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Original Research Article

A study on socio-demographic and environmental factors association with viral diarrhea in under 5 year children

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ABSTRACT

Background: The data associated with diarrheal diseases are limited in low and middle-income countries where it possesses a great threat to the population and its economy. Risk factors that can make a population more vulnerable to diarrhea can be environmental or behavioral, yet differ among individuals, populations, countries, and geographies. Finding out the etiology, socio-demographic determinants and environmental factors occurrence might help in designing intervention strategies.
Methods: A cross-sectional study was conducted for one year from July 2021 to July 2022 in Department of Microbiology. Stool samples of 150 under 5 year children were included and tested with multiplex PCR and monoplex PCR to detect viruses causing diarrhea. Data was analyzed and p value <0.05 considered as statistically significant.
Results: Out of 150 total samples 18.7% (28/150) were positive for viruses causing diarrhea. Rotavirus was most common cause for diarrhea. Maximum cases found in infants 53.6% followed by toddler 25%, and early childhood 21.4%. Out of 28 positive cases, 64.3% were males and 35.7% females. The maximum cases seen from July-September 50% and in rural areas 31% compared to urban areas 9%.
Conclusions: A number of socio-demographic determinants such as rural-urban residence along with child's age are associated with occurrence of diarrhea in under 5 children. Concerning environmental factors such as seasonal variations in specific geographic regions are associated with diarrheal disease with higher prevalence of viral diarrhea occurring in rainy season in current study.

Keywords: Socio-demographic, Seasonal variations, Viral diarrhea, Under 5 children

INTRODUCTION

Diarrheal diseases are documented as major public health problem in children under 5 years of age. Globally, diarrhea is the second leading cause of death in children under five. Even after being one of the leading causes of mortality and morbidity in the world, data associated with diarrheal diseases are limited[1]. In low and middle-income countries, diarrhea possess a great threat to the population and its economy. Risk factors that can make a population more vulnerable to diarrhea can be environmental or behavioral, yet differ among individuals, populations, countries, and geographies.[1] Different geographical areas have distinct seasonal patterns of diarrhea.[2] Viral diarrhea is more frequent during the drier, cool months, particularly diarrhea caused by rotavirus peak during the winter. Whereas bacterial diarrhea peak during the warmer, rainy season.[3] Young age, low socioeconomic status, poor maternal literacy, presence of under-five sibling in the family, birth weight, inadequate breastfeeding, malnutrition, poor sanitation and hygiene practices of the mother are associated with a higher incidence of diarrheal diseases in young children.[4] Finding out the socio-economic determinants of occurrence might also help in designing the intervention strategies.[4] We also intend to find the prevailing etiology and risk factors associated with diarrhea.

Acute gastroenteritis is usually caused by viral, bacterial or parasitic infections in the digestive tract. Of the infectious causes of acute gastroenteritis, it is estimated that 50–70%, 15–20% and 10–15% are caused by viral, bacterial and parasitic infections, respectively. In general, acute viral gastroenteritis peaks in the autumn and winter seasons, and the peak of acute bacterial gastroenteritis appears in summer. Outbreaks and sporadic cases of gastroenteritis occur throughout the year and pose a major public health burden worldwide. Most causes of acute gastroenteritis are foodborne or waterborne due to the contamination of a pathogen toxin and/or toxic microorganism.[5]

Acute gastroenteritis is one of the most common childhood diseases, especially in developing countries. Annually 2.5 million deaths are estimated to occur due to enteric infections, greatly impacting children younger than five years of age.[1] Over 20 different types of viruses have been identified as aetiological agents for gastroenteritis. Group A rotaviruses are considered to be the main agents followed by calicivirus, adenovirus and astrovirus.[6] Approximately 70% of episodes of acute gastroenteritis in children are due to a virus, and rotavirus is the most common virus causing the disease. Both rotavirus and norovirus are dominant among viral causes of acute gastroenteritis. Bacterial infection accounts for 10 to 20% of all. The disease is spread through eating contaminated food, including improperly prepared food, or drinking contaminated water and other liquids, sharing personal objects/close contact with a person who is infected, and handling pets and other animals.[7]

METHODS

The cross-sectional study was conducted in Department of Microbiology, Bundelkhand Medical College, Sagar, M.P for a period of one year from July 2021 to July 2022. The study was approved by Institutional Ethics Committee of BMC, Sagar (M.P). A total of 150 stool specimen of children under 5-year were included in the study.

The sampling technique is non-probability purposive sampling The sample size was calculated using the formula

$$Sample\ size = z^2pq/d^2$$

Here, Z=1.96 (at 95% confidence), p=9.5%, q=100-p, d=5% and p is the prevalence taken from the study reference Ghosh et al.[1] The prevalence of diarrhea in M.P is 9.5% according to NFHS-4, 2015-2016.[1] The sample size comes around 132, adding 10% to non-response rate leading to sample size of 150. A detailed clinical history and demographic profile were obtained from parents using structured questionnaire and duly recorded case record form.

