Kerala-tsunami-funds-diverted-to-tourism.html>. Published October 12, 2008. Accessed December 11, 2018.
40. Swenden W. Centre-State Bargaining and Territorial Accommodation: Evidence from India. *Swiss Polit Sci Rev*. 2016;22(4):491-515. doi:10.1111/spsr.12233

41. Banik D. The Hungry Nation: Food Policy and Food Politics in India. *Food Ethics*. 2016;1(1):29-45.
doi:10.1007/s41055-016-0001-1

Part 2: Publishable Paper

Abstract

Climate change has increased the severity of weather-related disasters, including floods and landslides. Floods are some of the deadliest natural disasters to affect populations. Moreover, people living below the poverty line or at lower socioeconomic levels are the most vulnerable. We conducted a study to assess the long-term mental health consequences for people exposed to the floods and landslides that occurred in the state of Kerala, India, in August 2018. We measured the prevalence and determinants of common mental health disorders (i.e., anxiety, depression, and post-traumatic stress disorder) and the factors predicting the common mental health disorders in the study samples. We conducted a community-based, cross-sectional survey with 369 individual's resident in settings exposed to the flood and landslides between December 2019 and January 2020. We administered standardized questionnaires (GAD-7, PHQ-9, and PTSD PCL-5) to screen for individuals with common mental health disorders. We defined a case as an individual who had scored above the cut-off score on any of the standardized questionnaire, and we reported that twenty percent of the population had at least one of these common mental health disorders. In a multivariate logistic regression model, we found that poverty, economic hardship, poor housing standards, and care-seeking behavior during and after the disaster were found to be associated with common mental health disorders. In this study we found that the people those who are poor are more vulnerable for long-term mental health problems and this group should be prioritized for vertical mental health programs to alleviate the suffering of those affected by disasters.

Key words: Impacts, consequences, floods, landslides, natural disaster, prevalence, common mental health disorders, India, social suffering

Background

Disasters, like floods, directly impact population health and cause long-term health burdens which have an adverse impact on productivity and sustainable development. The exposure to a disaster may cause both physical and mental trauma among people. In addition, physical damages to an individual's property is another concern. In 2018, globally, 60 million people were affected by disasters attributed to climate change. A majority of these incidents happened in low to middle-income countries. In India alone, 35 million people were directly affected by the floods in 2018.¹ Globally, between 1980 and 2002, the reported disasters, including landslides and floods, killed 195 individuals per incident on average. During this period, floods accounted for 40% of all disasters.²

Exposure to disasters may affect individuals in various ways and such problems may include both acute physical injury and life-threatening issues³ as well as mental health disorders. Previous studies have reported on the association between a victim's exposure to climatic events—e.g., floods, tsunamis, tornados, hurricanes, and heatwaves—and developing poor mental health outcomes.⁴ However, while the vast majority of the studies conducted with people affected by the disasters report the prevalence of acute mental health disorders, such as anxiety and stress disorders⁵, only a few have examined the long-term effects of mental health outcomes on people exposed to disasters.^{5,6} An essential step to preventing the later progression of chronic disability or mental health problems is the identification of long-term mental health problems among survivors of disasters.⁷

In India, the 2016 National Mental Health Survey (NMHS) survey reported that the estimated crude prevalence of any mental illness morbidity for a lifetime was 13.7%, and the twelve-month prevalence was 10.6%.⁸ In India, studies conducted in the tsunami-affected coastal areas of Tamil Nadu reported that the most common predictors of common mental health problems nine months

after the tsunami were female, aged 30 and above, poor marital relationships, and loss of a primary family members .^{9,10} Apart from this study, most disaster and post-flood assessments in India have been conducted by the state and central government for administrative purposes, in particular to measure the financial losses related to a particular disaster and floods. Similarly, non-governmental organizations (NGOs) focused on providing services like the distribution of clothes, food, and personal essential items to help people temporarily living in relief camps¹¹.

In August 2018, the state of Kerala in Southern India received a 42% increase in rainfall compared to the same period for the previous year, from 1 June 2018 to 19 August 2018, during the monsoon season. This excess rainfall resulted in the overflowing of water resources like lakes, ponds, and rivers across the state.¹² Within Kerala, 5.4 million people were directly affected by the floods and landslides, and 433 people lost their lives due to trauma and communicable diseases, like leptospirosis and hepatitis. Consequently, in 2018, the overall economic consequences of these extreme climatic events in Kerala was \$4.4 billion dollars. Kerala is one of the most densely populated states in India with an average of 860 people living in each square kilometer. Ten districts in Kerala were severely affected by the disaster including our study district, Thrissur. This was the worst disaster incident recorded in Kerala since 1924.¹¹

This aim of this study is to document the burden and determinants of mental health effects one year after exposure to floods and landslides in one district in Kerala. The specific objectives of the study were: 1) To describe the prevalence of common mental health problems 12 months after a disaster of severe flooding and landslides in the Thrissur district in Kerala, India; and 2) To describe the risk and protective factors associated with these mental health outcomes. We hope

that findings from this study will identify the need for and design of long-term mental health care interventions for people exposed to disasters.

Methods

Study design and population

We conducted a cross-sectional survey among people exposed to the floods and landslides in three rural communities in the Thrissur district in Kerala, India between December 2019 and February 2020. We selected these study sites based on the records of them being amongst the most severely affected places by the floods and landslides in Thrissur district in 2018. We defined “severity” based on the loss of human life and property caused by the floods and landslides in the affected areas. Two of our study areas, Desamangalam and Wadakkancherry, had experienced landslides. In Pariyaram there was extreme flooding. The landslide events resulted in four and nineteen deaths in Desamangalam and Wadakkancherry, respectively. The flooding events did not result in death; however, there was extreme property damage reported. In Desamangalam and Wadakkancherry, 36 families were evacuated to live in temporary relief camps after the landslides. Initially, the nearest public school was chosen as the site for this facility but the government later arranged to have people live at a common hall for displaced families. The members of those displaced families were scattered. At the time of our survey, some displaced people were living in rented houses in or around their neighborhoods, many others were still living in relief camps. (Figure 1)

Sampling and recruitment

Initially, the study team obtained permission from local self-governments to conduct the study in the three study areas. The electoral register, which consists of an ID number for each individual is publicly available on the Election Commission of Kerala’s website, was obtained for these areas. We listed out the eligible participants of three areas. A random number generator was used in Microsoft Excel. Next, the randomly generated numbers were used to match with the ID number of participants in the electoral register, for the survey. The selected individuals were approached at their homes and invited to participate. To avoid the household clustering effect, the study team only recruited one person from each household. The study team made repeated attempts (a maximum of three visits) to survey the randomly selected individual from the

electoral register. We randomly selected an adjacent household when the selected individual refused or could not be contacted to take part in the survey.

