

# Socio-demographic and environmental factors of diarrhoea among under-five children in India

Pintu Paul (✉ [pintupaul383@gmail.com](mailto:pintupaul383@gmail.com))

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## Research article

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# Abstract

**Background** Globally, diarrhoea is a second leading cause of deaths among under-five children and is a major public health problem. Despite several health care initiatives, a large proportion of under-five children are still experienced diarrhoeal diseases causes high mortality in India. This study aims to examine the socio-demographic and environmental factors of diarrhoea among children under-five in India.

**Methods** A cross-sectional study was designed using the recent round of the National Family Health Survey (NFHS), conducted in 2015-16. A total of living children below 5 years of age were utilized for the analysis of this study. Bi-variate and multivariate logistic regression were carried out to investigate the factors of childhood diarrhoea.

**Results** In India, about 9% under-five children experience diarrhoeal disease in the past 2 weeks. Children from rural areas (AOR: 1.05; 95% CI: 1.01, 1.09), Scheduled Tribe (AOR: 0.83; 95% CI: 0.79, 0.89) and others caste (AOR: 0.92; 95% CI: 0.88, 0.97), Muslim (AOR: 1.18; 95% CI: 1.13, 1.24), and from central (AOR: 1.61; 95% CI: 1.52, 1.70) and west region (AOR: 1.08; 95% CI: 1.01, 1.15) were significantly associated with higher likelihood of diarrhoea in past 2 weeks. Furthermore, this study also revealed that child's stool disposal (AOR: 1.06; 95% CI: 0.98, 1.09), floor materials (AOR: 1.08; 95% CI: 1.03, 1.12) and roof materials (AOR: 1.08; 95% CI: 1.04, 1.13) of the household were found to be significant factors of childhood diarrhoea occurrence.

**Conclusions** Diarrhoeal disease remains a serious public health problem in India. The findings of this study suggest strengthening of existing health care programs. Policy intervention should also address socio-economic vulnerabilities of mothers and children to combat the incidence of diarrhoea. In addition, provisioning of sanitation and housing facilities may help positively to control diarrhoeal disease that could eventually reduce the incidence of child mortality.

## Introduction

Childhood diarrhoea is a major public health problem in low- and middle-income countries leading to high morbidity and mortality among under-five children. World Health Organization (WHO) is defined diarrhoeal disease as the passage of three or more loose or liquid stools per day [1]. This preventable disease is a second leading cause of deaths in under-five children. Each year, nearly 1.7 billion cases of childhood diarrhoeal diseases are reported and killed around 525,000 under-five children, accounting for 8% of all deaths worldwide [1]. Most of the deaths from diarrhoea occur among children below 2 years of age. Globally, the episodes of childhood diarrhoea have been decreased by 60% between 2000 and 2017 [1, 2].

Diarrhoeal diseases have detrimental impact on child growth and cognitive development [3]. Diarrhoea is associated with an increased risk of malnutrition in children under 5 years of age [1]. Approximately 90% of diarrhoeal diseases occur in sub-Saharan and South Asian countries [4]. Although India has made

considerable achievement in reducing infant and child mortality over the past 20 years, the episodes of preventable diseases like diarrhoea remain high. According to the National Family Health Survey (NFHS)-4, about 9% under-five children had diarrhoea in the past 2 weeks preceding the survey in 2015-16 [5]. It is also notable that the prevalence of diarrhoea varied substantially across geographical regions of the country from as high as 13.1% in central to as low as 4.2% in northeast region. Pneumonia and diarrhoeal diseases accounted for 50% of all deaths among under-five children in India [6]. The Government of India initiated a number of maternal and child health (MCH) schemes including disease control programs. In 1975, Integrated Child Development Scheme (ICDS) was launched to reduce the incidence of childhood malnutrition, morbidity and mortality by providing supplementary nutrition and vaccination [7].