Stool suspension was prepared in 10% phosphate-buffered saline(PBS) (pH7.4) and stored at-20ºC. These suspensions were used for RNA extraction using a commercially available MagMax™Viral/Pathogen Nucleic Acid Isolation kit by Thermo Fischer Scientific, Applied Biosystems. This extracted RNA was stored at-80ºC for further testing, by using Allplex™ GI-Virus Assay, Multiplex real-time one-step RT-PCR on CFX96™ Real-time PCR System (Bio-Rad) for detection of five different enteric viruses Norovirus, Rotavirus, Adenovirus, Astrovirus, and Sapovirus. Mono-plex RT-PCR was done for detection of Enterovirus using Enterovirus TaqMan RT-PCR Kit Norgen Biotek Corporation.

Data was analyzed in Microsoft excel 2010 and the statistical analysis was done using statistical package for the social sciences (SPSS) version 20. Chi-square test was applied to determine statistically significant difference between different categorical variables. A p value <0.05 was considered statistically significant.

RESULTS

Out of 150 total samples 18.7% (28/150) cases were positive for viruses causing diarrhea. The majority of cases present in infants (1 month <12 months) with 53.6% (15/28). The highest prevalence was seen in the age group of 7-12 months with 39.3% (11/28) followed by a toddler (1 year to <2 years) with 25% (7/28), and early childhood (2 years to <5 years) with 21.4% (6/28). There was no positive case of viral diarrhea in neonates (birth <1 month). Figure 1 shows age wise distribution of total and positive cases of viral diarrhea (n=150).

Our study shows 63.3% (95/150) males and 36.7% (55/150) females were affected with diarrhea. Out of them 64.3% (18/28) males and 35.7% (10/28) females were positive for viral diarrhea. The present study shows higher prevalence of diarrhea in rural areas with 31% compared to urban population with 9%. Figure 2 shows distribution of urban-rural population of diarrheal cases (n=150). Seasonal distribution of viral enteropathogens causing diarrhea (Figure 3). The majority cases positive for viral diarrhea were in rainy season from July to September with 50%. Table 1 shows correlation of socio-demographic and seasonal variables with positive cases of viral diarrhea.

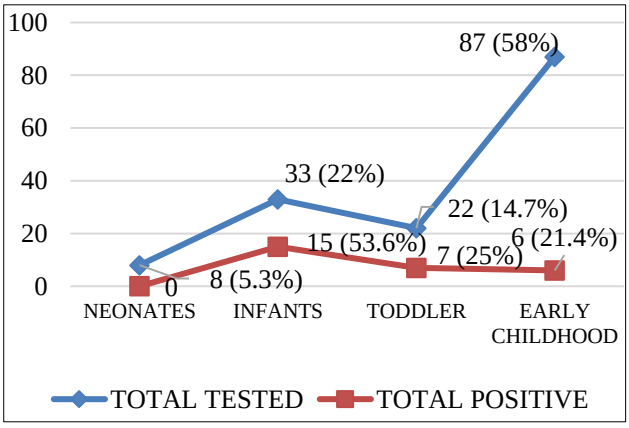

Figure 1: Age wise distribution of total and positive cases of viral diarrhea (n=150).

Table 1: Correlation of demographic variables with positive viral diarrhea cases.

Demographic variables	Positive, N (%)	Negative, N (%)	Total, N (%)	Chi-square test	P value
Age distribution (months)					
Neonate (0 to <1)	0	8 (6.6)	8 (5.3)	34.2722	0.000036 (p<0.05)
Infant (1-6)	4 (14.3)	11 (9)	15 (10)		
Infant (7-12)	11 (39.3)	7 (5.7)	18 (12)		
Toddler (13-24)	7 (25)	15 (12.3)	22 (14.7)		
Early childhood (25-60)	6 (21.4)	81 (66.4)	87 (58)		
Gender distribution					
Males	18 (64)	77 (63)	95 (63)	0.009232	0.009232 (p>0.05)
Females	10 (35.7)	45 (37)	55 (37)		
Population distribution					
Rural	20 (31)	45 (69)	65 (43.3)	11.06636	0.000879 (p<0.05)
Urban	8 (9)	77 (91)	85 (56.7)		
Seasonal distribution					
July-September	14 (50)	32 (26.2)	46 (31)	13.63105	0.003452 (p<0.05)
October-December	2 (7.1)	4 (3.3)	6 (4)		
January-March	8 (28.6)	22 (18)	30 (20)		
April-June	4 (14.3)	64 (52.5)	68 (45)		

