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AN EMPIRICAL STUDY ON IMPACT OF URBAN FLOODING ON HOUSEHOLD WATER QUALITY & PUBLIC HEALTH IN KALLUKUTTAI, CHENNAI

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ABSTRACT

Urban flooding has become a recurring environmental challenge in rapidly expanding metropolitan areas, particularly in cities such as Chennai. Low-lying localities like Kallukuttai frequently experience water stagnation during heavy rainfall due to inadequate drainage systems, unplanned urban development and poor waste management. Such flooding not only disrupts daily life but also poses serious risks to household water quality and public health. This study examines the impact of urban flooding on drinking water quality and the occurrence of water-related illnesses among residents in the Kallukuttai region. The research adopts an empirical approach using a structured questionnaire distributed among households in the study area. The survey collects information on flood frequency, depth and duration of water stagnation, sources of drinking water, water storage and treatment practices and health problems experienced by residents following flood events. The study also assesses sanitation conditions, including sewage overflow and blocked drainage systems, which may contribute to water contamination. The findings aim to identify the relationship between flood exposure, water contamination, and the incidence of illnesses such as diarrhea, fever, and skin infections. Additionally, the study highlights residents' coping strategies and their expectations regarding government intervention. By analysing these factors, the research seeks to provide practical recommendations for improving urban drainage infrastructure, ensuring safe drinking water, and enhancing public health preparedness in flood-prone urban communities.

KEYWORDS: Urban Flooding, Water Quality, Drinking Water Contamination, Sanitation,

Household Water Practices.

INTRODUCTION:

Urban flooding has become a frequent environmental and public health concern in rapidly expanding metropolitan cities. In India, cities such as Chennai have increasingly experienced severe flooding due to intense rainfall, inadequate drainage infrastructure, unplanned urbanization and climate change. Low-lying residential areas like Kallukuttai are particularly vulnerable to water stagnation, contamination of drinking water sources and sanitation breakdown during heavy rains. Floodwaters often carry sewage, solid waste and pollutants that may infiltrate household water supplies, thereby posing serious risks to public health. This study lies in understanding how urban flooding directly affects household water quality and contributes to the spread of water-borne and vector-borne diseases among residents. Despite several infrastructure initiatives undertaken by municipal authorities in Chennai, many communities continue to face recurring flood-related challenges that disrupt daily life and threaten environmental sustainability. Therefore, examining these issues at the local level can help identify gaps in urban planning, water management and disaster preparedness. The research problem focuses on the relationship between flood exposure, water contamination and health outcomes among households in the Kallukuttai region. The study aims to assess the extent of flooding, evaluate its impact on drinking water quality, and analyse the occurrence of illness among residents following flood events. It also seeks to understand household coping mechanisms and the effectiveness of existing infrastructure. The scope of the study is limited to selected households in Kallukuttai, Chennai and relies primarily on empirical data collected through structured questionnaires and field observations to provide insights for policy improvement and community-based solutions.

Review of Literature:

K. Jayanthi et al. (2016): The author analyse recurrent flooding in Chennai and attributes it to rapid urbanization, encroachment of natural water bodies, and inefficient stormwater drainage systems. The study highlights how blocked drains and poor land-use planning aggravate flood severity, especially in low-lying areas. However, the research primarily focuses on macro-level infrastructure issues and lacks micro-level empirical analysis. It does not adequately examine how such flooding directly impacts household water quality and public health, leaving a gap for localized studies such as the present research.[1]

Mark Fewtrell and Jamie Bartram (2001): The authors establish a strong relationship between contaminated drinking water and the spread of water-borne diseases. Their work, supported by

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[1] K. Jayanthi et al., *Urban Flooding in Chennai: An Integrated GIS-Based Approach*, Aquatic Procedia, Vol. 8, No. 1, pp. 209–216, 2016.

the World Health Organization, emphasizes that flooding significantly increases microbial contamination in water sources. While the study provides a foundational understanding of water-related health risks, it is largely based on generalized and global data. It lacks context-specific empirical insights from urban flood-prone communities, thereby limiting its direct applicability to localized settings like Kallukuttai.[2]

