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ORIGINAL ARTICLE

Association of Drinking Water Contamination and Pre-hospital Pharmacological Intervention with Hep E Outbreaks in Children under 12 Years in District East Karachi; A Case Control Study

SAIMA MANZOOR[1], GEETA MOOLCHANDANI[2], KIRAN KHAN[3], AISHA ANIS[4], MUHAMMAD AITMAUD UDDOLAH KHAN[5], AFTAB HUSSAIN ABRO[3]

[1]*Department of Community Medicine, Women Medical College Abbottabad*
[2]*BHY (Jamiyat) Hospital Dehli Colony Karachi*
[3]*Department of Community Medicine, Shaheed Mohtarma Benazir Bhutto Medical College Lyari, Karachi*
[4]*Department of Biochemistry, Fatima Jinnah Dental College, Karachi.*
[5]*Department of Pharmacology, Liaquat National Medical College, Karachi.*
Correspondence to: Kiran Khan, Email: kiranata2003@gmail.com

ABSTRACT

Background: Hepatitis E virus (HEV) remains an important cause of waterborne acute viral hepatitis in low-resource urban settings. Children are particularly vulnerable in areas where municipal water systems are inadequately treated and prone to faecal contamination. This study assessed the association between municipal drinking water, pre-hospital pharmacological management, and hepatitis E infection in children under 12 years in District East, Karachi.

Methodology: A hospital-based observational study was conducted among children under 12 years presenting with vomiting and diarrhoea lasting more than 18–24 hours. Of 638 children, 400 with a clear history of consuming water directly from the municipal supply line were selected for testing. Blood samples were analysed by PCR for HEV. Demographic data, drinking water history, and treatment details were recorded. Associations between HEV infection, age group, and water source were analysed using chi-square tests.

Results: Among 400 children tested, 313 (78.25%) were PCR-positive for HEV. There was a highly significant association between HEV infection and consumption of water directly from the municipal line ($p < 0.001$). Female children were predominantly affected, comprising 221 (70.6%) of infected cases. Age group was not significantly associated with infection ($p = 0.812$). Infected children were managed with acetaminophen, oral rehydration, soft diet, and antiemetics as needed. Severely dehydrated cases were admitted; mean hospital stay was 12.13 ± 2.08 days, and all patients survived.

Conclusion: The study demonstrates a strong link between unsafe municipal drinking water and paediatric HEV infection, with a notable female predominance but no age-group effect. Despite substantial burden, supportive management resulted in favourable outcomes. These findings underscore the need to improve urban water safety and strengthen early recognition and basic supportive care for hepatitis E in children.

Keywords: Drinking water, Contamination, Hep E, Outbreaks, Children under 12 years, Karachi

INTRODUCTION

Among various public health concerns in Pakistan unsafe drinking water has been identified as a major challenge to government specially in areas with heist population such as Karachi[1]. In a recent assessment on water sample collected from Karachi's water distribution system, it was identified that the supplied municipal water had bacterial contamination, high turbidity and more dissolved solids which proved that the water failed the basic safety standards and considered as unsafe for drinking. Sewage intrusion into drinking water lines is facilitated by rapid urbanization deteriorating pipelines illicit connections and sporadic water supply especially in densely populated areas[2]. Children in many low-income neighborhoods depend on a variety of water sources including bore wells tanker supplies and piped water all of which are unmonitored and treated inconsistently. Due to overburdened infrastructure and a lack of local capacity for regular water-quality surveillance District East which consists of both formal and informal settlements is particularly vulnerable. These gaps at the environmental and systemic levels provide the perfect environment for fecal contamination of drinking water which sustains the spread of enteric pathogens in young children[3].

Acute diarrhea typhoid fever and viral hepatitis are just a few of the many illnesses that children can contract from waterborne pathogens spread through fecal contaminated drinking water. In environments with contaminated water and poor sanitation the enterically transmitted hepatitis E virus (HEV) is known to be the cause of significant waterborne outbreaks[4]. Hepatitis E outbreaks and sporadic clusters have been documented in Pakistani communities' schools and institutional settings whenever sewage contaminates drinking water sources. Children are particularly vulnerable since they frequently drink untreated water at home in schools and on the streets and general hygienic conditions are not ideal[5]. Hepatitis E has historically affected older adults and adolescents but serological surveys show significant exposure in the pediatric population. When contamination is severe and persistent outbreaks can affect children younger than 12 years of age. Overcrowding a lack of awareness and a delay in seeking medical attention can exacerbate the disease burden and raise the risk of household transmission during such outbreaks[3, 4, 6].