Many socio-demographic, environmental and behavioural factors are responsible for the occurrence of diarrhoeal disease among under-five children. Important socio-demographic factors include child's age, place of residence, maternal education and household economic condition [8–15]. Environmental factors such as drinking water, sanitation facilities, waste disposal and dwelling characteristics are associated with childhood diarrhoea [11–13, 16, 17]. Furthermore, behavioural factors such as breastfeeding practices, eating habits and washing hand are found significant factors of diarrhoea among under-five children [12, 18, 19].

Despite high reported cases of diarrhoeal diseases, identifying risk factors of childhood diarrhoea is relatively scarce in India compared to other developing countries. Moreover, malnutrition and early childhood mortality are unacceptably high in India. Prevention of diarrhoea is necessary to reduce the incidence of morbidity and mortality among children. In this context, it is imperative to investigate the factors associated with childhood diarrhoea. Therefore, this study aims to examine the socio-demographic and environmental factors of diarrhoeal disease among under-five children in India using nationally representative sample.

## Methods

### Study design

A cross-sectional study was designed using latest round of NFHS, conducted in 2015-16.

### Sample size and procedure

All living under-five children (n = 247,743) were considered as total sample, collected from NFHS-4.

The NFHS-4 is a nationally representative large-scale sample survey carried out across all the states and union territories of India. The samples were selected using a two-stage stratified sampling design comprising of 28,586 clusters; 8,397 in urban, 20,059 in rural areas and 130 slums. The slums were selected from the list provided by Municipal Corporation Offices (MCOs). In the first stage, the clusters were selected using the method of probability proportional to size (PPS). In the second stage, a complete

household mapping and listing was done in the selected cluster and 22 households were randomly chosen in each cluster in a systematic manner from the household listing. The sampling frame used in this survey was the 2011 Indian Population and Housing Census. A detailed description of the sampling design and survey procedure is provided in the NFHS-4 national report [5].

## Outcome variables

The outcome variable of this study is diarrhoea of under-five children. Diarrhoea is defined as having 3 or more loose or watery stools in 24 hours, as reported by the mother/caregiver in the past 2 weeks preceding the survey.

## Explanatory variables

Socio-demographic and environmental characteristics were included for explanatory variables in this study. Socio-demographic characteristics include place of residence (rural and urban), caste (Scheduled Caste/Scheduled Tribe, Other Backward Classes and others), religion (Hindu, Muslim and others), maternal education (illiterate/primary and secondary/above) father's education (illiterate/primary and secondary/above), maternal age (15–24, 25–34 and 35–49 years), maternal body mass index [BMI] (underweight, normal and obese), access to mass media (no and yes), household size (< 6 and 6+), wealth quintile (poorer, poorest, middle, richer and richest), region (north, central, east, northeast, west and south), age of child (0–11, 12–23, 24–35, 36–47 and 48–59 months), sex of child (male and female), birth order (1, 1–3 and 4+) and birth weight (< 2.5 kg [low birth weight] and  $\geq$  2.5 kg [normal]).

Environmental characteristics include availability of toilet facility, sources of drinking water, child's stool disposal, and main floor and roof materials of the household. Any improved, unimproved and shared latrine facility (flush or pit) was considered as household having toilet facility. Sources of drinking water were categorized as improved and improved sources. Improved sources of drinking water include piped water, public taps, standpipes, tube wells and boreholes, protected dug wells and springs, rainwater, and community reverse osmosis plants. Child's stool disposal was grouped into safe and unsafe. Child's stool was considered to be safely disposed, if a child used a toilet or latrine, or put/rinsed into a toilet, or it was buried [5].

## Data analysis

Descriptive statistics were carried out to understand the distribution of socio-demographic and environmental characteristics for the study sample. Prevalence of diarrhoeal disease was estimated by selected explanatory variables. The sample weight was used for the estimation of percentage distribution. Pearson's chi-square tests were used and variables with  $P$ -value < 0.05 were included for further analysis. Bi-variate and multivariate logistic regression models were employed to assess the socio-demographic and environmental factors associated with diarrhoea among under-five children. The regression results were presented by unadjusted and adjusted odds ratios (ORs) with 95% confidence interval (CIs) and the results were considered to be statistically significant at  $p < 0.05$ . All the statistical analyses were performed using STATA version 14.0 (StataCorp LP, College Station, TX, USA).