Measures and data collection

The questionnaire included the following sections: 1) sociodemographic and economic characteristics, 2) trauma and loss related to the flooding and landslides, 3) health and other help-seeking behaviors, and 4) screening instruments that covered symptoms related to common mental health disorders, i.e. depression, anxiety, and post-traumatic stress. For depressive symptoms, we used the Patient Health Questionnaire-9 (PHQ-9) which has been validated in India in the local language of the target area. The validation study demonstrated a sensitivity of 82.5% and specificity of 90.1% for a cut-off score of greater than or equal to 9.¹³ For anxiety symptoms, the Generalized Anxiety Disorder, the GAD-7 scale was used and for post-traumatic symptoms the PCL-5 was used.^{14,15} Although the GAD-7 and the PCL-5 were not validated in the local language, these instruments demonstrated validity and reliability in other culturally diverse, resource-limited settings.¹⁶ All other questions were developed based on local knowledge and information about the impact of the flooding and landslides. We assessed the help-seeking behaviors of participants exposed to floods and landslides by categorizing the support they received from the government, non-governmental organizations, and medical assistance both during and after the disaster. We asked about details regarding the financial consequences of floods and landslides and number of lost school days for youth that lived in the participants' homes. Similarly, we collected details on the economic position of the participant's family by verifying the participant's Kerala government-issued public distribution card. Poverty was defined as those who were eligible for this public distribution card as indicated by the government of Kerala.

Our survey was conducted by the student investigator and the field team that included trained nurses from a collaborating regional institute, Jubilee Mission Medical College and Research Center, Thrissur. The overall project supervision was carried out by the student investigator of the project. The survey was

implemented in the local language of Malayalam. Aside from the PHQ-9, all other items initially were in English. Therefore, we translated the questionnaire from English to Malayalam, and then back translated it into English. Discrepancies between the original English-version and the back-translation were resolved and the translation was updated.

Data analysis

The sociodemographic and economic characteristics related to the flooding and landslides were calculated using frequencies for categorical variables and means and standard deviations (SDs) for continuous variables. We estimated the prevalence of common mental disorders among people exposed to the floods and landslides. To accomplish this, we considered an individual who experienced symptoms at or above the cut-off for at least one of the screening instruments (PHQ-9, GAD-7, and PCL-5) to have a CMD. Although the PHQ-9 was validated in the local context, we relied on the standard cut-off scores for the GAD-7 (a score of 10 or above) and PCL-5 (a score of 37 or above)^{15,17}. For bivariate analyses, chi-square tests were performed for categorical variables and t-tests for continuous variables. All variables in the bivariate analyses that had a p-value less than 0.2 were included in a logistic regression model. Using the stepwise option in Stata, a more efficient model including variables that resulted in p-values less than 0.1 was constructed. All analyses were performed using Stata, version 15.

Ethical considerations

Our study was approved by the Institutional Review Board at Harvard Medical School, Boston, USA and a regional collaborating institute, Jubilee Mission Medical College and Research Center, Thrissur, Kerala, India.

Results

Among 390 individuals selected from the register, 369 people provided consent resulting in a participation rate of 94%. The most common reason given for not participating in this survey was the fear of having a stranger collect survey details about them. Among our survey respondents, most were women (n=244, 66.3%) and the mean age was 51.7 years with a standard deviation (SD) of 15.9. Most survey participants were married (n=291, 79.8%), and the majority of them were unemployed (n=242, 65.6%). 193 (52.5%) participants were living below the poverty line (BPL) set by the government of India, which is an annual household income less than INR 27000.¹⁸ In the state of Kerala, a monthly per capita consumer expenditure of less than INR 537.32 is considered to place a person below poverty line. A quarter of participants were living in dwellings that had a tiled roof and mud walls. Nearly 3% (n=11) of people lived in huts built with plastic sheets and wooden materials. Over 60% (n=219) of participants reported that they knew someone who died as a result of a landslide in the study's locations such as Desamangalam and Wadakkancherry. Half of the participants reported that floods and or landslides damaged their home, with damages ranging from some destruction to severe destruction. For example, 17.1% (n=36) reported that their homes were completely damaged by the floods and landslides, whereas moderate destruction (destruction to wall, home appliances and furniture) accounted for 42.6% (n=90). The mean value of household items lost to participants was INR 267934 (USD 3814). After being exposed to floods and landslides, 10% (n=38) of individuals were hospitalized and the amount of money spent on health care was INR 17742. (USD 246.7) on average. Approximately 58% (211) of participants had sought help within their neighborhood. 28.2% (102) of participants received both financial and non-financial relief support (e.g., food, clothes, shelter support, and essential medicine). Nearly 38% (n=138) of participants reported assisting others during and after the landslides and floods (Table 2a).

The prevalence of common mental disorders

We observed that 7.9% of individuals were having moderate to severe anxiety disorders, 8.9% of individuals were experiencing post-traumatic stress disorder, and 17.6% of individuals were experiencing moderate to severe depression. As we defined above, a case of ‘any’ common mental disorder comprised all participants who met the criteria for any of these three mental health conditions. Based on this criterion, we observed that 21% individuals were suffering from any common mental health disorder (Figure 4). Of the 21.0% of participants with any disorder, 5.6% met criteria for only one disorder, 11.8% for two disorders and 3.4% for all three.

Factors associated with CMD

Bivariate analyses: The location of the survey was strongly associated with caseness ($p=0.001$), with the highest prevalence in Desamangalam (29.6%). Neither age nor gender were associated with caseness ($p=0.14$ and $p=0.29$, respectively). Economic variables, including housing type, being below the poverty line, and lower self-reported monthly income of participants were associated with CMDs. Indicators of exposure to the disaster, such as the level of damage to the property, being hospitalized as a result of flood and landslides ($p=0.001$) and receiving medical treatment during or after the disaster ($p=0.003$) were found to be associated with common mental health disorders. However, other help-seeking behavior variables, such as receiving assistance from the government and non-governmental organizations (NGO), were not associated with the common mental disorders. The number of school days lost for children that stayed in participants’ households was found to be associated with common mental health disorders among the caregivers ($p=0.02$) in this population (Table 3).

Multivariate analyses: In the final model, participants who lived in a home built with less permanent materials (e.g., a tiled roof, mud walls, wooden and plastic sheets) had two times greater odds of developing common mental health disorders than individuals living in a concrete home. Participants who reported having a ration card, i.e. those living below the poverty line, were also found to have a higher odds of developing common mental health disorders than those above the poverty line. In addition to these factors, individuals who received medical support during and after the flood and landslide events were found to have a two-fold higher odds of developing CMDs (aOR 2.00, 95% CI 1.00-4.03, $p=0.05$). Another factor associated with common mental disorders in this study population was hospitalization after being exposed to the flood and landslides compared to the individuals who did not require hospitalization.

