

## ORIGINAL ARTICLE

**Diarrhoeal diseases and its relation to WaSH practices and MPN count among under-five children residing in Resettlement colony, Delhi**Risa Vernetta Nengminza Sangma<sup>1</sup>, Sanjeev Kumar Rasania<sup>2</sup>, Joysula Gnani Prasuna<sup>3</sup>, Ranjan Das<sup>4</sup>, Manoj Jais<sup>5</sup>

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**Abstract**

**Background:** Globally, diarrhoeal diseases are the second leading cause of death among under 5 children and India alone accounts for 100,000 lives annually, third highest in the world. In low and middle-income countries, contaminated water has been the major source of diarrhoeal diseases and lack of improper WaSH (Water, Sanitation and Hygiene) practices accounts for 90% of the total death. **Aims and Objective:** To find out the burden of diarrhoea and its relation to WASH practices among children and mothers/care givers and Presumptive Coliform count of drinking water. **Materials and Methods:** A community-based cross-sectional study conducted in Resettlement colony, Delhi. A total of 553 under 5 children were studied after attaining consent from mothers/care givers. MPN count per 100 ml was measured from drinking water storage vessel. **Result:** Prevalence of diarrhoea was found to be 40.70%, being higher among children aged between 13-24 months (57.3%). Out of the total water samples, 37% of samples were unsatisfactory, 36% suspicious and 22% satisfactory. None of the samples were found to be satisfactory. Lack of WaSH practices was observed among mother/care givers. **Conclusion:** Understanding the factors influencing the occurrence of diarrhoeal diseases and drinking water quality will help reduce the burden of diarrhoeal diseases.

**Keywords**

Diarrhoeal Diseases; Under 5; Drinking Water Quality; Presumptive Coliform Count; WaSH Practices

**Introduction**

Diarrhoea is the passage of 3 or more loose or liquid stools per day, or more frequently than is normal for the individual. It is caused by a variety of microorganisms. Infection is spread through contaminated food, drinking-water, or from person to person as a result of poor hygiene. Severe

diarrhoea leads to fluid loss and each episode deprives the child of the nutrition necessary for growth. This may be life-threatening, particularly in young children and people who are malnourished or have impaired immunity (1).

Diarrhoeal diseases are the second leading cause of death among children under 5 years of age and

globally, nearly 1.7 billion cases are reported every year. It is also the leading cause of malnutrition among children (2). In India, according to NFHS 4 report prevalence of diarrhoea among under-5 children is 9.2 percent and there hasn't been any significant reduction in prevalence compared to NFHS 3 report of 9% prevalence (3).

Diarrhoeal disease can spread from person-to-person, aggravated by poor water, sanitation and hygiene practices.

It continues to be a problem of low and middle-income countries and in spite of constant efforts, it still remains a cause of significant morbidity and mortality in developing country like India.

### Aims & Objectives

1. To find out the burden of diarrhoeal morbidity among under 5 children.
2. To assess the relationship of diarrhoeal diseases and WaSH (water, sanitation and hygiene) practices among children and mothers/care givers.
3. To assess the drinking water quality by presumptive coliform count (MPN count)

### Material & Methods

**Study Type:** A community based, cross-sectional study

**Study population:** Children under 5 years of age

**Study Area:** A Resettlement colony in Kalyanpuri, Delhi

**Study duration:** The study was carried out from Jan 2018 to December 2018.

**Sample size:** Sample size has been calculated assuming the Prevalence (p) of diarrhoeal diseases in Urban slums as 14.8% (4), at 95 % confidence interval and relative error of 20%. The sample size came out to be 553 under five age children

Therefore,  $N = \frac{Z(1-\alpha)^2 * p * q}{E^2}$

p =14.8, q= 100-14.8, E=10%, Z(1- $\alpha$ )=1.96

**Inclusion criteria:** All children under 5 years of age residing in five randomly selected blocks of resettlement colony of Kalyanpuri, Delhi, for more than a year. 2. Mothers/care-givers of study subjects who give consent.