## Results

### Socio- demographic characteristics

A total of 247,743 living children aged 0–59 months were included for the analysis of this study. Most of children were lived in rural areas (71.6%), affiliated to Hindu (78.6%), economically poor (24.9% in poorest wealth quintile and 21.8% in poorer wealth quintile) and from central and east region of the country. About 43.5% mothers had below secondary level of education, while it was 31.6% for fathers. About 57.7% of mothers were in the age range of 25–34 years and nearly one-fourth (24.8%) of them were underweight. About one-third (34.3%) mothers were not exposed to mass media. Children were almost equally distributed in all age groups. Among total children, 52.1% were male, 47.5% were in the birth order of 2–3, and 17.7% had low birth weight.

### Environmental condition of household

Around 46.5% children had no toilet facility and 10% were drinking water from unimproved sources. More than one-third (65.9%) child stool disposal were not safe. About 43.2% houses of children were made of dirty floor materials and 14% of houses had thatch roof materials (Table 1).

Table 1  
Socio-demographic characteristics and environmental condition  
of living children aged 0–59 years in India, 2015–16

<b>Variables</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
Place of residence		
Urban	59,222	28.5
Rural	188,521	71.6
Caste		
Scheduled caste	46,486	22.4
Scheduled Tribe	49,804	11.0
Other Backward Classes	97,011	46.1
Others	43,329	20.5
Religion		
Hindu	178,712	78.6
Muslim	39,004	16.6
Others	30,027	4.9
Maternal education		
Illiterate/primary	112,129	43.5
Secondary and above	135,614	56.5
Father's education		
Illiterate/primary	13,864	31.6
Secondary and above	29,151	68.4
Maternal age in years		
15–24	80,714	34.9
25–34	142,212	56.7
35–49	24,817	8.4
Maternal BMI		
Underweight	57,793	24.8
Normal	152,834	60.4

<b>Variables</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
Obese	33,876	14.8
Access to mass media		
No	91,357	34.3
Yes	156,386	65.7
Household size		
< 6	104,964	43.3
6+	142,779	56.8
Wealth quintile		
Poorest	64,443	24.9
Poorer	58,294	21.8
Middle	49,588	19.9
Richer	41,472	18.4
Richest	33,946	15.1
Region		
North	46,775	13.2
Central	70,915	26.5
East	51,507	25.4
Northeast	35,761	3.5
West	17,706	12.9
South	25,079	18.4
Age of child in months		
0-11	48,295	19.3
12-23	49,284	20.0
24-35	49,084	19.8
36-47	51,497	20.9
48-59	49,583	20.0
Sex of child		
Male	128,609	52.1

Variables	Frequency (n)	Percentage (%)
Female	119,134	47.9
Birth order		
1	91,872	38.6
2–3	116,467	47.5
4+	39,404	13.9
Birth weight		
Low birth weight	31,928	17.7
Normal	155,254	82.4
Availability of toilet facility		
No facility	103,755	46.5
Facility	130,525	53.5
Sources of drinking water		
Unimproved	29,084	10.0
Improved	205,107	90.0
Child stool disposal		
Safe	83,545	34.1
Not safe	160,790	65.9
Main floor material		
Dirt	107,786	43.2
Non-dirt	126,668	56.9
Main roof material		
Thatch	32,407	14.0
Metal/concrete	193,533	86.0