Discussion

We conducted a cross-sectional study to estimate the prevalence of common mental disorders amongst individuals in a population affected by the flooding and landslides in three rural communities in Thrissur district, Kerala, India one year after exposure to the event. Our quantitative results suggest that one in five participants were suffering from at least one form of the investigated mental health disorders: anxiety, depression, and post-traumatic stress disorder. This prevalence rate is twice that reported in India's National Mental Health Survey (NMHS) and the prevalence of common mental health disorders reported by Shaji. et al. in 2017 in Kerala.²⁰ We observed two types of risk factors associated with the risk of common mental health disorders: lower socio-economic status, as evidenced by the higher risk for participants living below the poverty line as well as those in lower quality housing before the disaster; and exposure to the disaster, as evidenced by the higher risk for participants who had sought medical assistance during and after the disaster events, or were hospitalized after exposure to the floods and landslides. Since the state of Kerala is a front-runner in social and developmental indicators within India,²¹ it was unexpected that indicators of poverty (e.g. poor housing conditions and below poverty line factors) would be associated with CMDs. During the post-disaster period, the state of Kerala experienced an economic recession and the estimated financial burden due to this disaster was around \$4.4 billion dollars. The loss of permanent jobs might have affected the severity of participants' financial distress. Moreover, among the cases, the proportion of individuals who were hospitalized was 39.4%; this indicates that the severity of the trauma influenced long-term mental health outcomes.

In a survey conducted in 2018 soon after the occurrences of floods and landslides in the Idukki district of Kerala, researchers found that 7.2% of individuals were experiencing moderate to severe forms of depression.²² However, in our study, we found that 17.6% of individuals demonstrated a

moderate-to-severe level of depressive symptoms. However, that study may not be entirely comparable to the present one since the previous study used a convenience sampling method. In other studies from India, various kinds of mental health problems have been observed among people exposed to disasters including generalized anxiety, depression, stress disorders, adverse life events (e.g., loss of loved ones, disruption in the family connection, and loss of employment), and poor coping skills.²³ Of those studies, one study documented a high level of depression (87.9%) among the individuals affected by the floods in Chennai, Tamilnadu in 2015.^{24,25} Similar to the 2018 study in Kerala, the researchers used convenience sampling for participant recruitment in Chennai.

In this study, factors associated with CMD included poverty and poor housing conditions. Our findings are aligned with the strong evidence on the association between poverty and mental health disorders in developing countries.²⁶ Our findings are also comparable to a study conducted among people who lived in slums that had experienced seasonal household flooding in Mumbai, India.²⁷ The longer-term negative economic stressors compounded the trauma of the floods and landslides, which may have contributed to the development of CMDs. However, these findings demonstrate that the trauma alone does not fully explain the burden of CMDs in this community and that poverty is a major driver of persistent mental health problems. Our results are also similar to the effect of flooding among residents of Bago City Myanmar, in which the residents had long-term difficulties in coming out from the trap of poverty.²⁸

We anticipated that gender would be associated with CMDs, with women demonstrating a higher risk, as reported in many other epidemiological studies²⁹. The higher risk in women has also been shown in Kerala.²⁰ However, this was not observed in this study. We found that care seeking following the disaster were associated with common mental health disorders. In our study, we

also demonstrated that people who received medical support during and after the disaster had higher odds of having common mental health disorders. Our findings are consistent with other observational studies on the long-term effects of disasters.^{9,10,16,25,31–34}

In summary, we observed associations of economic insecurity and impact of trauma with CMDs after the occurrence of floods and landslides in Kerala. Kleinman et al. defines social suffering³⁵ and states that “the pain and suffering of a disorder is not limited to the individual sufferer, but extends at times to the family and social network.” We observed a link between personal and social suffering that implicates structural inequalities, particularly as they relate to the limited governmental response for people with fewer resources.³⁵ This is reflected to this day, since some families that were displaced due to the 2018 disaster still lack permanent housing. This type of consequence deepens the suffering of those who survived this traumatic event.

The main limitations of our study are the small sample size and recall bias that may have occurred as we collected the details about an event that happened in August 2018. To reduce the potential for bias, we used a structured questionnaire that was administered in the respondent’s spoken language. Also, the study was a cross-sectional design, therefore, causal inferences cannot be made. Similarly, we used standardized questionnaires to measure the burden of common mental health problems among this population, the tools such as PHQ-9, GAD-7, and PTSD PCI-5 have been widely used in epidemiological studies and have demonstrated reasonable sensitivity and specificity. However, only the PHQ-9 was validated locally and since all three measures are screening instruments they capture ‘probable’ disorder rather than a clinical diagnosis. Additionally, we could not collect information regarding participants’ physical injuries. This

would have offered greater detail on how sustaining an injury may differ from the mental health problems of participants.

Conclusion

Our study indicates the need to provide targeted mental health service delivery to individuals affected by disasters over the long-term, since these conditions can persist for at least a year after the disaster. Interventions must be equity sensitive and target those who were already in the poorer socio-economic groups at the time of the disaster, as well as those who have suffered higher levels of trauma, as indicated by care seeking and needing hospital admission. The provision of psychosocial care to people and meeting their immediate needs, like standard housing, providing employment support, and appropriate family-based and community support, is necessary to alleviate the suffering of people impacted by disasters. Further research on the historical context of the psychosocial care provided in this population and on how care delivery impacts people without much agency, representation, or possessions in the society is needed. This would help policymakers to consider an appropriate and equitable response to such disasters. We also suggest the provision of mental health care within the context of ongoing public health services through the nearest health care facilities.

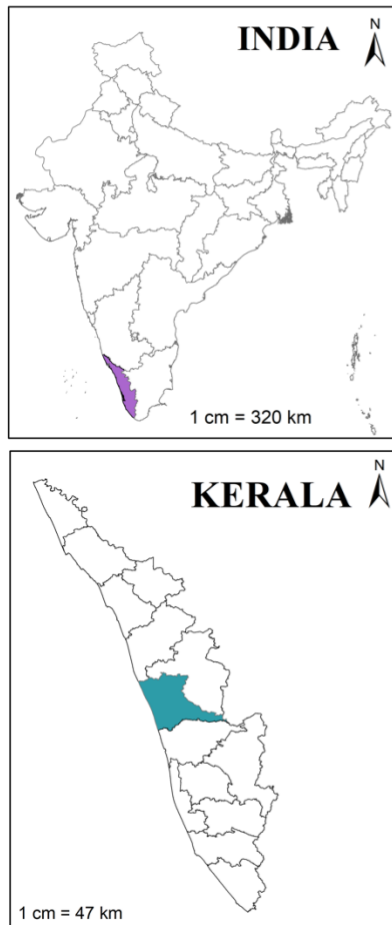
Funding: Shameer Kunnathpeedikayil, student investigator, received grant support from the Department of Global Health and Social Medicine, Harvard Medical School, USA to conduct this research project.

No other authors received any kind of funding for this project.

Declarations: The author reports no competing interests.