**Statistically significant at p value

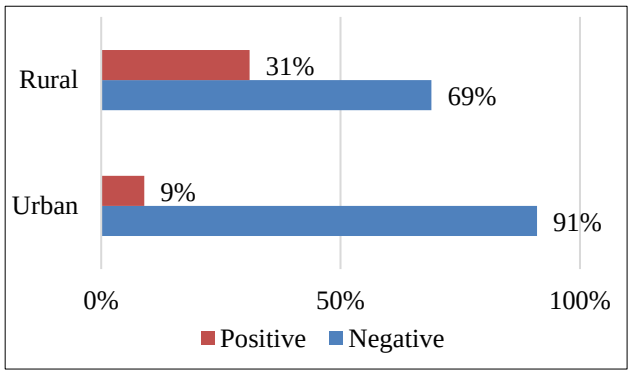

Figure 2: Distribution of urban-rural population of diarrheal cases (n=150).

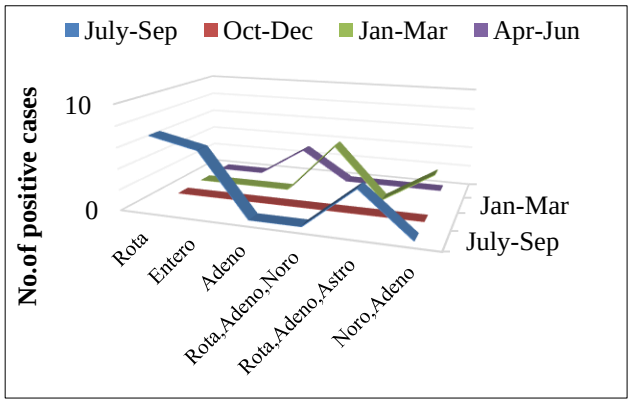

Figure 3: Seasonal distribution of viral enteropathogens causing diarrhea.

DISCUSSION

Our study shows highest number of cases in infants from 7 months to 12 months (39.3%) followed by toddler (1-2 years) 25%, whereas least positivity was observed in newborn infants (1-6 months) with 14.3%. This is probably because exclusive breastfeeding is encouraged for up to 6 months which reflects the protection offered by maternal antibodies through breastfeeding.[8] The next vulnerable age group was found to be 1 to <2 years as weaning is initiated after 6 months and is stopped by 1 year in the majority of children and the child is also exposed more to the environmental conditions as it starts crawling and walking.[9] The relatively low prevalence of viruses among older children could be partly due to immunity acquired through previous exposures. Thus, this calls for intensive health education of parents and proper immunization of the child.[9]

Our study shows concordance with the study conducted in South India by Stanly et al. Children in the age group 7-12 months had the highest prevalence of diarrhea at 40.7% followed by 32.1% in the age group of 13-24 months and 17% in 0-6 months and 12.8% in the age group above 25 months.[10] In the study of West Bengal by Gupta et al. The majority (26.97%) of the study participants were in the age group of less than 1 year and the prevalence of diarrhea was highest in the age group of 7-12 months (57.69%) followed by 13-24 months (25.71%).[8] A study was done in Bhopal by Gautam et al. This study shows a high prevalence of 27.3% in the age group of 7-12 months, followed by 26.6% in children from 13-24 months, 25% in 0-6 months and low prevalence of 21% in 25 months and above children.[11] According to a study done in Lucknow by Gupta et al, the positivity was higher among children less than 2 years of age.[12] And according to Rohra et al study done in South Mumbai, 65.21% of children under 3 years of age had viral diarrhea.[13] In a study from Assam by Goldar et al, the occurrence rate of viral diarrhea was 55%. Overall, viral diarrhea was more common than 2 years (68.1%).[14] The study results of Imade et al showed the

highest viral infection rate in infants 7-12 months with 58.5% and closely followed by 0-6 months which had a prevalence of 50.8%, age group of 13-18 months had positivity of 22.9% and children of 19-24 months with 19.2%, 25-30 months with low positivity of 18.2% and no cases were found positive from 31-36 months.[15]

Our study shows 64.3% male child were affected than female child with 35.7%, whereas this was not statistically significant. Similarly, Gautam et al showed the prevalence of acute diarrhea higher among males than females with 31.4% and 29.8% respectively.[11] A study by Imade et al reported 44.6% positive cases in males and 40.2% positive cases in females and this was not statistically significant.[15] A study by Gupta et al observed the prevalence of diarrhea in which females were affected with diarrhea at 22.89% than males at 21.73% in the study population.[8] The study conducted by Abida et al showed the prevalence of diarrhea more in females (16.9%) when compared to males (14.5%).[9]

This study shows the maximum number of cases were presented during the month of April to June followed by the rainy season from July to Sep with majority positive cases for viral diarrhea (50%). It is possible that, over and above climatic changes multiple factors interact in certain geographical regions and oppose climatic influences. The waterborne transmission route may dominate during heavy rainfall.[1]