## Prevalence of childhood diarrhoea by socio-demographic factors

The prevalence of diarrhoea was significantly higher among rural children than those living in urban areas (9.6 vs. 8.2%) ( $p = 0.001$ ). Childhood diarrhoea was also higher among Scheduled Caste (9.6%) and Other Backward Classes (9.6%) and those children belonged to Muslim religion (9.9%). Children's

experience of recent diarrhoea was also differed by maternal educational level ( $p < 0.001$ ). However, father's education had no significant variation with children's diarrhoea ( $p = 0.950$ ). The occurrence of diarrhoea was substantially higher among those children whose mothers were in 15–24 years (10.7%), underweight (10.1%) and had no access to mass media (10.3%). Childhood diarrhoea was also higher among children from poorest wealth quintile (10.2%) and those from central region of the country (13.1%). Furthermore, prevalence of diarrhoeal disease was more common among children aged 0–11 months (14.0%) and 12–23 months (13.4%), male children (9.5%), birth order with more than 3 (10.4%) and children with low birth weight (10.2%) (Table 2).

Table 2  
Prevalence of diarrhoeal disease by socio-economic and demographic characteristics of respondents in India, 2015–16

<b>Socio-economic and demographic characteristics</b>	<b>Prevalence (%)</b>	<b>P-value</b>
Place of residence		0.001
Urban	8.2	
Rural	9.6	
Caste		0.000
Scheduled Caste	9.6	
Scheduled Tribe	8.1	
Other Backward Classes	9.6	
Others	8.8	
Religion		0.000
Hindu	9.2	
Muslim	9.9	
Others	7.3	
Maternal education		0.000
Illiterate/primary	9.6	
Secondary and above	8.8	
Father's education		0.950
Illiterate/primary	9.6	
Secondary and above	9.2	
Maternal age in years		0.000
15–24	10.7	
25–34	8.5	
35–49	8.0	
Maternal BMI		0.000
Underweight	10.1	
Normal	9.2	

<b>Socio-economic and demographic characteristics</b>	<b>Prevalence (%)</b>	<b>P-value</b>
Obese	8.1	
Access to mass media		0.000
No	10.3	
Yes	8.6	
Household size		0.519
< 6	9.08	
6+	9.28	
Wealth quintile		0.000
Poorest	10.2	
Poorer	9.5	
Middle	9.3	
Richer	8.5	
Richest	7.8	
Region		0.000
North	8.1	
Central	13.1	
East	8.7	
Northeast	4.2	
West	8.5	
South	6.5	
Age of child in months		0.000
0–11	14.0	
12–23	13.4	
24–35	8.5	
36–47	5.8	
48–59	4.6	
Sex of child		0.000
Male	9.5	

Socio-economic and demographic characteristics	Prevalence (%)	P-value
Female	8.9	
Birth order		0.000
1	8.7	
2-3	9.2	
4+	10.4	
Birth weight		0.000
Low birth weight	10.2	
Normal	8.6	

## Childhood diarrhoea by environmental condition

Childhood diarrhoea was found to be considerably higher among the children of household who had no toilet facility compared to those whose household had toilet facility (10.0 vs. 8.3%). Surprisingly, proportion of children's diarrhoea was higher among the children of household consumed improved sources of drinking water than those children whose household consumed unimproved sources of drinking water (9.2 vs. 8.0%). Household's unsafe child stool disposal had higher prevalence of diarrhoea among children (10.0%). The occurrence of diarrhoea was substantially higher among the children living in houses with dirt floor (10.3%) and thatch roof materials (10.4%) (Table 3).

Table 3  
Prevalence of diarrhoeal disease by environmental condition  
of respondents in India, 2015–16

Environmental characteristics	Prevalence (%)	P-value
Availability of toilet facility		0.000
No facility	10.0	
Facility	8.3	
Sources of drinking water		0.000
Unimproved	8.0	
Improved	9.2	
Child stool disposal		0.000
Safe	7.7	
Not safe	10.0	
Main floor material		0.000
Dirt	10.3	
Non-dirt	8.2	
Main roof material		0.000
Thatch	10.4	
Metal/concrete	8.8	