Acknowledgments: The author is very grateful to Mrs. Neethu, a doctoral candidate at the University of Madras, Chennai, India, for preparing GIS-mapped images of the study settings. We are extremely thankful to Mr. Pranav, MPH, Amrita Institute of Medical Science, Kochi, India and the members of the research staff from the Jubilee Mission Medical College and Research Center- Thrissur, Kerala, India

Figure-1 Study Area



STUDY AREA

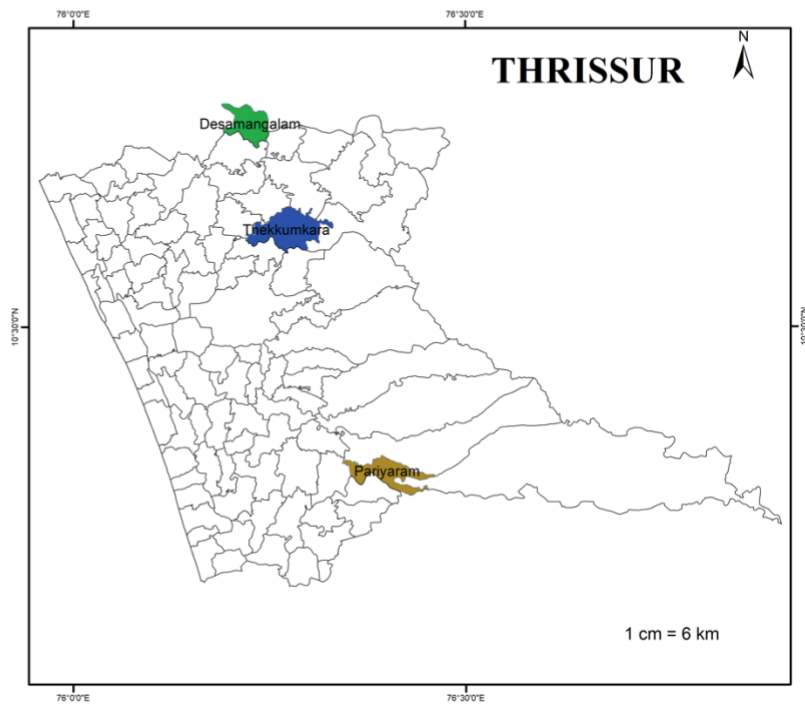


Figure-2 Distribution of Rain Fall Reported in Thrissur District in August 2018

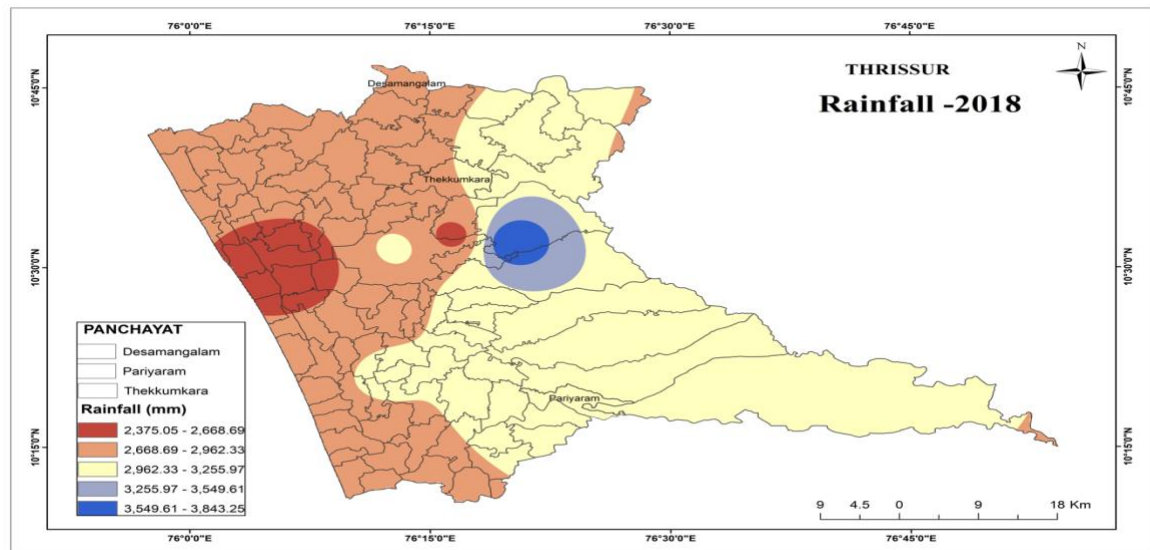


Figure-3 Prevalence of Common Mental Disorders in the Study Population

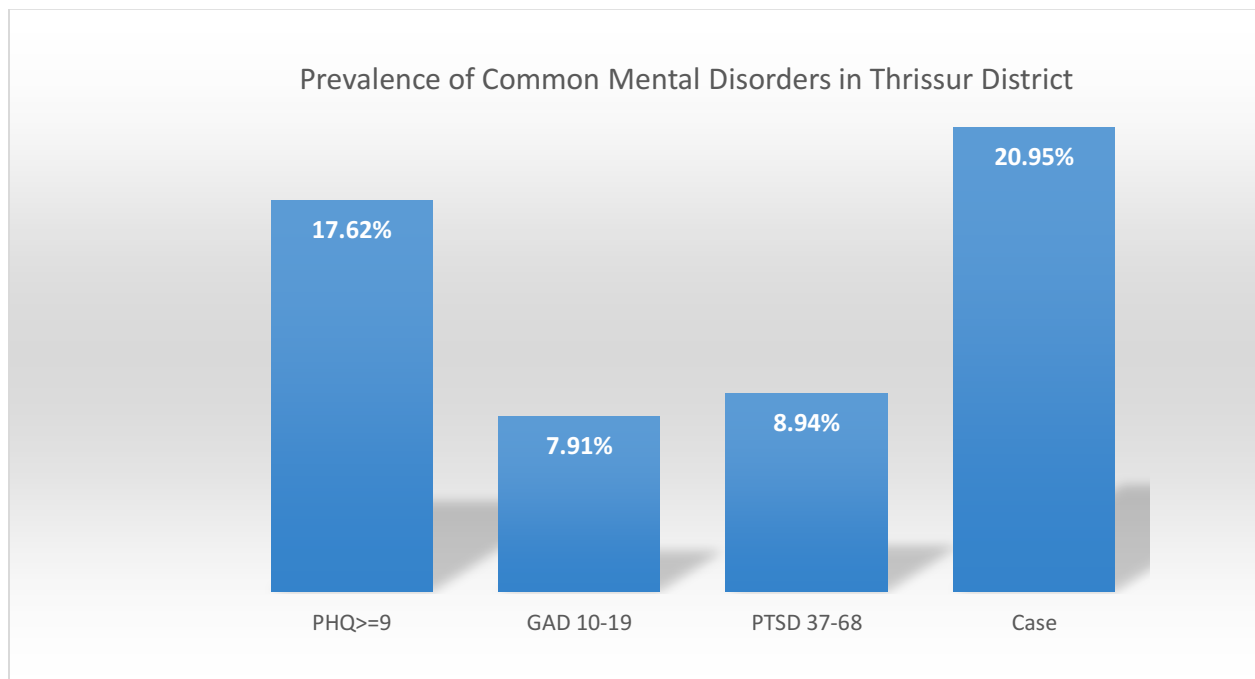


Table-1: Characteristics of the Survey Population

Location of the survey	Ward Number	Population of Ward	Number of Sample Recruited	Type of incident happened
Desamangalam	10	1165	132 (35.77%)	Landslide
Wadakkanchery	27	1254	128 (34.69%)	Landslide
Pariyaram	14	947	109 (29.54%)	Floods