The result is similar to the findings of the Gautam et al study done in Bhopal which observed a higher prevalence of diarrhea during the peak season from April to August month.[11] The study by Imade et al showed the seasonal pattern of enteric viruses of 46.9% prevalence in the rainy season while dry season had a 36.8% prevalence of viral diarrhea.[15] In thestudy conducted by Goldar et al viral diarrhea occurred mostly in the summer month i.e. April-July. According to Goldar et al, viral diarrhea was mostly seen in April-July.[14] According to Lohakpure et al, the highest incidence of diarrhea was in the summer season (36.5%) followed by the winter season (33.6%) and the rainy season (29.89%).[16] In study conducted by Gupta et al, Lucknow overall, the viruses were isolated during the cooler months with a peak between October and December among hospitalized children.[12] According to the study conducted by Gopalkrishna et al. The analysis of the enrolled diarrheal cases indicated a greater number of cases occurred in the winter season (December–February).[17]

The current study showed maximum number of diarrhea cases in rural areas with 31% compared to urban population with 9% in under 5 year children. The factors related to the higher prevalence of diarrhea are lack of proper personal hygiene, overcrowding, garbage disposal, sanitation and source of water supply, nutritional status, immunization status, literacy, education of mother, lack of exclusive breastfeeding, breastfeeding for less than 1 year.

The study by Ghosh et al, study finds hot spot areas mostly from central and eastern coastal part of India. Analysis of socio-economic determinants show the prevalence of diarrhea among under 5 children is higher in rural areas, among children living in kutcha house, living with unimproved sanitation facilities, belonging to under privileged community, children of younger mothers (<25 years) and poor households considering the wealth index.[4] The study conducted by Lohakpure et al observed diarrheal disease was higher in children from larger families than smaller sized families. Overcrowding in the households increases the risk for diarrhea.[16] The findings of Avachat et al reported low birth weight children had higher morbidity compared to normal birth weight, similar finding noted by Stanly et al infants who were exclusive breast fed had a lower incidence of diarrhea than those who were not. Higher morbidity of diarrheal disease observed among children who not received immunization compared to partially immunized and fully immunized. Diarrhea was twice more frequent in undernourished and poor sanitary conditions.[10,18]

The study conducted by Abida et al reported diarrhea was higher in lower socioeconomic groups. The type of houses are mostly kutcha houses (57%), and 30% were semi-pucca. Only 13% were pucca houses. The environment around the kutcha houses was poor with inadequate drainage facilities.[9] In line with Gupta et al West, Bengal diarrhea turned into cited to be 20.33% in exclusively breastfed youngsters and 31.57% in children who have been breastfed for much less than 6 months. In bottle-fed youngsters, the frequency of diarrhea was 26.08%. The prevalence of diarrhea was 21.83% in completely immunized youngsters and 30% inpart immunized kids.

The hazard of diarrhea became 19.80% in regular individuals and 27.45% in undernourished youngsters.[8] The study done by Gautam et al reported that partially immunized children and had higher risk for diarrhea compared to fully immunized children. The percentage of fully immunised children was 19%. Immunization coverage will help to reduce the burden of illness due to diarrhea in children. The prevalence of undernutrition in the study population was 69.9%. The under-nourished children had 14.4% better hazard for acute diarrhea than normal children. The threat of diarrhea become 4.3 instances extra in which insanitary practices of disposal became found.[11]

Limitations

It is important to highlight aspects that could have impacted the results or generalized, as the study focuses on patients in particular hospital of a particular region, the findings may not apply to broader or more diverse populations. Second the study was cross-sectional, capturing data at a point in time, limiting the ability to infer causality. There may be unmeasured variables that could influence the results as it is not possible to include all potential factors of diarrheal disease. Lastly Multiplex

PCR assay give quick results but at the same time it is not routinely used due to its high cost and availability.

CONCLUSION

The burden of diarrheal disease remains unacceptably high despite of control measures. A number of socio-demographic determinants such as rural-urban residence, lower income, lack of proper sanitation, safe and clean drinking water in household, along with child's age are associated with the risk of diarrhea in under 5 children. The maximum number of cases belonged to lower socio-economic status. Concerning environmental factors such as seasonal variations in specific geographic regions are associated with diarrheal disease with highest prevalence of viral diarrhea occurred during rainy season in current study. Thus focus on comprehensive diarrheal disease control strategy through rapid diagnosis, improved case management and targeted approach should be initiated to attenuate the poor health problem by providing adequate health care among socio-economically disadvantaged women and children and health promotion regarding environmental sanitation and clean drinking water and preventing practices like breastfeeding and research in field of cost-effective interventions to reduce the burden of diarrhea among under 5 year children.

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