Section: Public Health

Original Research Article

HEPATITIS A IN KERALA: TRENDS, CHALLENGES, AND PUBLIC HEALTH IMPLICATIONS (2013–2023)

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ABSTRACT

Background: Hepatitis A remains a major communicable disease in Kerala, with varying trends across districts and years. The disease has a varied presentation at the time of diagnosis, and it can progress from an accidental finding to life threatening conditions like hepatic failure. **Objective:** This study aims to examine year-wise and district wise trends in Hepatitis A cases and deaths, identify high risk areas and temporal pattern of disease.
Material and Methods: In this study, descriptive statistics, trend analysis, behavioural insights and advanced visualisation has been used.
Results: The analysis revealed that districts like Kollam and Malappuram consistently reports the highest number of Hepatitis A cases throughout the study period. The data also shown seasonal peaks in cases, with a marked increase during pre-monsoon and post-monsoon periods.
Conclusion: This study provides a detailed analysis of the epidemiological trends of Hepatitis A in Kerala over a ten-year period (2013-2023). The results underscore the need for targeted interventions in high-burden districts such as Kollam and Malappuram. The analysis also revealed seasonal spikes in Hepatitis A cases, predominantly during pre-monsoon and post-monsoon. This study provides data on interplay between climate change, sanitation challenges and disease epidemiology in Kerala.
Keywords: Hepatitis A, Kerala, Outbreak investigation, Trend, Climate.

INTRODUCTION

Hepatitis A is an infectious disease caused by Hepatitis A Virus (HAV), primarily affecting the liver.[1] Hepatitis A Virus (HAV) is a positive strand RNA virus that is transmitted faeco-orally through person to person contact, with contaminated food and water serving as the principal source of infection. Infection is often asymptomatic in children, but adult presents with jaundice, fatigue, abdominal discomfort and fever.[2] Diagnosis is through detection of immunoglobulin M antibodies against HAV and treatment is supportive. Vaccination is the mainstay of prevention and should be given before exposure whenever possible.[3,4] Unlike Hepatitis B and C, Hepatitis A does not cause chronic liver disease but it can cause debilitating symptoms and rarely fulminant hepatitis (acute liver failure), which is often fatal.[5] WHO estimates that in 2016, 7134 persons died from Hepatitis A worldwide (accounting for 0.5% of the mortality due to viral hepatitis).[6]

In areas like Kerala, India, the prevalence of Hepatitis A has been aggravated by multiple factors, including environmental vulnerabilities and changing societal behaviours.[7] Heavy monsoon rains and periodic flooding in Kerala often lead to contamination of water sources, as sewage mixes with drinking water supplies, increasing the risk of waterborne disease outbreaks. Erratic rainfall and rising temperature degrades water quality.[8] Districts such as Malappuram and Kozhikode have reported thousands of Hepatitis A cases during recent outbreaks.[9,10]

Adding to these environmental factors is the shift in food consumption habits following the COVID-19 pandemic. There has been a significant rise in dining at restaurants and street food stalls. The rapid increase of these establishments, particularly street food vendors, has further contributed to the spread

of Hepatitis A. Many of these vendors operate under poor hygienic conditions, lacking adequate water supply and sanitation facilities. Studies have consistently highlighted the role of contaminated food and beverages in facilitating HAV transmission and in densely populated regions, improper handling of food, inadequate waste disposal and insufficient cleanliness in eateries amplify this risk.

The WHO emphasises the importance of improving water quality, sanitation, and food safety standards to prevent Hepatitis A outbreaks. Strengthening surveillance systems for water and food hygiene, alongside targeted public health interventions, is essential to mitigate the risk posed by climate induced changes and evolving food consumption habits. For Kerala, addressing these multifaceted challenges will be crucial in controlling Hepatitis A and ensuring the health and safety of its population.