Table 2a. Sociodemographic characteristics of people exposed to the flood and landslides in Thrissur District, Kerala, India in 2018 and 2019 (n=369)

Participant Characteristics		n (%) or Mean (range)
Gender	Female	244 (66.3%)
Age	18-29	38 (10.3%)
	30-44	83 (22.6%)
	45-59	119 (32.4%)
	≥60	127 (34.6%)
Marital status (n=368)	Currently Married	291 (79.8%)
	Widowed	46 (12.5%)
	Never Married	22 (5.9%)
	Separated	9 (2.45%)
Size of the Family	≤4	204 (55.2%)
	5-12	165 (44.7%)
Completed education in years (n=368)	No education	19 (5.1%)
Primary School to high school	1-10	245 (66.5%)
Higher secondary and above	11-18	104 (28.26%)

Current employment status (n=368)	Unemployed	242 (65.58%)
Category of ration card (n=368)	BPL (Below Poverty Line)	193 (52.5%)
Type of participant houses before floods and landslides	Concrete house	275 (74.3%)
	Others (Tiled roof, mud, plastic sheet, or hut)	94 (25.47%)

Table 2b. Experiences of mental trauma, help seeking behavior and, hospitalization of participants exposed to floods or landslides.

Participant Characteristics	n(%)or (range)	Mean
Knew that someone died as a result of floods or landslides (n=365)	219 (60%)	
Flood or landslides damaged participant's house	189 (51.2%)	
	Serious destruction	36 (17.06%)
	Moderate Destruction	90 (42.65%)
Severity of participants houses destructed by floods	Some destruction	85 (40.28%)

Financial loss of property (INR and USD) (n=191)	mean= INR 267,934.6 (1,000-3500,000) USD 3814 (13.9-48611)
The number of days of school lost for a student that lived at respondent households (n=193)	mean=16.9 (2-45)
Hospitalized after exposed to flood or landslides (n=368)	38 (10.3%)
Money spent on treatment/ hospitalization in (INR) (n=28)	mean= INR 17742.86 (500-200000) USD 246.7 (6.9-2778)
Sought medical care during and after floods and landslide events	59 (15.9%)
Received help from others during the flood or landslides	211 (57.8%)
Received financial assistance from the government	124 (33.6%)
Received assistance from non- governmental organizations	102 (28.2%)
Assisted fellow victims during and after flood or landslides	138 (37.8%)

Table 3. Association of Common Mental disorders with disaster-related experiences among those exposed to floods and landslides in Thrissur district, India in 2018 and 2019 (n=358)

Participant Characteristics		Non-Case	Case	Chi square statistic	p-value
Demographics		n=283 (79.05%)	n=75 (20.95%)		
Location of the survey	Desamangalam	88 (70.40%)	37 (29.60%)	9.34	0.01
	Wadakkancherry	103 (81.75%)	23 (18.25%)		
	Pariyaram	92 (85.98%)	15 (14.02%)		
Age in years	18-29	33 (91.67%)	3 (8.33%)	5.39	0.14
	30-34	63 (79.25%)	16 (20.25%)		
	45-50	94	24		

		(76.66%)	(24.34%)		
	≥60	91	32		
		(73.98%)	(26.02%)		
Gender	Female	181	53		
		(77.35%)	(22.65%)	1.10	0.29
	Male	101	22		
		(82.11%)	(17.89%)		
Marital status	Currently married	229	52		
		(81.49%)	(18.51%)		
	Widowed	30	15	9.60	0.08
		(66.67%)	(33.33%)		
	Separated	5	4		
		(55.56%)	(44.44%)		
	Never Married	18	4		

(81.82%) (18.18%)

Monthly self-reported family income	<=1200	133 (71.12%)	54 (28.88%)	14.65	<0.001
	>1200	149 (87.65%)	21 (12.35%)		
Education status	Did not attend school	11 (61.11%)	7 (38.89%)	12.03	<0.001
	Lower primary school to High School	182 (76.15%)	57 (23.85%)		
	Higher secondary and onwards	90 (90.0%)	10 (10.0%)		
Employment status	Unemployed	187 (79.91%)	47 (20.09%)	0.30	0.58

	Employed	96 (77.42%)	28 (22.58%)		
Category of Ration Card	BPL (Below Poverty Line)	130 (69.52%)	57 (30.48%)	22.73	< 0.001
	APL (Above Poverty Line)	153 (90%)	17 (10%)		
Knew that someone died as a result of floods or landslides	Yes	160 (76.19%)	50 (23.81%)	2.63	0.104
	No	120 (83.33%)	24 (16.67%)		
Severity of housing damaged	Serious destruction	20 (57.14%)	15 (42.86%)	10.01	0.007
	Moderate destruction	71 (79.78%)	18 (20.22%)		
	Some destruction	65 (83.33%)	13 (16.67%)		
Participant home before the disaster	Concrete home	224 (83.27%)	45 (16.73%)	11.64	0.001

	Other homes	59 (66.29%)	30 (33.71%)		
Hospitalized after exposed to flood or landslide	Yes	23 (60.53%)	15 (39.47%)	9.09	0.003
	No	260 (81.50%)	59 (18.50%)		
Received medical treatment during the time of floods and landslides	Yes	36 (62.07%)	22 (37.93%)	12.05	0.001
	No	247 (82.33%)	53. (17. 67%)		
Received help from others during the flood or landslides	Yes	157 (76.96%)	47(23.04%)	1.25	0.26
	No	126 (81.82%)	28 (18.18%)		
Received immediate financial assistance	Yes	98 (80. 33%)	24 (19.67%)	0.18	0.66
	No	185 (78.39%)	51 (21.61%)		

from government					
Received assistance from non- governmental organization	Yes	77 (75.49%)	25 (24.51%)	1.08	0.29
	No	202 (80.48%)	49 (19.52%)		
The number of days of school lost for a student lived at respondent households (mean (SD))		44 (SD 8.46)	40 (SD9.29)	t = -3.08	0.02
Amount of money spent for health care related to flood and landslides		16 (SD 21553)	12 SD (56576)	t = -0.99	0.33

Table 4: Multivariate Logistic Regression Model for factors associated with symptoms comparable with moderate-to-severe common mental disorders