**Exclusion criteria:** Children with compromised immune system or with debilitating diseases or both.

**Strategy for collection:** Fifty percent of blocks of the resettlement colony of Kalyanpuri were randomly selected for conducting the study. Approximately, equal number of children were taken from all the five

blocks. The 1st household was selected according to serial number of houses and data was collected until sample size was complete. In households where there were no under 5 children, the next consecutive household was selected. In a household where there was more than one eligible subject then all the eligible subjects were included in the study. Pre tested semi-structured proforma was designed to collect data on prevalence of diarrhoeal diseases by history taking from responsible care-giver. A recall period of 14 days was taken for the study. Information was collected on water related human behaviour viz. water storage, source and availability of water, hand hygiene and sanitation practices. Bacteriological assessment of drinking water based on Presumptive Coliform Count using Multiple Tube Method was conducted using WHO (World Health Organization) standards (5). Houses were selected randomly for bacteriological examination of water.

### Working definition

**Diarrhoea:** The World Health Organisation (6) has defined diarrhoea as the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual). Frequent passage of formed stool is not diarrhoea nor is the passage of loose, pasty stools by breastfed babies. There are three clinical types of diarrhoea:

- Acute watery diarrhoea- lasts several hours or days, and includes cholera
- Acute bloody diarrhoea- also called dysentery and
- Persistent diarrhoea-last 14 days or longer

**Coliform organisms:** The term "total coliforms" refers to a large group of Gram-negative, rod-shaped bacteria that share several characteristics. The group includes thermotolerant coliforms and bacteria of faecal origin, as well as some bacteria that may be isolated from environmental sources (7).

**Classification of samples according to WHO criteria for drinking water** (guidelines for drinking water quality -water sampling and analysis) (5)

Grade	Presumptive count (per 100ml)
Excellent	0
Satisfactory	1-3
Suspicious	4-10
Unsatisfactory	>10

**Ethical approval:** The study has been conducted after the approval given by the Ethical Committee of Lady Hardinge Medical College, New Delhi.

**Consent:** The data was collected only after the consent given by the mother/care-givers of study subjects.

**Data Analysis:** Data was analysed using SPSS version 25. Suitable tests of significance were applied for comparisons whenever required. P-value <0.05 was considered statistically significant.

## Results

Nearly 70.1% of the study subjects belonged to the age group of 0 to 36 months. Mean age of the study subjects was 31 ±16 months. 46.3% of the study subjects were males and 53.7% were females. The overall prevalence of diarrhoeal diseases was found to be 40.70%.

## Discussion

**Prevalence of diarrhoea:** The prevalence of diarrhoea in the resettlement colony was found to be 40.70% which is observed to be three times higher than the prevalence of diarrhoea as reported by NFHS-4 (2015-2016) (3) of 9% [Table 1]. Higher prevalence of diarrhoeal disease was also observed in the study conducted by Balakrishnan Kalakheti et al (8) and Chilambwe M et al (9) in which the prevalence of diarrhoea was found to be 40.2% and 40.5% respectively.

**Water supply and water related storage practices:** The area under study obtained their drinking water supply either from private piped water supply, public piped water supply or drinking water supplied by Delhi Jal Board by water tankers. The piped water supplied to the community, both public and private, was intermittent (6 am in the morning and 6 pm in the evening).

The piped water supply being intermittent, caused inconvenience to the residents living in that area thereby forcing the resident to store water for consumption. This increases the chances of water being contaminated and due to frequent contamination, household water treatment becomes a must (10).

In this study, half (53.5%) of the study subjects who consumed drinking water from public taps were found to be suffering from diarrhoea as compared to those consuming from private taps [Table 2] and the difference of which was found to be statistically significant. Similarly, Metadel Adane et al (11) reported the prevalence of diarrhoea due to intermittent water supply and was found to be 4.8 times higher than where the supply was continuous.

**Sanitation and Hygiene related practices:** The most common practice of defecation among under five children was within the room (63.9%). Open defecation practice was also observed (1.3%) in our study area. Higher prevalence of diarrhoea was observed among children using public latrine or defecating in the open. This could possibly be because in such cases excreta remain open, flies and other vectors sit over the excreta and transmit various enteric pathogens [Table 3]. The presence of these flies and faecal matter on the toilet floor are potential risk factors for diarrhoea and other feco-oral disease transmission. In one of the report, in situ development of Kalyanuri slums Delhi, submitted to Ministry of Housing and elevation by Delhi Urban shelter improvement (published in 2016) (12) also mentions that 40% residents in this resettlement colony resorted to open defecation and 8% had constructed small toilets in their houses. It was also reported that toilets were ill maintained and even the functional toilets had problems like lack of privacy due to absence of door. Open defecation and inadequacy of proper sanitary facilities was directly impacting the health of the residents, including children.