This study aims to conduct a comprehensive analysis of the epidemiological trends of Hepatitis A in Kerala over a decade (2013-2023).[9] It focuses on identifying the spatial distribution of reported cases and deaths across all districts to determine high-burden regions. The temporal patterns are evaluated to understand seasonal variations in the incidence of cases, particularly during pre-monsoon and post-monsoon periods. Moreover, the study integrates insights from climatic patterns to explore the potential role of climate change in influencing disease outbreaks. Specific attention is given to how extreme weather events, such as rainfall, flooding, and rising temperatures, may have contributed to the increased transmission of the Hepatitis A virus through contaminated water sources. By examining these trends, the research seeks to provide data-driven recommendations for public health interventions, such as targeted vaccination campaigns, improved water sanitation, and climate-adaptive healthcare strategies.

MATERIALS AND METHODS

This study utilised district-wise and monthly data on reported cases and deaths due to Hepatitis A in Kerala from 2013 to 2023. The data was sourced from Kerala's health surveillance system [9], which compiles records from public health institutions and district health departments. These records provided detailed information, including yearly and district-level counts of confirmed cases and deaths, as well as monthly distributions of cases. This comprehensive dataset enabled a thorough analysis of both temporal and spatial trends.

The study employed a multi-step approach to analyse the data, incorporating descriptive statistics, trend analysis and behavioural insights. First, descriptive statistics were calculated to understand the overall burden of disease. The total number of cases and deaths was analysed across district, years, and months to identify patterns. The case-fatality rate (CFR), a key metric to assess disease severity was calculated for each district and year using the formula.

$$CFR = \left(\frac{Total\ Death}{Total\ Case}\right) \times 100$$

This metric highlighted variations in disease severity across the state.

Trend analysis was conducted to delve deeper into the temporal and spatial dimensions of the data. Year-wise trends were assessed to identify years with significant outbreaks or declines in reported cases and deaths. District-wise variations were analysed to pinpoint high-burden regions and areas with persistent disease prevalence. Additionally, monthly patterns were evaluated to detect seasonal trends, particularly the relationship between Hepatitis A incidence and climate conditions, such as pre-monsoon and post-monsoon months.

The study also incorporated behavioural insights by exploring the potential impact of post-COVID changes in food consumption habits. Increased reliance on restaurants and street food after 2020 was examined as a possible factor influencing the transmission dynamics of Hepatitis A [11]. These behavioural shifts were contextualised within the broader trends observed during the pandemic and its aftermath.

To effectively present the findings, various visualisation tools were employed. Heat maps were used to represent district-wise case density and highlight high-burden regions. Bar charts provided clear comparisons of total cases and deaths across districts, while line graphs illustrated year-wise and month-wise trends in cases and deaths over the study period. These visualisations enhanced the interpretability of the data and provided a clear picture of the disease distribution over time and space.

Ethical considerations were central to this study. All data was anonymised to ensure the confidentiality of affected individuals, and no personal identifiers were included in the analysis or reporting process. The study adhered to ethical guidelines for using public health surveillance data, ensuring the responsible use of sensitive information.

By combining descriptive statistics, trend analysis, behavioural insights, and advanced visualisation, this methodological framework provides a detailed understanding of Hepatitis A epidemiology in Kerala. It also explores the potential influence of climate change and post-pandemic behavioural shifts on the disease's patterns, offering valuable insights for public health planning and intervention.

DISCUSSION

3.1. Key Observation

The analysis revealed that districts like Malappuram, Kozhikode and Kollam consistently reported the highest number of Hepatitis A cases throughout the study period as shown in Figure 1. This trend may be attributed to a combination of

factors, including high population density, which facilitates disease transmission, and inadequate sanitation infrastructure, leading to contamination of water sources.[12,13] These findings suggest that socio-environmental conditions play a critical role in disease prevalence in these districts.