Characteristics	Adjusted OR	95% CI	p-value
Homemade of Mud, tiled roof and plastic sheet or hut	2.02	1.12-3.66	0.019
Below Poverty Line	3.07	1.65-5.68	0.000
Received medical support during or post disaster	2.00	1.00-4.03	0.050
Hospitalized after the floods and landslides	2.28	1.00-5.21	0.049

References

1. UN Agency Report Kerala Flood CREDCrunch53N.pdf
<https://reliefweb.int/report/india/cred-crunch-newsletter-issue-no-53-december-2018-flash-floods-sharing-field-experience>. Accessed March 10th 2020.
2. Matthew E Khan, The Death Toll from Natural Disasters: The Role of Income, Geography, and Institutions. *The Review of Economics and Statistics*, Vol. 87, No. 2 (May, 2005), pp. 271-284 Published by: The MIT Press Accessed 4th April 2020..
3. Stanke C, Murray V, Amlôt R, Nurse J, Williams R. The effects of flooding on mental health: Outcomes and recommendations from a review of the literature. *PLoS Curr*. 2012. doi:10.1371/4f9f1fa9c3cae
4. Goldmann E, Galea S. Mental Health Consequences of Disasters. *Annu Rev Public Health*. 2014;35(1):169-183. doi:10.1146/annurev-publhealth-032013-182435
5. Zhong S, Yang L, Toloo S, et al. The long-term physical and psychological health impacts of flooding: A systematic mapping. *Sci Total Environ*. 2018;626:165-194. doi:10.1016/j.scitotenv.2018.01.041
6. Ponnampertuma T, Nicolson NA. The Relative Impact of Traumatic Experiences and Daily Stressors on Mental Health Outcomes in Sri Lankan Adolescents: Mental Health Impact of Trauma and Daily Stressors. *J Trauma Stress*. 2018;31(4):487-498. doi:10.1002/jts.22311
7. Acuda W. Where There is No Psychiatrist: A Mental Health Care Manual. an_introduction_to_mental_health_problems.pdf. Vikram Patel London: Gaskell, 2003, £8.00 pb, 288 pp., ISBN: 1-901242-75-7. *Psychiatric Bulletin*. 2004;28(11):430-430. doi:10.1192/pb.28.11.430 <https://www.cambridge.org/core/journals/psychiatric-bulletin/article/where-there-is-no-psychiatrist-a-mental-health-care-manual-vikram-patel-london-gaskell-2003-800-pb-288-pp-isbn-1901242757/EBFE9661E2940B493D4E756853D1FB84>.
8. Murthy RS. National Mental Health Survey of India 2015–2016. National Mental Health Survey of India 2015–2016.
9. Raju E. Housing Reconstruction in Disaster Recovery: A Study of Fishing Communities Post-Tsunami in Chennai, India. *PLoS Curr*. 2013. doi:10.1371/currents.dis.a4f34a96cb91aaffacd36f5ce7476a36
10. George C, Kanakamma LG, John J, Sunny G, Cohen A, De Silva MJ. Post-tsunami mental health: A cross-sectional survey of the predictors of common mental disorders in South India 9-11 months after the 2004 Tsunami: Post-tsunami mental health. *Asia-Pac Psychiatry*. 2012;4(2):104-112. doi:10.1111/j.1758-5872.2012.00196.x

11. Report of Post Disaster Needs Assessment_Kerala.pdf. Accessed March 10th 2020
https://rebuild.kerala.gov.in/reports/PDNA_Kerala_India.pdf.
12. Sudheer KP, Murty Bhallamudi S, Narasimhan B, et al. Role of Dams on the Floods of August 2018 in Periyar River Basin, Kerala. *Curr Sci*. 2019;116(5):780.
doi:10.18520/cs/v116/i5/780-794
13. Indu PS, Anilkumar TV, Vijayakumar K, et al. Reliability and validity of PHQ-9 when administered by health workers for depression screening among women in primary care. *Asian J Psychiatry*. 2018;37:10-14. doi:10.1016/j.ajp.2018.07.021
14. Blevins CA, Weathers FW, Davis MT, Witte TK, Domino JL. The Posttraumatic Stress Disorder Checklist for *DSM-5* (PCL-5): Development and Initial Psychometric Evaluation: Posttraumatic Stress Disorder Checklist for *DSM-5*. *J Trauma Stress*. 2015;28(6):489-498.
doi:10.1002/jts.22059
15. Spitzer RL, Kroenke K, Williams JBW, Löwe B. A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. *Arch Intern Med*. 2006;166(10):1092.
doi:10.1001/archinte.166.10.1092
16. Fernandez A, Black J, Jones M, et al. Flooding and Mental Health: A Systematic Mapping Review. Ebi KL, ed. *PLOS ONE*. 2015;10(4):e0119929.
doi:10.1371/journal.pone.0119929
17. Blevins CA, Weathers FW, Davis MT, Witte TK, Domino JL. The Posttraumatic Stress Disorder Checklist for *DSM-5* (PCL-5): Development and Initial Psychometric Evaluation: Posttraumatic Stress Disorder Checklist for *DSM-5*. *J Trauma Stress*. 2015;28(6):489-498.
doi:10.1002/jts.22059
18. Joyita. Below Poverty Line Estimation in India. The PRS Blog. August 5th 2013. Accessed on March 10th 2020. <https://www.prsindia.org/theprsblog/poverty-estimation-india>
19. PDS Detailed Project Report. Office of the Commissioner of Civil Supplies. Poverty Line Estimate Kerala.PDF.pdf. Accessed on March 20th 2020.
<https://civilsupplieskerala.gov.in/index.php/content/index/acts-and-rules#>
20. Shaji K, Raju D, Sathesh V, et al. Psychiatric morbidity in the community: A population based-study from Kerala. *Indian J Psychiatry*. 2017;59(2):149.
doi:10.4103/psychiatry.IndianJPsychiatry_162_17
21. Parayil G. The “Kerala model” of development: Development and sustainability in the Third World. *Third World Q*. 1996;17(5):941-958. doi:10.1080/01436599615191