V. Srinivasan (2016): This paper critically examines the urban flooding crisis in Chennai, particularly in the context of the 2015 floods. The study highlights governance failures, poor urban planning, and inadequate maintenance of drainage systems as key contributing factors. It also emphasizes the role of institutional inefficiencies in exacerbating flood impacts. However, the analysis remains largely policy-oriented and does not incorporate household-level empirical data, thereby failing to capture the lived experiences of affected communities.[3]

Alderman, Turner, and Tong (2012): This research examines the global health impacts of flooding and identifies increased risks of water-borne and vector-borne diseases following flood events. Published in The Lancet Planetary Health, the study highlights how exposure to contaminated water and poor sanitation contributes to adverse health outcomes. However, the analysis is largely global in scope and does not provide detailed micro-level insights. It overlooks localized behavioural and environmental factors, thereby underscoring the need for focused empirical research in specific urban communities such as Kallukuttai.[4]

RESEARCH GAP:

Existing literature on urban flooding, particularly in Chennai, largely concentrates on macro-level issues such as infrastructure deficiencies, governance failures, and climate-induced risks. While studies by Jayanthi et al. (2016) and Srinivasan (2016) critically analyse the

[2] Mark Fewtrell & Jamie Bartram, *Water Quality: Guidelines, Standards and Health: Assessment of Risk and Risk Management for Water-Related Infectious Disease*, IWA Publishing / WHO, 2001.

[3] Veena Srinivasan, *Floods in Chennai: A Wake-Up Call*, Economic and Political Weekly, Vol. 51, No. 2, pp. 15–18, 2016.

[4] Katrina Alderman, Lara R. Turner & Shilu Tong, *Floods and Human Health: A Systematic Review*, Environment International, Vol. 47, No. 1, pp. 37–47, 2012.

Structural and policy dimensions of flooding, they do not sufficiently capture the **household-level consequences**, especially the direct impact on drinking water quality and public health. Similarly, global research by Fewtrell and Bartram (2001) and Alderman et al. (2012) establishes a general link between contaminated water and disease, but lacks **context-specific empirical evidence** from localized urban communities. Therefore, a clear gap in integrating **flood exposure, water contamination, and health outcomes** within a single empirical framework at the micro level. This study addresses that gap by generating primary data from households in Kallukuttai, thereby providing grounded insights into lived experiences, coping mechanisms, and risk patterns. The research contributes to future studies by offering a **replicable empirical model**, highlighting key variables for analysis and identifying localized risk factors that are often overlooked. It also opens a way for interdisciplinary research combining urban planning, environmental science and public health, while informing policy-oriented studies on climate resilience, municipal accountability and sustainable urban development.

Objectives of the study:

1. To examine the extent of urban flooding in Kallukuttai.
2. To analyse the impact of Urban flooding on household drinking water quality and public health in Kallukuttai. evaluate coping practices.
3. To assess infrastructure deficiencies and identify community-preferred remedial measures for effective governance intervention.

RESEARCH METHODOLOGY:

This research is based on both doctrinal and non-doctrinal research. The sources of data collected from various newspapers, magazines, books and e-resources. The data was

collected from 50 respondents. This research was done by a stratified random sampling method. This research adopted the sum of the statistical tools, percentage method and average method and the jurisdiction of the research is to cover Kallukuttai in Chennai city. The duration of the research is three months. The methodology will yield a holistic understanding of how urban flooding is impacting on the daily usage of water for both drinking and using for other purposes.

Limitations of the Study

This study is subject to certain limitations that may affect the generalizability and precision of its findings. First, the sample size is relatively small and confined to a single locality (Kallukuttai, Chennai), which limits the ability to extend conclusions to other urban areas with different environmental and socio-economic conditions. Second, the study relies primarily on self-reported data, which may be influenced by recall bias, exaggeration, or inconsistency in responses. Third, the absence of laboratory-based water quality testing restricts the findings to perceived contamination rather than scientifically measured parameters. Fourth, inconsistencies in data recording and variations in respondent interpretation may affect the accuracy of analysis. Additionally, the study does not incorporate seasonal comparisons or longitudinal data, making it difficult to assess long-term trends. Finally, the lack of advanced statistical analysis limits the strength of causal inferences drawn between flooding, water quality, and health outcomes.