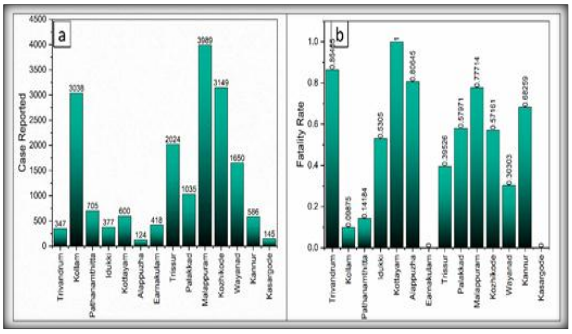

Figure 1: Number of HAV cases reported (a) across various districts of Kerala, showing significant variation, with Malappuram, Kozhikode, and Kollam reporting the highest numbers and Idukki, Kasaragod, and Trivandrum reporting the lowest and (b) Fatality rate.

The largest number of cases occurred in 2013, after which a downward trend was observed (Figure 2). This decline may be attributed to greater public awareness, higher vaccination coverage, or enhanced water sanitation measures in the following years. Interestingly, there was a notable decline in reported cases during the COVID-19 pandemic years (2020-2021). This decline could reflect changes in disease surveillance and reporting priorities during the pandemic, as health systems were overwhelmed by COVID-19. Alternatively, it may indicate behavioural changes, such as improved hygiene practices and reduced social interactions, which may have indirectly curbed the spread of Hepatitis A.

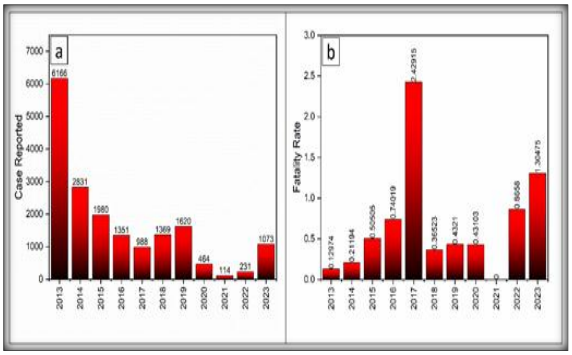

Figure 2: Number of HAV cases reported (a) during from 2013 to 2023 and (b) Fatality rate during 2013 to 2023

The Figure 3 highlighted clear seasonal peaks in cases, with a marked increase during pre-monsoon and post-monsoon periods. These periods are known for waterborne disease outbreaks, likely due to flooding, water stagnation, and the overflow of sewage systems, which exacerbate the risk of viral transmission. Seasonal spikes underline the importance of strengthening water management systems and public health responses during these high-risk periods.

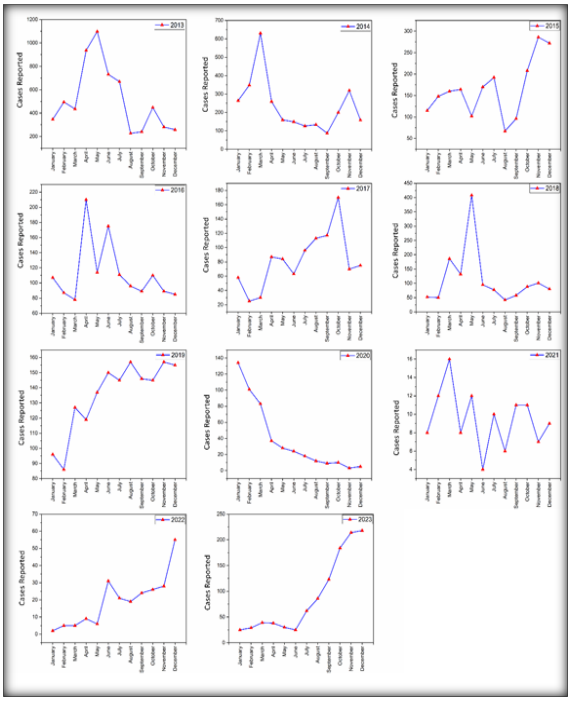

Figure 3: The trend of HAV cases reported at the state of Kerala during each year from 2013 to 2023

3.2. Public Health Implications

The findings emphasise the need for targeted public health interventions in high-burden districts like Kollam and Malappuram. Priority should be given to preemptive vaccination campaigns, especially before the monsoon season, to protect vulnerable population. Additionally, improving water sanitation infrastructure, such as ensuring access to clean drinking water and upgrading sewage systems, is critical in reducing disease transmission.