Since there is currently no approved antiviral medication for routine use particularly in children the management of acute hepatitis E is primarily supportive. Although off-label antiviral treatments like ribavirin have been investigated for severe or persistent HEV infection their widespread use is limited due to worries about teratogenicity hemolytic anemia and a lack of pediatric data[6, 7]. Although they are still in the preclinical or early clinical stages other direct-acting antiviral candidates and repurposed agents (such as nucleoside analogues and polymerase inhibitors initially created for hepatitis C or other RNA viruses) exhibit in vitro activity against HEV. Pre-hospital pharmacological interventions for suspected hepatitis E in children are therefore usually non-specific in real-world settings like District East Karachi[8]. These interventions include antipyretics antiemetics empirical antibiotics or herbal remedies that are prescribed or purchased prior to receiving formal care[9, 10]. These early interventions may affect the clinical course postpone a conclusive diagnosis or conceal severity however their patterns and correlations with the dynamics of childhood outbreaks have not been thoroughly studied. In light of these gaps the current case-control study Association of drinking water contamination and pre-hospital pharmacological intervention with Hep E outbreaks in children under 12 years in District East Karachi aims to: (1) determine the relationship between hepatitis E outbreaks among children under 12 years in District East Karachi and microbiological

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and physicochemical contamination of drinking water sources and (2) assess the relationship between the types and timing of pre-hospital pharmaceutical interventions in these pediatric cases. The study aims to produce local evidence that can direct targeted water safety measures and sensible early pharmacological practices for preventing and mitigating hepatitis E outbreaks in vulnerable children by connecting environmental water quality data with individual-level exposure and treatment histories.

METHODOLOGY

It was a cross sectional study conducted at tertiary care hospital of Karachi from July 1 2021 to December 31, 2022. Children of age up to 12 years who reported to hospital with complaints of diarrhea and vomiting were included in the study. The sample size n = 385 was calculated at 50% proportion of the population keeping the confidence interval at 95%. The children were divided into 4 groups according to age group 1 had an age range of 0-3 years, group 2 had 3-6 years, group 3 had 6-9 and group 4 had 9-12 years. A preformed questionnaire was designed to record the history regarding drinking water, pharmacological management and outcome of the management was recorded on a pre formed questionnaire. Hep E detection was performed after taking history and confirmation of the patient that they use drinking water supplied by municipal corporation. PCR was performed at local lab of karahi to identify the presence of Hep E virus in the admitted/suspected patients as per recommended protocol by the manufacturer. SPSS version 20. was used to analyze the data chi square analysis was performed to generate the associations, p value < 0.05 was considered as significant.

RESULTS

A total of 638 children under the age of 12 were reported to the hospital with history of vomiting and diarrhea for more than 18 - 24 hours. After clinical examination and history of drinking water from municipal supply line 400 blood samples were taken and sent for PCR. The PCR analysis confirmed the presence of hep E infection among 313 (78.25%) children out of 400 (100%). Chi square analysis showed a significant (p-value < 0.001) association of presence of hep E infection in children who consumed drinking water directly from municipal supply line. Amongst the infected children females [221 (70.6%)] were prominently infected in our study cohort figure 1. The mean age was calculated as per age groups of the children Table 1 shows the mean age and gender distribution of the children. When evaluated as per age groups there was no association (p-value = 0.812) which highlighted that age factor does not determine the occurrence of infection. The infected patients were provided acetaminophen syrup for fever and supportive management that included rehydration, soft diets antiemetic drugs (if required). Whereas for patients who were severely dehydrated and were not responding to primary treatment were admitted to pediatric ward for further management and assessment. The mean hospital stay for admitted children was 12.13 ± 2.08 days in pediatric ward all the patients survived after the management of the diseases.