22. Jom Thomas J, Prakash B, Kulkarni P, Narayana Murthy MR. Prevalence and severity of depression among people residing in flood affected areas of Kerala. *Int J Community Med Public Health*. 2019;6(3):1143. doi:10.18203/2394-6040.ijcmph20190600
23. Makwana N. Disaster and its impact on mental health: A narrative review. *J Fam Med Prim Care*. 2019;8(10):3090-3095. doi:10.4103/jfmph.jfmph_893_19
24. Fernandes E, Borah H, Shetty S. Mainstream disaster health as a policy priority: experiences from Chennai floods and a cross sectional study during disaster relief phase. *Int J Community Med Public Health*. 2016;1589-1592. doi:10.18203/2394-6040.ijcmph20161634
25. Angeline N, Anbazhagan S, Surekha A, Joseph S, Kiran PR. Health Impact of Chennai Floods 2015: Observations in a Medical Relief Camp. :3.
26. Patel V, Kleinman A. Poverty and common mental disorders in developing countries. *Bull World Health Organ*. 2003;7.
27. Subbaraman R, Nolan L, Shitole T, et al. The psychological toll of slum living in Mumbai, India: A mixed methods study. *Soc Sci Med*. 2014;119:155-169. doi:10.1016/j.socscimed.2014.08.021
28. Kawasaki A, Kawamura G, Zin WW. A local level relationship between floods and poverty: A case in Myanmar. *Int J Disaster Risk Reduct*. 2020;42:101348. doi:10.1016/j.ijdrr.2019.101348
29. Vikram Patel et.al Women, Poverty and common mental disorders in four restructuring societies. *Social Science and Medicine* 49 (1999) 1461-1471
30. Bell SA, Abir M, Choi H, Cooke C, Iwashyna T. All-Cause Hospital Admissions Among Older Adults After a Natural Disaster. *Ann Emerg Med*. 2018;71(6):746-754.e2. doi:10.1016/j.annemergmed.2017.06.042
31. Moitinho de Almeida M, Schlüter B-S, van Loenhout JAF, et al. Changes in patient admissions after the 2015 Earthquake: a tertiary hospital-based study in Kathmandu, Nepal. *Sci Rep*. 2020;10(1):4956. doi:10.1038/s41598-020-61901-7
32. Irmansyah I, Dharmono S, Maramis A, Minas H. Determinants of psychological morbidity in survivors of the earthquake and tsunami in Aceh and Nias. *Int J Ment Health Syst*. 2010;4(1):8. doi:10.1186/1752-4458-4-8
33. Chennai-Floods-2015 A Rapid-Assessment-Report.pdf. Balaji Nara Simaham et al. Accessed on March 18th 2020. <https://www.cag.org.in/database/chennai-floods-2015-rapid-assessment>

34. Rao S. A natural disaster and intimate partner violence: Evidence over time. *Soc Sci Med.* 2020;247:112804. doi:10.1016/j.socscimed.2020.112804
35. Kleinman A. Four social theories for global health. *The Lancet.* 2010;375(9725):1518-1519. doi:10.1016/S0140-6736(10)60646-0

Appendix 1 (Questionnaire for Cross Sectional Study Data Collection)

Title of the Project: LONG-TERM EFFECTS OF FLOODS ON HUMAN HEALTH IN THRISSUR DISTRICT, KERALA, India: A Mixed Method Study.

Data Collection Form:

ID Number of the Data Collector Data Collection

1. Kindly read all questions carefully before interviewing study participants
2. Kindly write neatly in the given appropriate space
3. **In case if you feel very discomfort towards the questions asked, you can abstain from answering such questions. Feel free to skip such questions that impair your emotional thinking.**

1. Social and Demographic Details

Note: Please feel free to skip any questions that has contain sensitive information about your social and personal status, if you feel like you are not comfortable in answering.

1	Name of the Panchayath (Local Self Government)	☐ Desamangalam ☐ Wadakkanchery ☐ Pariyaram
2	Name of the Village	
3	Participant ID number	
4	Age	
5	Sex	☐ Male ☐ Female ☐ Others.....

6	Religion:	☐ Hindu..... ☐ Muslim..... ☐ Christian..... ☐ Others ..Specify..... ☐ No Religion.....
7	Marital status	☐ CURRENTLY MARRIED..... ☐ WIDOWED..... ☐ DIVORCED..... ☐ SEPARATED..... ☐ DESERTED..... ☐ NEVER MARRIED.....
8	Employment	☐ Full time ☐ Part time ☐ Housewife ☐ Student ☐ Unemployed ☐ Others
9	Number of total usual members in the family	
10	Monthly income of the family	
11	Completed Education in years	
12	Were you physically injured by the flood?	☐ Yes ☐ No
13	If yes, did you seek treatment for the injury?	☐ Yes ☐ No

14	Did your relative or someone close to you die as a result of the flood or landslide?	☐ Yes ☐ No
15	If yes, whom did you lose during and after the flood?	☐ Mother ☐ Father ☐ Brother ☐ Sister ☐ Uncle ☐ Child ☐ Grandparents ☐ Close friend ☐ Others.. Specify
16	Did you lose employment due to flood or landslide?	☐ Yes ☐ No
17	If yes, temporary or permanent number of days of job lost?	☐ Temporary Days..... ☐ Permanent Days lost.....
18	In your family did children lose school days due to flood?	☐ Yes ☐ No
19	If yes number of school days lost?	
20	Did flood damage your home?	☐ Yes ☐ No
21	how bad is the destruction of the housing?	☐ Serious destruction (lost almost all items) ☐ Moderate Destruction (lost half of the items) ☐ Some destruction (less than half of the items)
22	Type of your home	☐ Concrete

		☐ Mud ☐ Others.....
23	If Yes, approximate market cost for items you lost	
24	Were you hospitalized as a direct result of flood?	☐ Yes ☐ No
24	If yes, outcome after the treatment?	☐ Better ☐ Unchanged ☐ Continuing
25	How much money spent on treatment?	

Note: Please feel free to skip any questions that has contain sensitive information about your social and personal status, if you feel like you are not comfortable in answering.

PATIENT HEALTH QUESTIONNAIRE-9 (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems?
(Use "✓" to indicate your answer)

	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

FOR OFFICE CODING 0 + _____ + _____ + _____
=Total Score: _____

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all ☐	Somewhat difficult ☐	Very difficult ☐	Extremely difficult ☐
--	--	--	---

34	Have you ever used products like cigarettes?	☐ Yes
----	--	------------------------------

		☐ No
35	Has your smoking of cigarettes reduced, stayed the same or increase??	☐ Reduced ☐ Same Increased
36	Have your drunk alcohol in last two months?	☐ Yes ☐ No If yes do WHO-AUDIT Questionnaire
37	Do you think your alcohol consumption increased after the flood than before the flood?	☐ Yes ☐ No
38	Do you think your chewing tobacco consumption increased after the flood?	☐ Yes ☐ No

Note: Please feel free to skip any questions that has contain sensitive information about your social and personal status, if you feel like you are not comfortable in answering.

