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**RISK FACTORS ASSOCIATED WITH ACUTE DIARRHOEA AMONG CHILDREN UNDER FIVE YEARS OF AGE IN NORTHERN INDIA**

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**Abstract**

Diarrhoea is a common cause of morbidity and a leading cause of death among children aged less than five years, particularly in low and middle income countries. The study was aim to find out the socio demographic, environmental and behavioural determinants of acute diarrhoea among children under five years of age in Northern India. Community-based case control study was carried out at Tertiary care Centre between 2011 to 2013. Data collected from 355/ 150 cases and control respectively using structured and pre-tested questionnaire, entered into a computer, edited and analysed using SPSS version 16.0. Stepwise logistic regression model was used to calculate the Odds ratios and 95% confidence interval for the different risk factors. The study revealed that the occurrence of diarrhoea was significantly associated with children whose mothers were housewife (OR=2.94, 95%CI=1.32-6.52,  $p<0.01$ ). The tap water as a source of drinking was significantly associated with the risk of diarrhoea (OR=0.55, 95%CI= 0.28-1.05,  $p=0.01$ ), diarrhoea was more in those store drinking water. The risk was lower among those in whom the toilet facility was available within the house (OR=0.04, 95%CI=0.02-0.08,  $p<0.001$ ). The risk of diarrhoea was lower among those who had good hygienic practices and literate. Diarrhoea was more who live in rural area than urban. Bottle fed children have more risk. As diarrhoea morbidity is major problem among under-five children, continuous, regular and targeted hygiene education programs are very essential in order to bring about behavioural change and reduce the risk of childhood diarrhoeal morbidity.

**Keywords:** Acute diarrhoea, Case control study, Children, India

**Introduction**

Diarrhoea remains the second leading cause of death among children under five globally. It kills more young children than AIDS, malaria and measles combined (UNICEF/WHO, 2009). Nearly one in five child deaths about 1.5 million each year is due to diarrhoea (WHO/UNICEF, 2012) The burden of Diarrhoeal disease disproportionately affects young children in low and middle-income countries who have higher incidence rates due to inadequate water and sanitation and nutritional risk factors, such as suboptimal breastfeeding, zinc and vitamin A deficiency (Christa L Fischer Walker *et al.*, 2012). Worldwide, 780 million individuals lack access to improved drinking water and 2.5 billion lack improved sanitation (CDC, 2013). Diarrhoea is usually a symptom of an infection in the intestinal tract, which can be caused by a variety of bacterial, viral and parasitic organisms (WHO,1999 and Nyantekyi A *et al.*, 2010) Infection is spread through contaminated food or drinking water, or from person to person as a result of poor hygiene (Godana W *et al.*, 2013).

Diarrhoea is defined as the passage of loose or watery stools at least three times a day, characterised by increase in volume, fluidity or frequency of bowel movement relative to the usual pattern for a particular person. There are three clinical syndromes of diarrhoea: (i) acute watery diarrhoea, lasting less than 14 days; (ii) bloody diarrhoea; and (iii) persistent diarrhoea, lasting at least 14 days (Shimelis D, 2008). As immune systems are progressively compromised with each bout of diarrhoea related illnesses indirectly kill millions more (Jill W *et al.*, 2010). The occurrence of childhood diarrhoea are significantly associated with such responsible factors are as quality and quantity of water availability, latrine utilization, family size, educational status, financial status, feeding habits, drinking water conditions, sanitary and hygiene condition around the residential place. Environmental, behavioural, nutritional, socioeconomic and demographic factors may affect directly and indirectly. The aim of the study was to find out the socio demographic, environmental and behavioural determinants of acute diarrhoea among children less than five years of age in Northern India.

## Methods

### Study setting and duration

All cases enrolled in the study were the children less than five years of age suffering from diarrhoea admitted to Tertiary care centre, Lucknow between the periods of May 2011 to May 2013.

### Study design

A Community based case-control study was performed. A case was defined as a child less than 5 years of age having three or more loose, liquid, or watery stools within the last 24 hours included in the study. Control subjects included individuals of same age group presenting to paediatrics OPD at tertiary care centre, Lucknow for routine health check-up visits and minor illnesses not including diarrhoea. The sample collection was performed with the consent of the children's parent or guardian and was approved by the bioethical committee of the faculty of Medical Sciences, King George's Medical University, Lucknow, U.P. Face-to-face interviews based on the questionnaire were conducted with mothers on the day of admission. Information on households' socio-demographic, environmental and behavioural characteristics was collected using structured, pre-tested questionnaire by trained data collectors. Stool samples were collected from all cases immediately after their admission, then send to Laboratory for processing of enteropathogens. The univariate and multivariate logistic regression analysis was carried to find out the risk factors for incidence of diarrhoea.