Table 1: Showing the mean age and gender distribution of participants age wise.

Age group	Mean ± SD (Age in years)	P-value	Gender of participants	
			Females (n =221)	Males (n=92)
0-3	1.8 ± 0.31	0.812	39 (17.6%)	17 (18.4%)
3-6	4.1 ± 0.62		77 (34.8%)	31 (33.6%)
6-9	8.1 ± 0.91		67 (30.3%)	23 (25%)
9-12	10.3 ± 1.2		38 (17.1%)	21 (22.8%)

Table 2. Association of Hep E infection in study participants

Age group	Mean ± SD (Age in years)	Gender of participants	
		Females (n =221)	Males (n=92)
0-3	1.8 ± 0.31	39 (17.6%)	17 (18.4%)
3-6	4.1 ± 0.62	77 (34.8%)	31 (33.6%)
6-9	8.1 ± 0.91	67 (30.3%)	23 (25%)
9-12	10.3 ± 1.2	38 (17.1%)	21 (22.8%)

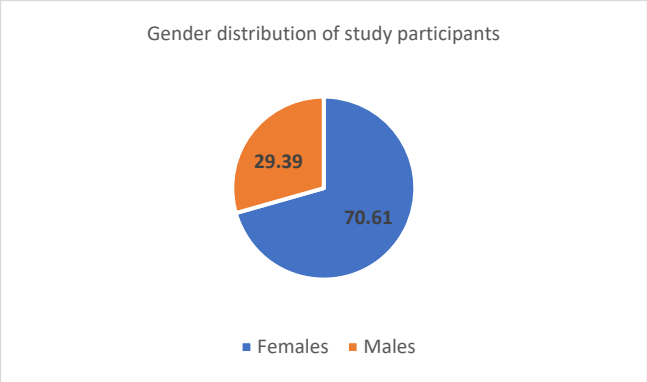

Figure 1. Gender distribution of study participants

DISCUSSION

The current study highlights three important findings regarding a significant cluster of hepatitis E virus (HEV) infection among children in District East Karachi: a strong correlation with municipal drinking water a notable female predominance and reassuring outcomes with supportive management. Four hundred of the 638 children under the age of twelve who reported drinking straight from the municipal supply line underwent PCR testing after experiencing vomiting and diarrhea for longer than eighteen to twenty-four hours. 313 (78. 25%) of these kids had confirmed HEV infection and chi-square analysis revealed a highly significant correlation between infection and municipal line water consumption (p 0. 001). This pattern is in line with recent data from Pakistan and other Asian nations where HEV outbreaks and sporadic clusters are still primarily caused by fecally contaminated piped water. HEV has been found in surface waters sewage and occasionally treated water in environmental and wastewater surveys conducted throughout Asia. This suggests that current treatment and distribution systems frequently fall short of completely stopping viral transmission. Similar to the strong correlation between exposure to municipal water and infection observed in this cohort outbreak investigations from various parts of Pakistan as well as from China and India have reported tap-water-mediated HEV transmission in communities dependent on compromised municipal networks[11, 12].

In contrast to isolated sporadic cases the extremely high percentage of PCR-confirmed HEV in clinically suspected children who drank municipal water points to a severe localized contamination event. Similar circumstances have been reported in Asian settings where a single contaminated source such as an inadequately chlorinated reservoir or a leaky pipeline—served a specific catchment area and caused an abrupt increase in acute hepatitis cases. Research from Indian states and the Malwa region of Punjab India has demonstrated that HEV can be responsible for over half of all cases of acute viral hepatitis during such outbreaks especially in younger age groups and in communities with lower socioeconomic status. According to recent reports from Pakistan sewage is drawn in and contaminates municipal water used for drinking and food preparation in peri-urban and urban areas with deteriorating infrastructure intermittent supply and negative pressure in pipelines[3, 13]. By concentrating on children under the age of twelve in a densely populated area of Karachi the current findings contribute to the body of literature and show that young children are severely impacted by unsafe municipal water[14].