A. How often do You Have drink Containing Alcohol ?	☐ Never ☐ SKIP TO QUESTION I-J ☐ Monthly or less ☐ 2-4 times per a month ☐ 2-3 times per week ☐ 4 or more times per week
B. How many drinks containing Alcohol do you have on a typical day when you are drinking ?	☐ 1 or 2 ☐ 3 or 4 ☐ 5 or 6 ☐ 7,8,9 ☐ 10 or more

C. How often do you have six or more drinks in one occasion SKIP questions 9-10 if total score for question 2-3 =0	☐ Never ☐ Less than Monthly ☐ Monthly ☐ Weekly ☐ Daily or almost daily
D. How often during the last year have you found that you were not able stop drinking once you had started ?	☐ Never ☐ Less than Monthly ☐ Monthly ☐ Weekly ☐ Daily or almost daily
E. How often during the last year have you failed to do what was normally expected from you because of drinking	☐ Never ☐ Less than Monthly ☐ Monthly ☐ Weekly ☐ Daily or almost daily
F. How often during the last year have you needed a first drink in the morning to get yourself going after heavy drinking session ?	☐ Never ☐ Less than Monthly ☐ Monthly ☐ Weekly ☐ Daily or almost daily
G. How often during the last year have you had a feeling of guilt or remorse after drinking ?	☐ Never ☐ Less than Monthly ☐ Monthly ☐ Weekly ☐ Daily or almost daily
H. How often during the last year have you been unable to remember what happened the night before because you had been drinking ?	☐ Never ☐ Less than Monthly ☐ Monthly

	☐ Weekly ☐ Daily or almost daily
I. Have you or someone else been injured as a result of your drinking ?	☐ No ☐ Yes, but not in the last year ☐ Yes, during the last year
J. Has a relative or friend or a doctor or another health worker been concerned about your drinking or suggested you cut down ?	☐ No ☐ Yes, but not in the last year ☐ Yes, during the last year

Social Support Services?

Note: Please feel free to skip any questions that has contain sensitive information about your social and personal status, if you feel like you are not comfortable in answering.

49	How far is your home from nearest health center	KM
50	Have you received any social support from government agencies?	☐ Yes ☐ No
51	When did you receive the last payment?	☐Months
52	What is the current status	☐ Yet to deliver final payment ☐ Cancelled, ☐ Application Rejected ☐ Pending
53	Did you use the money for the intended purpose?	☐ Yes (Picture evidence, or observational image) ☐ No

54	Was it helpful to rebuild the housing?	☐ Yes ☐ No
55	When is next disbursement	☐ Don't know ☐ Date :
56	Whether have you received social support or similar level of aid from non-governmental agencies?	☐ Yes ☐ No
57	What were the assistance you were provided with?	
58	How many live-stocks you had during flood time?	☐
59	Were there any casualties to live-stocks/ pets?	☐ Yes ☐ No
60	Status of causality?	☐ Died ☐ Injured ☐ missing ☐ diseased

Help Seeking:

Note: Please feel free to skip any questions that has contain sensitive information about your social and personal status, if you feel like you are not comfortable in answering.

61	During the time of flood were you able seek help from others?	☐ Yes ☐ No
62	If yes: Who helped you the most during the crisis time?	
67	What kind of support you received?	
68	Did you receive medical support?	☐ Yes ☐ No
69	What kind of medical treatment you received?	
70	What kind of No non-medical assistance	
71	Did you help fellow victims in rescue assistance?	☐ Yes ☐ No

Note on Adult Resilience Measure Revised (ARM-R):

This following questionnaire is developed to measure the resilience of adults in social-ecological settings. The reflection of youth and adults confront the situation of resilience and measures called upon to meet such challenges resulted in the formation of Self Reporting Adult Resilience Measure Revised (ARM-R). This Questionnaire has higher face, content validity with detection of psychometric validity. Recommended by the researchers to use in diverse context and situations among people experienced chronic stress in diverse context. ¹

Note: Please feel free to skip any questions that has contain sensitive information about your social and personal status.

¹ <https://www-tandfonline-com.ezp-prod1.hul.harvard.edu/doi/full/10.1080/23761407.2018.1548403>

Adult Resilience Measure-Revised (ARM-R)

ARM-R						
To what extent do the following statements apply to you? There are no right or wrong answers.						
		Not at all [1]	A little [2]	Somewhat [3]	Quite a bit [4]	A lot [5]
1	I cooperate with people around me	1	2	3	4	5
2	Getting and improving qualifications or skills is important to me	1	2	3	4	5
3	I know how to behave in different social situations	1	2	3	4	5
4	My family have usually supported me through life	1	2	3	4	5
5	My family knows a lot about me	1	2	3	4	5
6	If I am hungry, I can get food to eat	1	2	3	4	5
7	People like to spend time with me	1	2	3	4	5
8	I talk to my family/partner about how I feel	1	2	3	4	5
9	I feel supported by my friends	1	2	3	4	5
10	I feel that I belong in my community	1	2	3	4	5
11	My family/partner stands by me during difficult times	1	2	3	4	5
12	My friends stand by me during difficult times	1	2	3	4	5
13	I am treated fairly in my community	1	2	3	4	5
14	I have opportunities to show others that I can act responsibly	1	2	3	4	5
15	I feel secure when I am with my family/partner	1	2	3	4	5
16	I have opportunities to apply my abilities in life (like skills, a job, caring for others)	1	2	3	4	5
17	I enjoy my family's/partner's cultural and family traditions	1	2	3	4	5

Note: Please feel free to skip any questions that has contain sensitive information about your social and personal status, if you feel like you are not comfortable in answering.

PCL-5

Instructions: Below is a list of problems that people sometimes have in response to a very stressful experience. Please read each problem carefully and then circle one of the numbers to the right to indicate how much you have been bothered by that problem in the past month.

In the past month, how much were you bothered by:	Not at all	A little bit	Moderately	Quite a bit	Extremely
1. Repeated, disturbing, and unwanted memories of the stressful experience?	0	1	2	3	4
2. Repeated, disturbing dreams of the stressful experience?	0	1	2	3	4
3. Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?	0	1	2	3	4
4. Feeling very upset when something reminded you of the stressful experience?	0	1	2	3	4
5. Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?	0	1	2	3	4
6. Avoiding memories, thoughts, or feelings related to the stressful experience?	0	1	2	3	4
7. Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?	0	1	2	3	4
8. Trouble remembering important parts of the stressful experience?	0	1	2	3	4
9. Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?	0	1	2	3	4
10. Blaming yourself or someone else for the stressful experience or what happened after it?	0	1	2	3	4
11. Having strong negative feelings such as fear, horror, anger, guilt, or shame?	0	1	2	3	4
12. Loss of interest in activities that you used to enjoy?	0	1	2	3	4
13. Feeling distant or cut off from other people?	0	1	2	3	4
14. Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)?	0	1	2	3	4
15. Irritable behavior, angry outbursts, or acting aggressively?	0	1	2	3	4
16. Taking too many risks or doing things that could cause you harm?	0	1	2	3	4
17. Being "superalert" or watchful or on guard?	0	1	2	3	4
18. Feeling jumpy or easily startled?	0	1	2	3	4
19. Having difficulty concentrating?	0	1	2	3	4
20. Trouble falling or staying asleep?	0	1	2	3	4

Note: Please feel free to skip any questions that has contain sensitive information about your social and personal status, if you feel like you are not comfortable in answering.

GAD-7

Over the <u>last 2 weeks</u> , how often have you been bothered by the following problems? (Use "✓" to indicate your answer)	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

(For office coding: Total Score T_____ = _____ + _____ + _____)

Thank you for taking time to respond to these questions.