Hypothesis of the study:

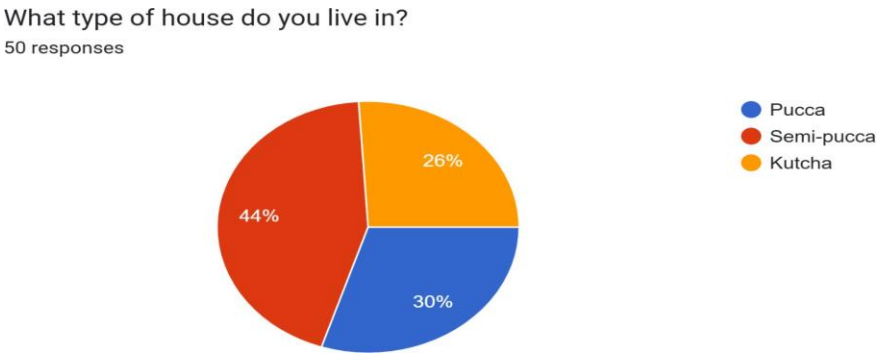
1. Urban flooding significantly collapses household water quality in Kallukuttai, leading to increased contamination levels.
2. Households exposed to urban flooding in Kallukuttai experience a significantly higher incidence of water-borne and vector-borne diseases compared to non-flood periods.

RESULTS AND DISCUSSION:

Table 1: Type of Houses.

Type of Houses	Frequency	Percentage
Semi-Pucca	22	44.00
Pucca	15	30.00
Kutcha	13	26.00
Total	50	100.00

Source: Primary Data

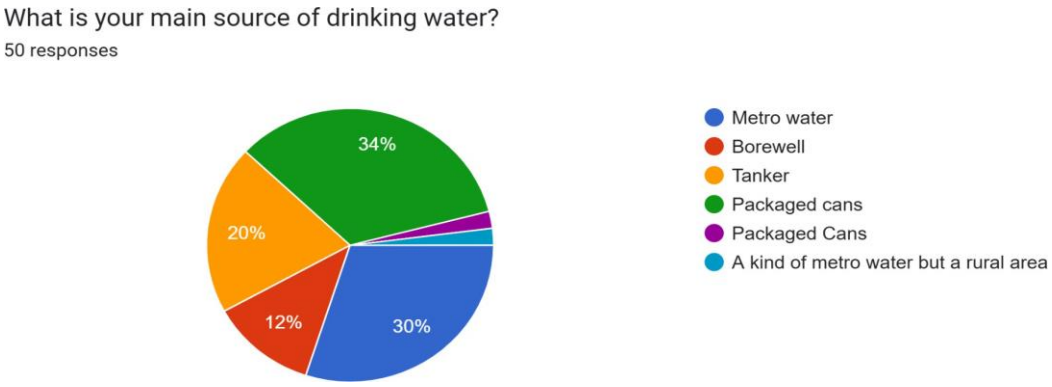


The table shows that 54 percent of people experienced ankle-level flooding, while 22 percent reported water entering their homes. Smaller proportions faced knee (16.00) and waist-level (8.00) flooding. Even though most flooding is shallow, the fact that over one-fifth of households experience indoor flooding is critical. This directly increases contamination of household environments, especially drinking water storage areas.

Table 2: Main Source of Drinking Water.