## Socio-demographic factors of diarrhoea among under-five children

In bi-variate analysis, it is found that all the selected socio-demographic factors were significantly associated with children's diarrhoea in the past 2 weeks. Multivariate analysis of this study revealed that children living in rural areas were associated with 5% higher likelihood of diarrhoeal disease (AOR: 1.05; 95% CI: 1.01, 1.09) than those children from urban areas. Children belonged to Scheduled Tribe (AOR: 0.83; 95% CI: 0.79, 0.89) and others caste group (AOR: 0.92; 95% CI: 0.88, 0.97) were less likely to develop diarrhoea compared to Scheduled Caste children. The likelihood of childhood diarrhoea was 18% higher among Muslim children (AOR: 1.18; 95% CI: 1.13, 1.24) compared to children from Hindu religion. Children of mothers who had secondary and above level of education were associated with 9% decreased odds of diarrhoea (COR: 0.92; 95% CI: 0.88, 0.97) compared to those mothers who had no formal education or had primary level of education in crude analysis. However, this association was not significant in the adjusted analysis.

Unadjusted analysis of this study also found that the likelihood of childhood diarrhoea was decreased with increase in maternal age. Children of mothers aged 25–34 years (COR: 0.77; 95% CI: 0.75, 0.80) and 35–49 years (COR: 0.73; 95% CI: 0.69, 0.77) were less likely to suffer from diarrhoeal disease than those children of mothers aged 15–24 years. Maternal BMI also had a significant association with children's diarrhoea occurrence in unadjusted analysis. Children of underweight women (COR: 1.11; 95% CI: 1.08, 1.15) were 11% more likely and children of obese women (COR: 0.87; 95% CI: 0.83, 0.91) were 13% less likely to develop diarrhoea compared to children of mothers who had normal BMI. The results also revealed that access of mass media of women was found to be a protective factor against childhood diarrhoea. Children of women who had mass media exposure were associated with 18% decreased odds (COR: 0.82; 95% CI: 0.80, 0.95) of diarrhoea than those women who were not exposed to mass media. Wealth status of household was found to have a strong association with childhood diarrhoea. Children in richest wealth quintile were 26% lower likely to have diarrhoea compared to those children in poorest wealth quintile (COR: 0.74; 95% CI: 0.71, 0.78). The occurrence of diarrhoea was also varied across geographical regions. After adjusting for socio-demographic and environmental characteristics, children from central region (AOR: 1.61; 95% CI: 1.52, 1.70) and western region (AOR: 1.08; 95% CI: 1.01, 1.15) were more likely and children from northeast region (AOR: 0.49, 95% CI: 0.43, 0.56) and southern region (AOR: 0.80, 95% CI: 0.75, 0.85) were less likely to experience diarrhoea compared to children from northern region.

The risk of diarrhoea was decreased by 4–71% in children aged 12–23 (AOR: 0.96; 95% CI: 0.92, 1.00), 24–35 (AOR: 0.58; 95% CI: 0.55, 0.61), 36–47 (AOR: 0.39; 95% CI: 0.37, 0.41) and 48–59 months (AOR: 0.29; 95% CI: 0.28, 0.31) compared to those children aged 0–11 months. Female children were associated 8% decreased odds of diarrhoea (AOR: 0.92; 95% CI: 0.89, 0.95) than the male children. Higher birth order was associated with an increased risk of diarrhoea among under-five children. The odds of diarrhoeal disease was increased by 22% in 4 or higher birth order children (COR: 1.22; 95% CI: 1.17, 1.27) compared to first birth order children. Low birth weight was also increased the risk of diarrhoea by 19% (COR: 1.19; 95% CI: 1.15, 1.24) compared to children with normal birth weight (Table 4).