### Study Variables

The primary outcome variable was the occurrence of diarrhoea in the period preceding data collection. The independent variables included socio-demographic (residence, family size, occupation, educational status, child age, gender and locality), environmental (Source of drinking water, Storage of drinking water, Toilet facility in home) and behavioural (Hygiene practices, Child feeding habit and immunization).

Some variables are defined: Water from protected springs and/or wells, from pipe and from distribution post was considered as improved source. Disposal of child's stool was considered proper if the stool was put into the latrine or buried. Hand washing before eating, after toilet, after feeding children was considered good hygienic practices. Logistic regression analysis was performed separately for three variables estimated the effect on socio-demographic, environmental, and behavioural factors.

### Data Analysis

All data were analysed using SPSS v.16 (Chicago Inc, USA) Statistical software. Data were collected using structured and pre-tested questionnaire, entered into a computer, edited and analysed. The results are presented in mean  $\pm$ SD and percentages. The univariate and multivariate logistic regression analysis was carried to find out the risk factors for incidence of diarrhoea. The unadjusted odds ratio (OR) and its 95% confidence interval (CI) was calculated as well as adjusted OR. The p-value <0.05 was considered significant.

## Results

A total of 355 cases and 150 matched controls included in the study. In this study, 57.7% (205/355) were males and 63.3% (225/355) children were <2 year of age. The average no. of days since onset of diarrhoea was 5.34(4.64).

**Risk factors for diarrhoea:** Risk factors for the diarrhoea is analysed by Univariate and Multivariate logistic regression methods.

### Univariate logistic regression analysis:

#### Socio-demographic Characteristics

The incidence of diarrhoea was higher among those children whose mothers were illiterates (55.2%) than literate (44.8%). There was 13% lower risk of diarrhoea among literates than illiterates (OR=0.87, 95%CI=0.59-1.28, p=0.508), however, this was statistically insignificant. The risk of diarrhoea was significantly higher among the children whose mothers were housewife (OR=2.94, 95%CI=1.32-6.52, p<0.01). There was no effect of family size in the risk of diarrhoea (p>0.05). The risk of diarrhoea was higher among younger children and this was statistically significant. Males were more affected than females (OR=1.78, 95%CI=1.21-2.62, p<0.01), Risk of diarrhoea was less in whom live in urban area than rural area. (OR=0.62, 95%CI=0.42-0.91, p=0.01) (Table 1).

**Table 1. Socio-demographic factors associated with the incidence of diarrhoea**

Factors	Cases No. (%)	Controls No. (%)	OR (95%CI), p-value
<b>Maternal Education</b>			
Literate	159 (44.8%)	72 (48.0%)	0.87 (0.59-1.28), 0.508
Illiterate	196 (55.2%)	78 (52.0%)	1.00 (Ref.)
<b>Occupation</b>			
Housewife	343 (96.6%)	136 (90.7%)	2.94 (1.32-6.52), 0.006*
Working	12 (3.4%)	14 (9.3%)	1.00 (Ref.)
<b>Family size</b>			
<5	81 (22.8)	29 (19.3)	1.23 (0.76-1.98), 0.38
$\geq$ 5	274 (77.2)	121 (80.7)	1.00 (Ref.)
<b>Child Age in years</b>			
<6	47 (13.2)	6 (4.0)	1.00
6-11	86 (24.2)	47 (31.3)	0.23 (0.09-0.58), 0.002*
12-23	92 (25.9)	42 (28.0)	0.28 (0.11-0.70), 0.007*
$\geq$ 24	130 (36.6)	55 (36.7)	0.30 (0.12-0.74), 0.01*
<b>Gender</b>			
Male	205 (57.7%)	65 (43.3%)	1.78 (1.21-2.62), 0.003*
Female	150 (42.3%)	85 (56.7%)	1.00 (Ref)
<b>Locality</b>			
Urban	212 (59.71%)	72	0.62 (.42-.91), 0.01*
Rural	143	73	1.00 (Ref)

OR-Odds Ratio, CI-Confidence Interval, Ref-Reference category, \*Significant

### Environmental factors associated with diarrhoea

Statistically significant association was found between childhood diarrhea and sources of water (Tap) (OR=0.55, 95%CI=

0.28-1.05,  $p=0.01$ ), toilet facility available within the house ( $OR=0.04$ ,  $95\%CI=0.02-0.08$ ,  $p<0.001$ ), and those store drinking water ( $OR=2.01$ ,  $95\%CI=1.32-3.05$ ,  $p<0.01$ ) (Table 2).