Source	Frequency	Percentage
Packaged Cans	18	36.00
Metro Water	16	32.00
Tanker	10	20.00
Borewell	06	12.00
Total	50	100.00

Source: Primary Data

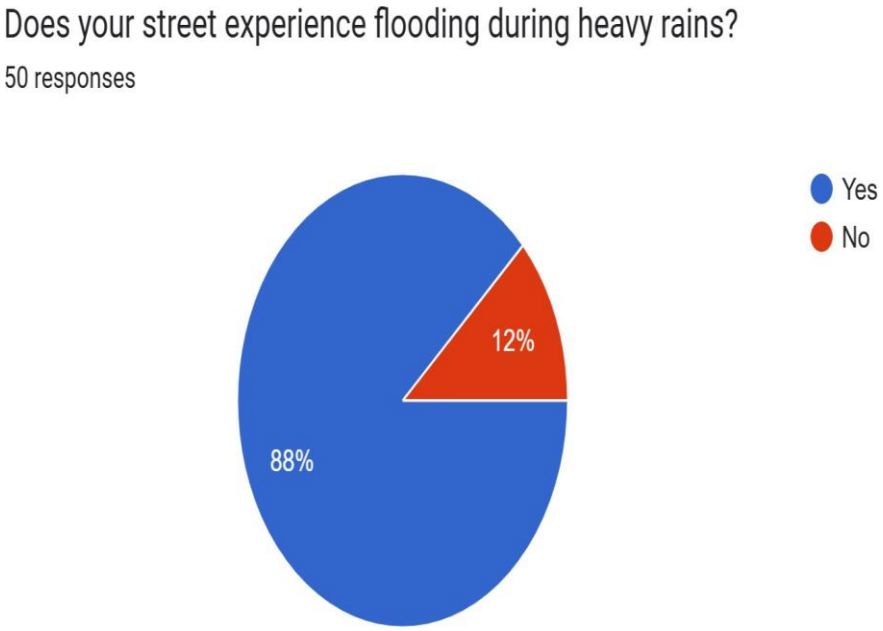


The table and chat shows that 36 percent of people depend on packaged water cans, 32 percent on metro water, while 20 percent and 12 percent rely on tanker and borewell water respectively. Heavy reliance on external and purchased water sources reflects lack of secure in-house water systems. During floods, these sources are easily disrupted or contaminated, increasing dependency on unsafe alternatives and raising public health concerns.

Table 3: Flooding During Heavy Rain.

Response	Frequency	Percentage
Yes	44	88.00
No	06	12.00
Total	50	100.00

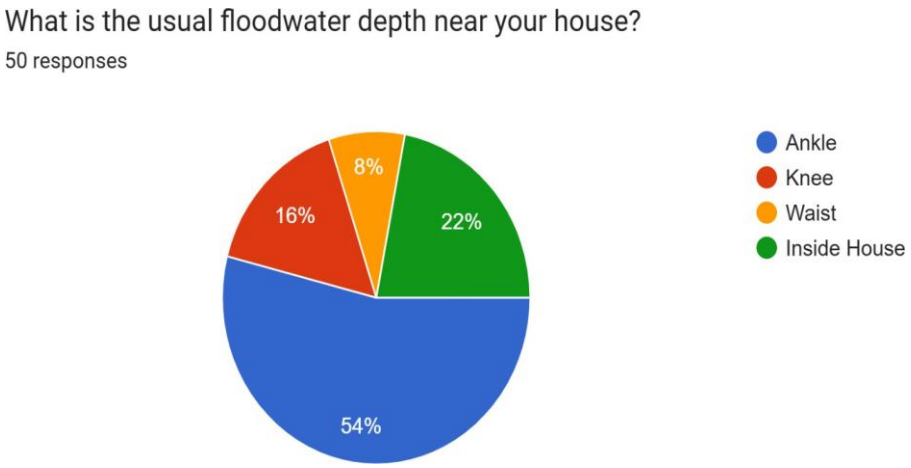
Source: Primary Data



An overwhelming 88 percent of respondents reported flooding during heavy rainfall. The remaining 12 percent of the people are in the elevated areas, so they are not affected by the flood during heavy rain. Flooding is not occasional but a systemic and recurring issue in the area. This strongly supports the core research premise that urban flooding is a persistent environmental and public health threat in Kallukuttai.

Table 4: Floodwater Depth.