Table 4

Bivariate and multivariate logistic regression analysis of factors associated with childhood diarrhoea in India, 2015–16

Characteristics	Crude OR	95% CI		Adjusted OR	95% CI	
Place of residence						
Urban	1.00			1.00		
Rural	1.18*	1.14	1.22	1.05*	1.01	1.09
Caste						
Scheduled Caste	1.00			1.00		
Scheduled Tribe	0.83*	0.78	0.87	0.83*	0.79	0.89
Other Backward Classes	1.00	0.96	1.04	0.97	0.93	1.01
Others	0.91*	0.87	0.95	0.92*	0.88	0.97
Religion						
Hindu	1.00			1.00		
Muslim	1.09*	1.05	1.13	1.18*	1.13	1.24
Others	0.79*	0.73	0.85	1.07	0.99	1.16
Maternal education						
Illiterate/primary	1.00			1.00		
Secondary and above	0.91*	0.88	0.93	1.01	0.98	1.05
Maternal age in years						
15–24	1.00			-	-	-
25–34	0.77*	0.75	0.80	-	-	-
35–49	0.73*	0.69	0.77	-	-	-
Maternal BMI						
Underweight	1.11*	1.08	1.15	-	-	-
Normal	1.00			-	-	-
Obese	0.87*	0.83	0.91	-	-	-
Access to mass media						

\*  $p < 0.05$ ; OR = Odds ratio; CI = Confidence interval.

Characteristics	Crude OR	95% CI		Adjusted OR	95% CI	
No	1.00			1.00		
Yes	0.82*	0.80	0.85	0.98	0.94	1.02
Wealth quintile						
Poorest	1.00					
Poorer	0.92*	0.88	0.96	-	-	-
Middle	0.90*	0.86	0.93	-	-	-
Richer	0.82*	0.78	0.85	-	-	-
Richest	0.74*	0.71	0.78	-	-	-
Region						
North	1.00			1.00		
Central	1.71*	1.63	1.79	1.61*	1.52	1.70
East	1.09*	1.03	1.14	1.02	0.97	1.08
Northeast	0.49*	0.44	0.55	0.49*	0.43	0.56
West	1.05	0.99	1.11	1.08*	1.01	1.15
South	0.79*	0.75	0.83	0.80*	0.75	0.85
Age of child in months						
0–11	1.00			1.00		
12–23	0.95*	0.92	0.99	0.96*	0.92	1.00
24–35	0.57*	0.55	0.60	0.58*	0.55	0.61
36–47	0.38*	0.36	0.40	0.39*	0.37	0.41
48–59	0.30*	0.28	0.31	0.29*	0.28	0.31
Sex of child						
Male	1.00			1.00		
Female	0.93*	0.91	0.96	0.92*	0.89	0.95
Birth order						
1	1.00			1.00		
2–3	1.07*	1.03	1.10	1.01	0.98	1.05
* $p < 0.05$ ; OR = Odds ratio; CI = Confidence interval.						

Characteristics	Crude OR	95% CI		Adjusted OR	95% CI	
4+	1.22*	1.17	1.27	1.02	0.97	1.07
Birth weight						
Low birth weight	1.19*	1.15	1.24	-	-	-
Normal	1.00			-	-	-
Availability of toilet facility						
No facility	1.00			1.00		
Facility	0.82*	0.80	0.84	0.97	0.94	1.02
Sources of drinking water						
Unimproved	1.00			1.00		
Improved	1.17*	1.12	1.24	1.03	0.98	1.09
Child stool disposal						
Safe	1.00			1.00		
Not safe	1.32*	1.28	1.36	1.06*	1.02	1.11
Main floor material						
Dirt	1.28*	1.25	1.32	1.08*	1.03	1.12
Non-dirt	1.00			1.00		
Main roof material						
Thatch	1.21*	1.16	1.25	1.08*	1.04	1.13
Metal/ concrete	1.00			1.00		
* $p < 0.05$ ; OR = Odds ratio; CI = Confidence interval.						

## Environmental factors of diarrhoea among under-five children

Crude analysis showed that children whose households had toilet facility were associated with 18% lower likelihood of diarrhoeal disease (COR: 0.82; 95% CI: 0.80, 0.84) than those children who had no toilet facility in their house. Surprisingly, children whose households having improved sources of drinking water were associated with higher odds of diarrhoea (COR: 1.17; 95% CI: 1.12, 1.24) compared to those households having unimproved sources of drinking water. Child's unsafe stool disposal was associated with an elevated risk of diarrhoea (AOR: 1.06; 95% CI: 1.02, 1.11) compared to safe disposal of child stool. Children from households having dirt floor materials were associated with 8% higher likelihood of

diarrhoea (AOR: 1.08; 95% CI: 1.03, 1.12) compared to those whose households had non-dirt floor materials. Similarly, children of houses having thatch roof materials were 8% more likely to experience diarrhoeal disease (AOR: 1.08; 95% CI: 1.04, 1.13) than those children from houses with metal or concrete roof materials (Table 4).