In our study the prevalence of diarrhoea among under five children was found to be the highest when hands were washed with water only (52.5%) [Table 4] after defecation. Interesting finding in this study was that the prevalence of diarrhoea was found to be 37.6% when hands were washed with soap and water which clearly suggest that merely washing hands with soap and water and not rubbing the hands against each other as per six hand washing steps is equivalent to not washing hands at all (the prevalence of diarrhoea when hands were not washed at all was found to be 33.0%) [Table 4]. In our study the results also suggest that the prevalence of diarrhoea was highest among those children whose mother washed their hands only with water (51.6%) [Table 5], after cleaning child's excreta.

Studies conducted by Madhulika et al (13) and Nazia et al (14) suggest that hand washing with soap and water before cooking and eating food leads to decrease in diarrhoeal morbidity. Study conducted by Kumar et al showed that 36.0% reduction of diarrhoeal risk was observed when sanitation interventions were adopted and a reduction of 47.0% was observed when hand-washing with soap was practiced. The practice of handwashing among mothers after cleaning child's excreta has a major

role to play in the occurrence of diarrhoea among under-fives. Studies suggest that practice of hand washing was low among people belonging to low-socioeconomic status. Lack of hand washing among mothers with soap and water were associated with increased risk of diarrhoea (15). In our study, the close association of mothers not washing their hands before preparing food and diarrhoea has been observed. 52.7% of the children were found to be suffering from diarrhoea out of 12.8% of the mothers who did not wash their hands at all, before preparing food [Table 6].

**Relationship of MPN count with diarrhea:** In our study, out of the total 36 children who suffered from diarrhoea, 61.1% of the children were consuming water which was unfit for human consumption [Table 7]. Study conducted by Ayse et al (16) it was observed that in 14% of the water samples, E.coli counts were over the low-risk limit and 3% exceeded the moderate-risk limit.

### Conclusion

Improper WaSH (water, sanitation and hygiene) practices and low socioeconomic status greatly influences the occurrence of diarrhoeal diseases, as was observed in this resettlement colony. Understanding the different factors that influences the occurrence of diarrhoeal diseases and also the quality of drinking water will help reduce its burden. Diarrhoeal diseases are preventable diseases, yet it is still one of the major causes of public health problem. Good sanitation and hygiene practices are still lacking and importance of the same needs to be emphasized.

### Recommendation

WaSH (water, sanitation and hygiene) practices hold a great importance in preventing many diseases including diarrhoea, yet it is one of the most neglected issue by the community. The importance of WaSH practices should be made known with the help of Behaviour Change Programmes on a regular basis.

The Sustainable Development Goal 6 states the importance of clean water and sanitation for achieving good health therefore, sanitary survey of household water storage containers to find out the bacteriological quality of drinking water, method of water treatment required, if any, needs to be performed on a regular basis, for decreasing the burden of diarrhoea.

### Limitation of the study

Microbiological assessment of drinking water quality of all sources neither all household level storage containers could be done because this was a single investigator study.

### Relevance of the study

The findings of this study suggest that diarrhoeal diseases are still prevalent among under 5 children and it is more prevalent in areas where living conditions are compromised due to poor living standards, leading to improper WaSH practices. The prevalence of the disease in such settings are higher than the country's average of 9.20%.