Depth level	Frequency	Percentage
Ankle	27	54.00
Inside House	11	22.00
Knee	08	16.00
Waist	04	08.00
Total	50	100.00

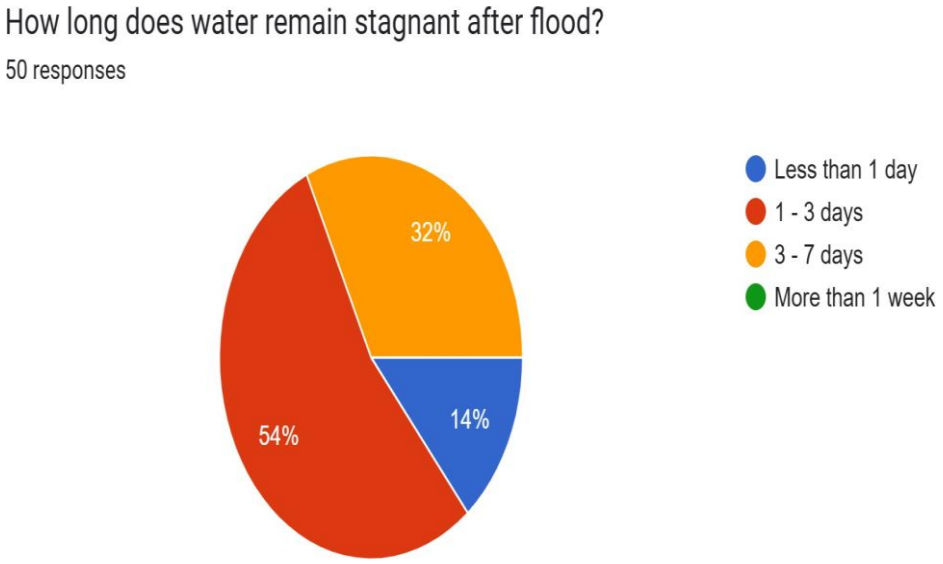


The table shows that 54 percent experienced ankle-level flooding, while 22 percent reported water entering their homes. Smaller proportions faced knee (16.00) and waist-level (8.00) flooding. Even though most flooding is shallow, the fact that over one-fifth of households experience indoor flooding is critical. This directly increases contamination of household environments, especially drinking water storage areas.

Table 5: Water Stagnation Duration.

Duration	Frequency	Percentage
1-3 days	27	54.00
3-7 days	16	32.00
Less than 1 day	07	14.00
Total	50	100.00

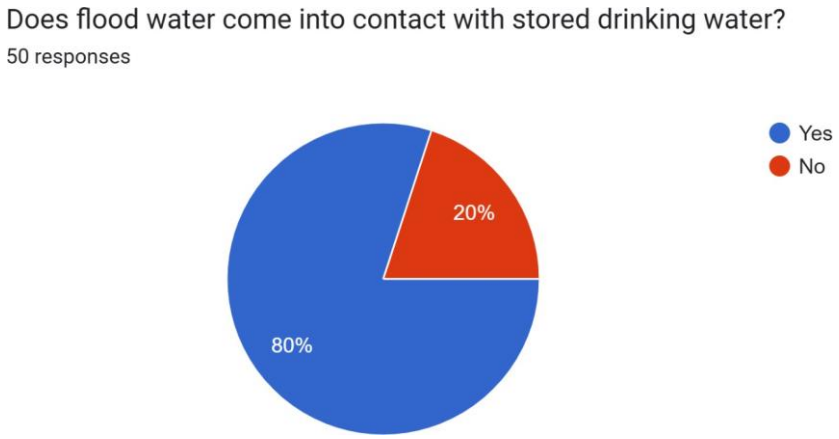
Source: Primary Data



Over the period, 54 percent reported stagnation lasting 1–3 days, while 32 percent experienced 3–7 days of stagnant water. Prolonged stagnation creates ideal conditions for bacterial growth and contamination. The longer the water remains, the higher the probability of waterborne diseases, making this a serious public health concern.

Table 6: Contact with Drinking Water & Change in Water Quality.