## Discussion

The present study has examined socio-demographic and environmental factors of diarrhoea among under-five children in India. Although the prevalence of childhood diarrhoea has reduced over recent past, the burden of this preventable disease remains high.

The findings of this study reveal that children from rural areas were more likely to experience diarrhoea than those from urban areas. This finding is in the line of previous studies conducted in India [13] and Jamma district of Ethiopia [17]. This could be due to limited healthcare and sanitation facilities in rural areas [17]. Caste and religion were significantly associated with childhood diarrhoeal disease. This present study found that children from Scheduled Tribe and others caste group were found to be associated with lower risk of diarrhoea compared with those from Scheduled Caste. This finding is consistent with a study done in India [13]. Moreover, Muslim children were 18% more likely to develop diarrhoeal disease compared to Hindu children. This might be due to Scheduled Caste and Muslim children have lower access to improve sources of drinking water and sanitation facilities than the other group of children.

From maternal characteristics, maternal education and access to mass media were included in the multivariate analysis and none of these variables were found significant. However, crude analysis of this study showed that all maternal factors were significantly determined diarrhoea among under-five children. For instance, women's secondary and higher level of education was associated with 9% lower likelihood of diarrhoea among children compared to those who had no education or primary level of education. Similar finding also reported in other studies conducted in Bangladesh [9] and different parts Ethiopia [8, 11, 14]. This could be explained by hygiene practices, child feeding and caring practices, and of improved living conditions of an educated mother [14]. Furthermore, this study also found that underweight mothers were associated with 11% increased risk of diarrhoea in children. Children born to underweight women may also be malnourished and have weak immune system. Therefore, they are highly susceptible to infectious diseases including diarrhoea. Mass media exposure of women was found to be a protective factor of diarrhoea. The women who had access to mass media were associated with 18% reduced risk of diarrhoea among children under 5 years in unadjusted analysis.

Crude analysis of this study also indicated that wealth status of household was significantly associated with children's recent diarrhoea occurrence. The present study revealed that diarrhoea prevalence was reduced by 26% in children from richest wealth quintile compared to those from poorest wealth quintile. Similar finding is also found in earlier studies conducted in India [13] and other developing countries [9, 20]. Wealth quintile variable was excluded from the multivariate analysis due to the fact that household

wealth was measured from a number of consumer items, drinking water and sanitation facilities including dwelling characteristics. Many of these characteristics were included in the multivariate analysis as environmental factors.

Geographical region also made significant variations in the prevalence of diarrhoeal diseases. The present study indicated that children from central region were 61% and west region were 8% more likely to experience diarrhoea compared to southern region. In contrast, children from northeast region were 51% and south region were 20% less likely to develop diarrhoea among under-five children. Geographical differences in diarrhoeal disease also reported in a study done in India [21]. This could be due to unequal access to healthcare and inequity in provisioning of drinking water and sanitation facilities.

This study found that the risk of diarrhoea was decreased by 43–70% among children aged 24 to 59 months compared to infants (children aged 0–11 months). Similar finding is also reported in a study done in Bangladesh [9]. Likewise, a study carried out in Jamma district of Ethiopia found that the likelihood of developing diarrhoea was more than twice among children aged 6 to 23 months compared to children aged 2 years or above [17]. This is because in the infant age, children are exposed to different contaminated agents leading to infectious diseases while crawling and walking [14]. Female children were found to have 8% reduced risk of diarrhoea than male children. A study conducted of Bangladesh also revealed that male children had higher odds of diarrhoea than the female children [9].