To mitigate seasonal outbreaks, enhanced disease surveillance during the monsoon months is essential. This includes setting up rapid response teams, increasing community awareness campaigns, and ensuring early detection and treatment of cases. Integrating climate adaptation strategies, such as improved flood management and resilient water supply systems, could also significantly reduce the burden of waterborne diseases like Hepatitis A.

3.3. Limitations

While the study provides valuable insights, it is important to acknowledge certain limitations. The possibility of underreporting of cases and deaths cannot be ruled out, as some cases may not have been diagnosed or recorded due to limitations in surveillance systems. This is particularly likely in rural or underserved areas with limited healthcare access.

Furthermore, the lack of demographic data, such as age and gender, restricts the ability to conduct subgroup analyses. This prevents a deeper understanding of how the disease impacts specific

population groups, such as children or elderly individuals, who may be at higher risk. Future studies should aim to collect more granular data to address these gaps and provide a more comprehensive understanding of the disease epidemiology.

CONCLUSION

This study provides a comprehensive analysis of the epidemiological trends of Hepatitis A in Kerala over a decade (2013–2023), shedding light on significant temporal and spatial variations in the disease burden. The findings offer critical insights that can guide public health planning and intervention strategies to combat Hepatitis A more effectively.

Key Findings

1. **High-Burden Districts**

- Districts such as Kollam and Malappuram consistently recorded the highest numbers of cases and deaths. These areas are marked by high population densities and frequent monsoon-related flooding, exacerbating waterborne disease transmission due to poor sanitation and contaminated water sources.
- Periodic outbreaks in districts like Wayanad were also observed, although with fewer overall cases compared to Kollam and Malappuram.

2. **Seasonal Patterns**

- Hepatitis A cases exhibited seasonal spikes during pre-monsoon (April–June) and post-monsoon (August–October) periods.
- Heavy rainfall during these periods often leads to contamination of water sources and fosters the spread of waterborne pathogens, with stagnant water during floods playing a key role in Hepatitis A Virus (HAV) transmission.

3. **Temporal Trends**

- The highest number of cases was reported in 2013, followed by a general decline, likely due to improved awareness, vaccination programs, and better water sanitation practices.
- Deaths peaked in 2021, potentially due to challenges in healthcare delivery during the COVID-19 pandemic, which underscored the system's vulnerabilities in managing comorbidities and ensuring timely treatment during crises.

Implications for Public Health

The study highlights the urgent need for targeted public health measures to address the spatial and temporal burden of Hepatitis A:

1. **District-Specific Strategies**

- High-burden districts like Kollam and Malappuram require tailored interventions, including improved disease surveillance, vaccination drives, and investments in water sanitation infrastructure.
- Public health campaigns should focus on high-risk groups, such as children and individuals in flood-prone areas.

2. **Seasonal Preparedness**

- Pre-monsoon and post-monsoon periods should be recognised as critical windows for intensified public health efforts, including:
  - Preemptive vaccination programs.
  - Community education on safe water and sanitation practices.
  - Emergency water purification and sanitation measures during flooding events.

3. **Climate-Adaptive Healthcare Policies**

- With the increasing frequency of extreme weather events due to climate change, integrating climate-resilient approaches into public health strategies is essential.
- Preparing for indirect climate impacts on waterborne diseases like Hepatitis A should be a priority.

Final Remarks

This study highlights the intricate relationship between climatic factors, sanitation challenges, and disease epidemiology in Kerala. The identification of high-burden districts and seasonal trends underscores the need for proactive, data-driven public health strategies. By addressing these critical insights, Kerala can effectively reduce the burden of Hepatitis A and enhance resilience to future outbreaks, particularly in the context of climate change.

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