Particulars	Yes	No	Total
Contact with Drinking Water	40 (80.00)	10 (20.00)	50 (100.00)
Change in Water Quality	43 (86.00)	07 (14.00)	50 (100.00)

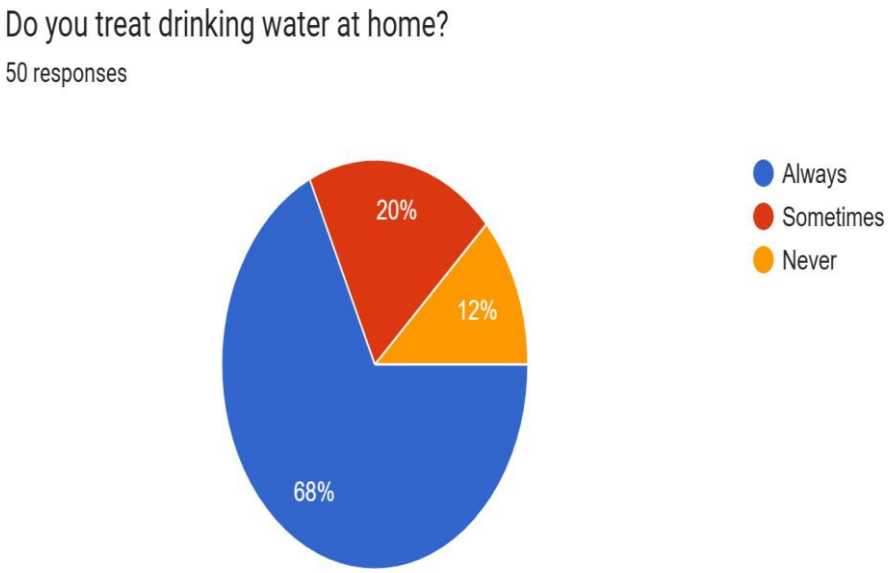


As per the table, 80 percent reported that floodwater comes into contact with drinking water sources. The other 20 percent of the respondents used Packaged Cans for drinking water. This establishes a direct contamination pathway. When floodwater mixes with drinking water, the risk is no longer hypothetical. It becomes immediate and unavoidable, explaining the high illness rates observed later. 86 percent have observed changes in water quality after flooding. Perceived changes in taste, color and smell indicate actual contamination. This reinforces that flooding has a direct negative impact on potable water safety in the study area.

Table 7: Water Treatment Practice.

Practice	Frequency	Percentage
Always	34	68.00
Sometimes	10	20.00
Never	06	12.00
Total	50	100.00