**Table 2. Environmental factors associated with the incidence of diarrhoea**

Factors	Cases No. (%)	Controls No. (%)	OR (95%CI), p-value
<b>Source of drinking water</b>			
Tap	172 (48.5)	95 (63.3)	0.55 (0.28-1.05), 0.01*
Hand pump	137 (38.6)	41 (27.3)	1.02 (0.50-2.03), 0.96
Other	46 (13.0)	14 (9.3)	1.00 (Ref)
<b>Toilet facility in house</b>			
Yes	25 (7.0)	92 (61.3)	0.04 (0.02-0.08), 0.0001*
No	330 (93.0)	58 (38.7)	1.00 (Ref)
<b>Store drinking Water</b>			
Yes	205(57.74%)	110(73.3%)	2.01(1.32-3.05) .001*
No	150 (42.2%)	40 (26.6%)	1.00 (Ref)

OR-Odds Ratio, CI-Confidence Interval, Ref-Reference category, \*Significant

**Table 3. Behavioural factors associated with the incidence of diarrhoea**

Factors	Cases No. (%)	Controls No. (%)	OR (95%CI), p-value
<b>Hygienic practices</b>			
<b>Hand washing before eating with soap</b>			
Yes	91 (25.6)	130 (86.7)	0.05 (0.03-0.08), 0.0001*
No	264 (74.4)	20 (13.3)	1.00 (Ref)
<b>Hand wash after defecating with soap</b>			
Yes	125 (35.2)	106 (70.7)	2.00 (1.28-3.13), 0.002*
No	230 (64.8)	44 (29.3)	1.00 (Ref)
<b>Hand washing after cleaning infant faeces</b>			
Yes	109 (30.7)	114 (76.0)	0.14 (0.09-0.21), 0.0001*
No	246 (69.3)	36 (24.0)	1.00 (Ref)
<b>Bottle Feeding habit</b>			
Yes	209	113	2.13(1.39-3.27) 0.001*
No	146	37	
<b>Immunization</b>			
Yes	192(54.08%)	106 (70.66%)	2.77(1.54-4.99) 0.001*
No	163	44	

OR-Odds Ratio, CI-Confidence Interval, Ref-Reference category, \*Significant

#### Behavioural factors associated with diarrhoea

The acute childhood diarrhoea had significant associations with feeding habit of children, hand washing practices, and Immunization. Children had high risk who were bottle fed ( $OR=2.13$ ,  $95\%CI=1.39-3.27$ ,  $p<0.01$ ), not immunized ( $OR=2.77$ ,  $95\%CI=1.54-4.99$ ,  $p<0.01$ ) and poor hand washing practices (Table 3).

#### Multivariate logistic regression analysis

From the total variables entered in multivariate logistic regression following were found to have significant association with the diarrhoea (Table 4).

**Table 4. Significance factors associated with the incidence of diarrhoea**

Factors	Adjusted OR	95%CI		p-value
		Lower	Upper	
<b>Occupation of mother</b>				
Housewife	3.54	1.04	12.04	0.04*
Working	1.00 (Ref.)			
<b>Child Age in years</b>				
<6	1.00 (Ref.)			
6-11	0.10	0.03	0.38	.001*
12-23	0.17	0.05	0.65	.009*
≥24	0.10	0.03	0.38	.001*
<b>Source of drinking water</b>				
Tap	0.30	0.13	0.71	.006*
Hand pump	0.29	0.11	0.77	.013*
Other	1.00 (Ref.)			
<b>Hand washing before eating with soap</b>				
Yes	0.05	0.03	0.10	0.0001*
No	1.00 (Ref.)			
<b>Hand wash after defecating with soap</b>				
Yes	0.21	0.11	0.39	0.0001*
No	1.00 (Ref.)			
<b>Hand washing after cleaning infant stool</b>				
Yes	0.39	0.21	0.73	0.003*
No	1.00 (Ref.)			

OR-Odds Ratio, CI-Confidence Interval, Ref-Reference category, \*Significant

The odds of developing diarrhoea was 3.54 times higher among children whose mothers were housewives compared with children whose mother were working. (Adjusted  $OR=3.54$ ,  $95\%CI=1.03-12.04$ ,  $p=0.04$ ). Younger children and those using other source of drinking water other than tap and hand pump were at higher risk. The risk of diarrhoea was higher among those children who had no good hygiene practices of hand washing.