The fact that females made up 70. 6 percent of the infected children (221 of 313) is a startling aspect of this study. While more recent research from Pakistan and neighboring countries has shown that women predominate in some settings particularly in household clusters or communities where women and girls have distinct water-related roles classic descriptions of HEV frequently report similar infection rates among males and females[15]. For instance, outbreak investigations in Khyber Pakhtunkhwa and

recent seroprevalence studies in Pakistani women have revealed significant HEV exposure among females connecting it to shared use of stored household water and participation in food preparation[8,9]. Girls may use communal drinking utensils spend more time at home and drink more water from household storage containers in South Asian contexts all of which increase their exposure to contaminated household water. Gendered behavior intra-household water uses and care-seeking patterns appear to be significant factors in determining which children are most likely to be exposed tested and diagnosed according to certain paediatric series from Bangladesh and India. Although mean age varied among groups in the current study age-group analysis did not reveal a significant association with infection (p = 0. 812) suggesting that age was not a risk factor in this outbreak. This is consistent with recent data from highly endemic settings where both younger and older children may be affected when a common water source is contaminated and where severe contamination results in comparatively uniform exposure throughout childhood[16, 17].

Clinically the majority of infected children had diarrhea and vomiting with or without other systemic symptoms. They were treated with rehydration a soft diet acetaminophen for fever and antiemetics as needed. Children who were admitted to the pediatric ward due to severe dehydration or poor response to initial treatment had an average hospital stay of 12. 13 ± 2. 08 days. Notably every child who was admitted survived[11, 13, 17]. These results are consistent with recent reviews and pediatric HEV cohorts which typically describe a self-limited course in immunocompetent children and a favorable prognosis with prompt supportive care. Antiviral therapy is only used in very specific cases such as chronic infection in immunocompromised patients. Recent pediatric studies have emphasized that treatment for acute HEV primarily consists of symptomatic management including maintaining nutrition treating fever and nausea monitoring for complications and ensuring adequate hydration[18, 19].

The predominance of gastrointestinal symptoms (diarrhea and vomiting) for more than 18 to 24 hours prior to hospital presentation is consistent with findings from reports of pediatric HEV in Asia where early symptoms frequently resemble those of other enteric infections. Early clinical differentiation from simple gastroenteritis is difficult when children with acute viral hepatitis including HEV present with fever abdominal pain vomiting and diarrhea prior to the onset of obvious jaundice according to a number of hospital-based studies. In low-resource urban environments where multiple pathogens co-circulate this overlap is extremely important[20]. If clinicians only concentrate on bacterial or parasitic causes of diarrhea HEV may be missed. According to the available data children who exhibit prolonged vomiting and diarrhea should be evaluated for HEV by clinicians in areas where water contamination is known or during suspected outbreaks. This is especially true when multiple cases are connected to the same municipal water source. Appropriate testing water safety counseling and closer monitoring for possible hepatic involvement are made possible by early detection[21].

When considered collectively the results of this cohort align well with the larger regional literature and suggest a number of useful implications. First the strong correlation between HEV and municipal water highlights the critical need for Karachi and similar cities to upgrade their urban water infrastructure guarantee efficient disinfection fix leaks and shield pipelines from sewage intrusion[22]. Second the predominance of women indicates that health education and prevention strategies should be sensitive to gendered water-use behaviors. They should specifically target girls and caregivers with messages about boiling filtration safe storage and avoiding uncoiled municipal water during suspected contamination events[23]. Third the positive results under supportive management highlight how important it is to improve primary and secondary care facilities so that children with acute HEV are quickly identified properly hydrated and monitored without needless interventions. Overall, this study contributes locally relevant child-focused evidence to the body of research on waterborne HEV in Pakistan and Asia emphasizing how the burden and outcome of hepatitis E in vulnerable pediatric populations are influenced by social patterns of exposure timely supportive care and contaminated municipal water[24, 25].

CONCLUSION

This study shows a significant association between direct water consumption from the municipal supply line in Karachis District East and hepatitis E infection in children under the age of twelve. In the context of compromised urban water infrastructure, a high PCR positivity rate among clinically suspected cases with this exposure suggests likely waterborne transmission. These results highlight the critical need to enhance community education and drinking water safety while bolstering early detection and supportive care pathways for pediatric hepatitis E in urban Pakistan.

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