Source: Primary Data

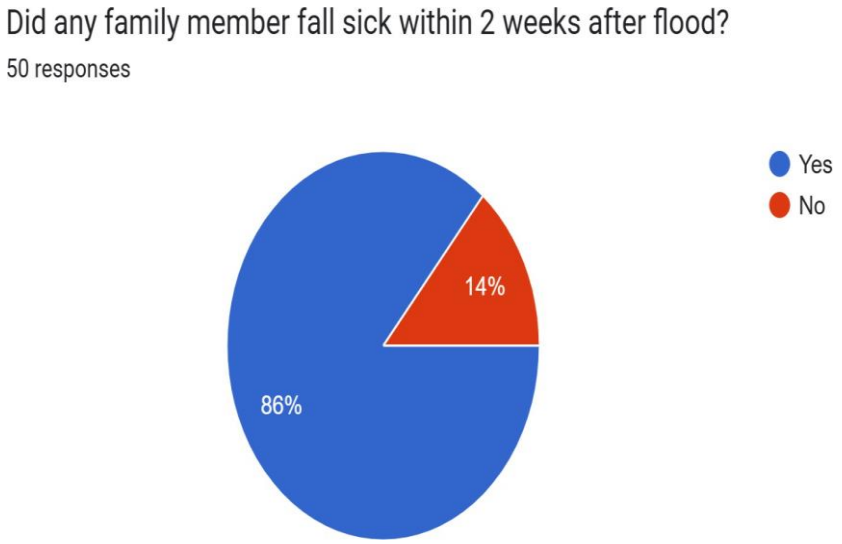


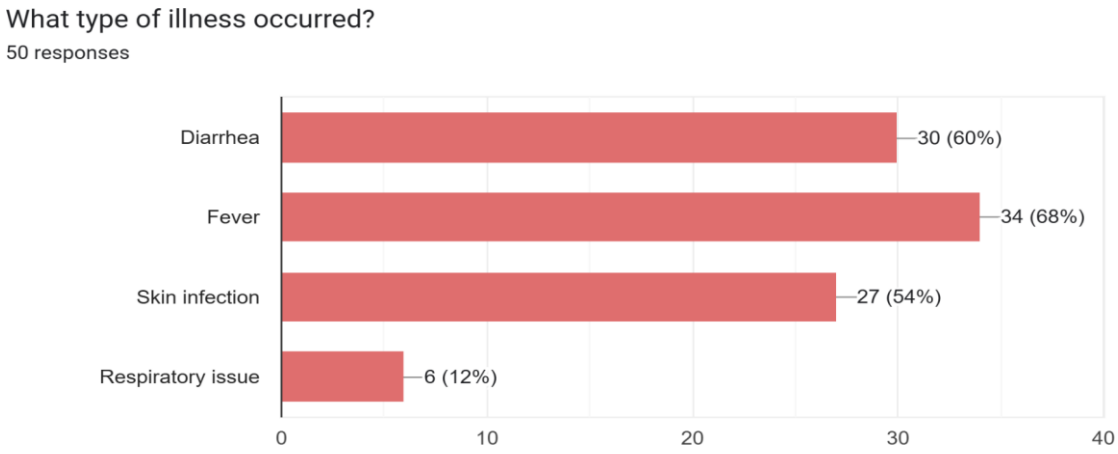
68 percent always treat water, 20 percent sometimes and 12 percent never treat drinking water. While a majority attempt preventive measures, inconsistency and neglect among a section of respondents leave gaps in protection. This uneven practice contributes to continued health risks despite awareness.

Table 8: Post-Flood Illness.

Response	Frequency	Percentage
Yes	43	86.00
No	07	14.00
Total	50	100.00

Source: Primary Data





The table, pie chart and bar graph shows that 86 percent of respondents reported illness after flooding events. This is a direct outcome of poor water quality and sanitation conditions. The extremely high percentage confirms a strong correlation between flooding and public health deterioration. The data indicates that respondents reported multiple types of illnesses following flood events, with the most common being waterborne and vector-borne diseases such as diarrhea, fever, skin infections, and mosquito-related illnesses (e.g., dengue/malaria-like symptoms). A smaller proportion reported respiratory issues and general fatigue. The pattern of illnesses reported is not random but it directly reflects the environmental conditions created by urban flooding.

Waterborne Diseases (Diarrhea, Vomiting, Gastrointestinal Issues): These are the most critical indicators of contaminated drinking water. Given that: 80 percent reported contact between floodwater and drinking water and 92 percent experienced sewage overflow.

Vector-Borne Diseases (Dengue, Malaria, Fever): Prolonged water stagnation (1–7 days for majority) creates ideal breeding grounds for mosquitoes. The presence of fever-related illnesses indicates secondary health impacts of flooding, beyond direct water contamination.

Skin Infections and Allergies:

Many people in the Kallukuttai region stated that the ground water of such a region is not even fit to use for daily usage and direct exposure to polluted floodwater leads to dermatological issues. This aligns with the finding that floodwater often enters living spaces and comes into physical contact with residents.

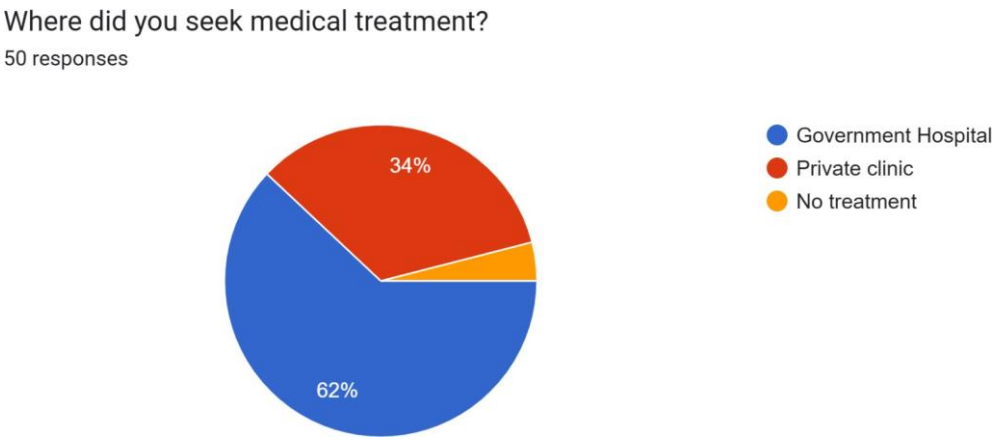
Respiratory Issues:

Though less dominant, these may result from damp indoor environments and poor sanitation conditions post-flooding, indicating indirect environmental health effects.

Table 9: Medical Treatment Source – Analysis & Interpretation.

Source	Frequency	Percentage
Government Hospital	31	62.00
Private clinic	17	34.00
No Treatment	02	04.00
Total	50	100.00

Source: Primary Data



The table shows that 62 percent depend on government hospitals, 34 percent on private clinics and 4% did not seek treatment. The heavy reliance on government healthcare indicates economic constraints among residents. It also highlights pressure on public health infrastructure during flood-related disease outbreaks.

Testing of Hypothesis:

Hypothesis no. 1: Urban flooding significantly collapses household water quality in Kallukuttai, leading to increased contamination levels.

Table no. 6 shows that 86 percent have observed "changes in water quality" after flooding. Perceived changes in taste, color and smell indicate actual contamination.

H : p > 0.5 or 50 percentage

Thus, the Hypothesis statement no. 1 is agreed by greater than 50 percent of responses. So, this is a Null Hypothesis (H_0).

Hypothesis no. 2: Households exposed to urban flooding in Kallukuttai experience a significantly higher incidence of water-borne and vector-borne diseases compared to non-flood periods.

Table no. 8 shows that 86 percent of respondents reported illness after flooding events. H : p > 0.5 or 50 percentage

Thus, the Hypothesis statement no. 2 is agreed by greater than 50 percent of responses. So, this is also a Null Hypothesis (H_0).

SUGGESTIONS:

- The local authorities must upgrade and maintain drainage and sewage infrastructure, as 92 percent of respondents reported sewage overflow during flooding.
- A proper stormwater management system should be implemented to reduce recurring flooding, which affects 88 percent of households in the study area.
- The Government should provide safe, protected and regular drinking water supply systems, since major respondents are dependent on Metro water for drinking and other purposes.
- Public health departments must conduct regular water quality monitoring and emergency chlorination during flood periods to prevent contamination.
- Awareness programs should be strengthened to ensure 100 percent adoption of water treatment practices, as a portion of residents still do not consistently treat water.
- Immediate measures for mosquito control and sanitation should be enforced during water stagnation periods (1–7 days) to prevent vector-borne diseases.
- Government healthcare facilities should be strengthened and equipped for surge capacity, as 62 percent of affected residents depend on them during post-flood illness outbreaks.

CONCLUSION:

This study demonstrates that urban flooding in Kallukuttai, Chennai, is not an isolated environmental issue but a persistent and systemic problem with serious implications for household water quality and public health. The findings reveal that a vast majority of households experience recurrent flooding, with prolonged water stagnation and sewage overflow. These conditions create a direct pathway for contamination, as evidenced by the high proportion of respondents reporting contact between floodwater and drinking water sources and noticeable deterioration in water quality. The health impact is equally significant, with a substantial percentage of respondents reporting post-flood illnesses, particularly waterborne and vector-borne diseases. The results of hypothesis testing further confirm a strong relationship between flooding, water contamination, and adverse health outcomes. Despite some level of awareness and preventive practices among residents, such as water treatment and container cleaning, these measures remain insufficient in the face of systemic infrastructural failures. Overall, the study highlights the urgent need for integrated

interventions, including improved drainage systems, reliable water supply, and strengthened public health responses. Without structural and policy-level changes, urban flooding will continue to pose a critical threat to environmental safety and community well-being.

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