#### Discussion

This study investigated the socio demographic, environmental, behavioural risk factors of diarrhoea morbidity in children less than 5 years old. We found that determinants of diarrhoea were significantly associated with the socio demographic, environmental and behavioural factors. The occurrence of diarrhoea was positively associated with occupation and education of mother, source and storage of Water, lack of hand washing, toilet facility, feeding habit, immunization and rural residence. In fact, an estimated 88 per cent of diarrhoeal deaths worldwide are attributable to unsafe water, inadequate sanitation and poor hygiene, indicating that water supply and sanitation interventions can play an important role in combating the incidence of this disease among children (Rania Roushdy *et al.*,

2012) One of the key factors contributing to the frequency and burden of diarrhoeal disease is the pronounced lack of water and sanitation in a majority of developing countries (Zwane *et al.*, 2007) In this study incidence of diarrhoea was low in children whom mother were literate. The study in Ghana, indicated that the prevalence of diarrhoea varies according to education of mother being significantly lower among children of more educated mothers (secondary or higher) than among children of mothers with no or primary education (Kwasi Owusu Boadi *et al.*, 2005) The education provides the knowledge of the hygiene, feeding and weaning practices, the interpretation of symptoms and enhances timely action to childhood illness (Shikur Mohammed *et al.*, 2013) The occupation of mother also affects diarrhoea morbidity. Children whose mothers were house wife had higher risk of diarrhoea morbidity (OR=2.94, CI= 1.32-6.52 p= 0.006<0.01). In the study male were more affected than females this was similar to other study (Siziya S *et al.*, 2013). The boys would be affected more compared to girls, as under the age of five years, boys are likely to wander off in unsanitary surroundings compared to girls. Prevalence of diarrhoea in age group 6-23 months was 50.1%, this coincided with a study done in Ethiopia, that revealed a higher prevalence of diarrhoea was found in age group 6-11 and 12-23. Water sources are significantly affects the incidence of diarrhoea. The chance of transmission of diarrhoea depends upon water sources whether or not the source is protected (Godana W *et al.*, 2013). In our study we found that the risk was lower among those whom used tap water as a source of drinking (OR= 0.55, 95%CI= 0.28-1.05, p=0.01) as compare to hand pump and other sources in bivariate analysis, but in multivariate logistic regression, the children were at high risk using other source of drinking water other than tap and hand pump. In this study other source comes in unprotected source. The risk of contamination of water sources is high due to poor storage and mishandling (Boadi KO *et al.*, 2005). In the present study who living in rural area had more risk of developing diarrhoea. This was similar in other studies showing the fact that rural residents tend to be poorer than urban residents, which impact the level of hygiene (el-Gilany AH *et al.*, 2005). In this study children from households whom store drinking water had high rate of diarrhoea morbidity. Because collected water is liable for contamination during collection, transportation and storage which may in turn increase risk of diarrhoeal diseases (Godana W *et al.*, 2013). This finding is similar with study in Kenya (Fewtrell L *et al.*, 2005). but contradicts other previous study in Ethiopia (Andualem A, 2010). Our study showed a significant association between drinking water to the house and under five year childhood diarrhoeal morbidity.

In the present study children from households in whom the toilet facilities was not available within the house were more likely to develop diarrhoea compared with children from households with toilet facilities. The presence of toilets increases the chance of safe disposal of faeces, one way to decrease contact between the causative organisms of diarrhoea and the host. This finding was similar to other studies (Wondwossen BA, 2008, Mediratta P *et al.*, 2010, Bettenheim M, 2008). A significant association was also obtained between access to a toilet facility and the incidence of diarrhoea (p<0.001, 95% CI). There was also a significant positive association between the availability of hand washing facility with childhood diarrhoea. A number of studies

have shown that hand washing with soap can reduce the incidence of diarrhoeal disease by over 40 per cent (Curtis V, 2003). Washing child hands with soap is another important barrier to transmission and has been cited as one of the most cost-effective public health interventions (Jamison *et al.*, 2008)

In the present study, significant association was observed between feeding habit and diarrhoeal morbidity. Children who were on bottle feeding had two time more likely to have diarrhoea than those children who did not used bottle feeding (OR=2.13, 95%CI=1.39-3.27, p=<0.01). This was similar with the findings reported by other study which found that there was a high chance of contamination and greater risk of diarrhoea associated with bottle-feeding (Getaneh T *et al.*, 1997). Immunization is a corner stone of public health in eradicating the infectious diseases in many regions of the world. In our study, n=196 (54.08%) children who were immunized had less risk of diarrhoea morbidity than children non-immunized (OR=2.77, 95%CI=1.54-4.99, p=<0.01).

### Study Strength and Limitations

It was community based case- control study and it addressed on acute childhood diarrhoeal morbidity. In this study we did not included all the determinants which are great impact on diarrhoea, like water treatment, distance of water source, type of hand pump.

### Conclusions

The importance of providing adequate safe water, appropriate hand washing, mother education, mother occupation, exclusive breast feeding and improve sanitation were demonstrated to be protective against contracting diarrhoea. As diarrhoea morbidity was major problem among under-five children, continuous, regular and targeted hygiene education programs are very essential in order to bring about behavioural change and reduce the risk of childhood diarrhoeal morbidity. Awareness about the importance of providing adequate safe water, appropriate hand washing, mother education, mother occupation, exclusive breast feeding and improve sanitation were demonstrated to be protective against contracting diarrhoea and will be beneficial to public health.

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