### Authors Contribution

RVNS: Data collection and water quality analysis, data analysis and paper writing. SKR: Data Analysis and critical review. JGP & RD: critical review. MJ: water quality analysis

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**Tables**

**TABLE 1 PREVALENCE OF DIARRHOEA AMONG UNDER FIVE CHILDREN IN RELATION TO WATER RELATED STORAGE PRACTICES**

Water related practices	Total Children (n=559) No. (%)	Children suffered from diarrhoea (n=225)	Prevalence of diarrhoea	Remarks
<b>a). Primary water storage vessel</b>				
Plastic bottles	243 (43.5)	107	44%	x <sup>2</sup> =30.299 d.f=5 p<0.000
Earthen Pitcher	55 (9.8)	10	18.2%	
Plastic Jug	73 (13.1)	37	50.6%	
Plastic cans	112 (20.0)	35	31.3%	
Commercially available containers	45 (8.1)	15	33.3%	
Bucket	31 (5.5)	21	67.7%	
<b>b). Storage vessel covered</b>				
Yes	549 (98.2)	217	39.5%	x <sup>2</sup> =6.6 d.f=1 p<0.01
No	10 (1.8)	8	80%	
<b>Figures in bracket in italic denotes column percentages</b>				

**TABLE 2 PREVALENCE OF DIARRHOEA AMONG UNDER FIVE CHILDREN IN RELATION TO SOURCE AND AVAILABILITY OF WATER SUPPLY**

Sources of water supply	Total children No. (%)	Children suffered with diarrhoea	Prevalence of diarrhoea
Public tap	224 (40.1)	120	53.50%
Private tap	335 (59.9)	105	31.34%
<b>Total</b>	<b>559 (100.0)</b>	<b>225</b>	<b>100%</b>
<b>x<sup>2</sup>=27.5 d.f=1 p&lt;0.00</b>			

**TABLE 3 SANITATION RELATED PRACTICE OF UNDER FIVE CHILDREN WITH DIARRHOEA**

Sanitation related practices of under five children	Total children	Children suffered with diarrhoea	Prevalence of diarrhoea	Remarks
	(n=559)	(n=225)		
	No (%)			
<b>Defecation practice of under five children</b>				
Open defecation	7 (1.3%)	5	71.40%	x <sup>2</sup> =21.5 d.f.=3 p<0.000
Within the room	357 (63.9%)	149	41.70%	
Household latrine	173 (30.9%)	54	31.20%	
Public latrine	22 (3.9%)	17	77.30%	
Figures in bracket in italic denotes column percentages				

**TABLE 4 PREVALENCE OF DIARRHOEA IN RELATION TO HAND WASHING PRACTICE AFTER DEFECACTION IN CHILDREN**

Hand washing practice of under five children	Total children*	Children suffered with diarrhoea (n=123)	Prevalence of diarrhoea	Remarks
	(n=288)			
	No (%)			
No hand washing practice	3 (1.0)	1	33%	x <sup>2</sup> =2.3 d.f.=2
Only with water	99 (34.4)	52	52.50%	p>0.3
With soap and water	186 (64.6)	70	37.60%	
Figures in bracket in italic denotes column percentages *Less than 2 year age children excluded for this analysis				

**TABLE 5 PREVALENCE OF DIARRHOEA IN RELATION TO HAND WASHING PRACTICE OF CARE GIVER AFTER CLEANSING CHILD'S EXCRETA**

Hand washing practice	Total children	Children suffered with diarrhoea	Prevalence of diarrhoea	Remark
	(n=559)	(n=225)		
	No (%)			
With water only	153 (27.4)	79	51.60%	x <sup>2</sup> =11.3 d.f=1
With soap and water	406 (72.6)	146	35.9	p< 0.01
Figures in bracket in italic denotes column percentages				

**TABLE 6 DIARRHOEA AND HAND WASHING PRACTICE OF MOTHER BEFORE PREPARING FOOD**

Hand washing practice	Total children	Children with diarrhoea	Prevalence of diarrhoea	Remarks
	(n=559)	(n=225)		
	No (%)			
No	72 (12.8 %)	39	52.70%	x <sup>2</sup> =9.7 d.f=2
With water only	332 (59.4%)	118	35.50%	p< 0.001
With soap and water	155 (27.9%)	68	43.80%	
Figures in bracket in italic denotes column percentages				

**TABLE 7 RELATIONSHIP OF MPN COUNT WITH DIARRHOEA**

Children suffered with diarrhoea (n=95)	MPN count			Total (n=95)	Remarks
	Satisfactory	Suspicious	Unsatisfactory		
Yes	4 (11.1%)	10 (27.7%)	22 (61.1%)	36	x <sup>2</sup> = 12.5 p<0.02
No	18 (30.5%)	26 (44.1%)	15 (25.4%)	59	