Among environmental factors, child's stool disposal, floor and roof materials of household were significantly associated with diarrhoea among under-five children in multivariate analysis. In agreement with previous research [11], the current study also revealed that unsafe disposal of child stool was associated with 6% increased likelihood of diarrhoea compared to safe stool disposal of children. This might be due to disposed child stool contaminated the water storage that may cause diarrhoeal diseases. The odds of having diarrhoea was 8% higher among children from households with dirt floor materials compared to those from households with non-dirt floor materials. This finding is consistent with other studies conducted in Ethiopia [8, 10, 11, 17]. Similarly, the risk of developing diarrhoeal disease was 8% higher among children from households having thatch roof materials than those from household having metal or concrete roof materials. This finding is also in the line of other studies conducted in Ethiopia [16]. This could be due to dirty floor and thatch roof materials of dwelling causes transmission of pathogens, which may increase the risk of diarrhoeal diseases [8].

## Limitations and strengths

The current study findings should be discussed in the light of some limitations. This study used cross-sectional data. Therefore, this study was unable to assess cause-effect relationship in the analysis. Further research is needed using longitudinal data to examine the potential pathways for the occurrence of diarrhoea among children. Most of the information used for the analysis in this study was self-reported. Therefore, the data are prone to recall bias. This present study could not include the other important factors of diarrhoea, mainly behavioural factors due to paucity of data.

Besides the above limitations, this study provides comprehensive evidence on the factors of diarrhoeal disease among under-five children using large-scale survey in India. This study was utilized large number of sample with nation-wide representation. This study is important for public health intervention to reduce the burden of diarrhoeal disease among children.

## Conclusions

The present study has identified a number of socio-demographic and environmental factors of diarrhoeal disease among under-five children in India. The findings of this study reveal that rural-urban residence, caste, religion, region, child's age and sex were significantly associated with diarrhoea occurrence of children. The prevalence of diarrhoea was significantly higher among rural, Scheduled Caste, Muslim and poor children. Among environmental factors, child's stool disposal, main floor and roof materials were significant factors of diarrhoea even after controlling for socio-demographic characteristics. Unsafe stool disposal, dirt floor and thatch roof materials of household were increased the risk of diarrhoea among under-five children. This study has several important policy implications to combat the incidence of diarrhoeal disease and eventually early childhood mortality. The findings of this study suggest that interventions should be made in improving MCH to reduce the burden of diarrhoeal disease among under-five children. Targeted approach should be initiated to mitigate the problem of poor health status of children by providing adequate health care among socio-economically disadvantaged women and children. In addition, the current study also recommends that policy-maker and stakeholder should address adverse environmental condition by provisioning of latrine and housing facilities.

## Abbreviations

AOR: Adjusted odds ratio; BMI: Body mass index; CI: Confidence interval; COR: Crude odds ratio; ICDS: Integrated Child Development Scheme; MCH: Maternal and child health; MCOs: Municipal Corporation Offices; NFHS: National Family Health Survey; PPS: Probability proportional to size; WHO: World Health Organization

## Declarations

### Ethical approval and consent to participate

The present used secondary data which is available in public domain. The dataset has no identifiable information of the survey participants. Therefore, no ethical approval is required for conducting this study.

### Consent for publication

Not applicable

### Availability of data and materials

The dataset analysed during the current study are available in the Demographic Health Surveys (DHS) repository, <https://dhsprogram.com/data/available-datasets.cfm>.

### **Competing interests**

The author declares no competing interests.

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### **Authors' contributions**

PP conceptualized and designed the study, gathered and analysed the data and wrote the manuscript.

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### **Authors' information**

The author is currently pursuing Ph.D. at the Centre for the Study of Regional Development, Jawaharlal Nehru University, New Delhi. His current research interests include child marriage, public health, nutrition, epidemiology and gender. The author published research articles in various public health journals. He received his M.A. and M.Phil. degree in Geography from Jawaharlal Nehru University, New Delhi.

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