Socio-demographic, Epidemiological and Environmental Determinants of Acute Gastroenteritis in Western India

Mihir Prafulbhai Rupani,[1] Atul V Trivedi,[1] Manindra Pratap Singh,[1] Mohnish N Tundia,[2] Kaushal N Patel,[1] Khushali D Parikh,[3] Vijay B Parmar[1]

[1]Department of Community Medicine, Government Medical College, Bhavnagar, Gujarat, India, [2]Department of Community Medicine, American International Institute of Medical Sciences, Udaipur, Rajasthan, India, [3]Department of Pathology, BJ Medical College, Ahmedabad, Gujarat, India.

ABSTRACT

Introduction: An outbreak of acute gastroenteritis had occurred in Rajpara village of Bhavnagar district. The objective of this study was to find out the socio-demographic, epidemiological and environmental determinants of this outbreak.

Methods: A case-control study was conducted in Rajpara village among 238 cases of acute gastroenteritis and an equal number of controls in January 2015. Multiple logistic regression was used for identifying the variables independently predicting acute gastroenteritis.

Results: Upper socio-economic status, occupation requiring travel outside village, source of drinking water from well of 'new' Rajpara village, change in taste of water, use of chlorine tablets, travel outside village in last week, another family member affected with acute gastroenteritis, using common utensil for hand washing, hand washing before eating, ate food from outside in last week, having sanitary latrine at house, waste disposal in a common dump (instead of at house), waste accumulation around house and flies inside house were significantly associated with occurrence of acute gastroenteritis. On multiple logistic regression, change in taste of water (P<0.001), waste disposal in a common dump (P=0.012), another family member been affected (P<0.001), waste accumulation around house (P<0.001), higher socio-economic status (P=0.002) and eating outside food (P=0.011) made a significant contribution to prediction.

Conclusions: Socio-demographic factors (higher socio-economic status), epidemiological correlates (change in taste of water, another family member been affected with acute gastroenteritis and eating outside food) and environmental determinants (waste disposal in a common dump and waste accumulation around house) significantly determines the occurrence of cases of acute gastroenteritis.

Keywords: *case-control studies; diarrhea; epidemiologic determinants; gastroenteritis; social determinants of health.*

INTRODUCTION

India is now the country reporting the highest number of deaths due to diarrhea.[1] Diarrhea was responsible for 9% of deaths among children under-five years of age in the year 2015.[1] Globally, around 88% of diarrheal deaths are attributed to unsafe water, inadequate sanitation and poor hygiene.[2]

The urban-rural disparity is quite evident, especially looking at life style and living conditions of people residing there. An outbreak of acute gastroenteritis

Correspondence: Dr. Mihir Prafulbhai Rupani, Department of Community Medicine, Government Medical College, Bhavnagar, Gujarat, India. Email: mihirrupani@gmail.com, Phone: +91-9925222421.

had occurred in Rajpara village of Bhavnagar district in December 2014. The epidemiological investigation revealed that a well supplying water to the village was the source of contamination. In spite of the fact that the entire village received water from the same source, a few residents suffered from acute gastroenteritis, whereas the others escaped contracting the infection.

The objective of this study was to find out the socio-demographic, epidemiological and environmental determinants for the cases of acute gastroenteritis.

METHODS

Study design: It was a case-control study conducted in Rajpara village of Bhavnagar district in January 2015.

Place and duration of study: The study was conducted in Rajpara village of Bhavnagar district for a duration of one month in January 2015. Rajpara is a village in Talaja taluka of Bhavnagar with farming being the main occupation of people residing here. It is situated around 22 kilometers from Bhavnagar city. The village is divided into two geographical parts, the 'new' Rajpara village and the 'old' Rajpara village, both the parts being supplied water from a different source. Bhavnagar district is located around 225 kilometers south-west from Ahmedabad city of Gujarat, western India.

Ethical approval and patient consent: Written informed consent was taken from the patients after explaining them the purpose of the study in detail. Permission for conducting the study was obtained from the Chief District Health Officer (CDHO) of Bhavnagar district. Permission for conducting the study was taken from the Dean of Government Medical College Bhavnagar. Institutional Ethics Committee (IEC) approval was obtained from Government Medical College Bhavnagar.

Inclusion and exclusion criteria: Respondents of all ages and both gender were included in the study. Those respondents not giving written informed consent to participate in the study were excluded.

Definition of case: A case of acute gastroenteritis was defined as a person of any age/gender suffering from diarrhea (3 or more loose/watery stools with change in consistency in 24 hours) and/or suffering from vomiting in the last one week.

Definition of control: Controls were defined as a person of any age/gender not suffering from diarrhea/vomiting in the last one week.

Selection of cases: Cases were selected randomly so as to cover the three main areas affected by the outbreak, namely, 'Gorkhi wado', 'Bahar para' and 'Shankar nu mandir'. These areas mainly fell in the 'new' Rajpara village.

Selection of controls: The controls were either neighborhood controls or controls from the same family. The neighborhood controls were taken from the 'old' Rajpara village.

Sample size and sampling: Based on an epidemiological outbreak investigation in the same village by the authors in December 2014, the sample size (of 238 cases and 238 controls) was calculated for an unmatched case-control study using Epi Info 7 Statcalc software considering 95% confidence level, 80% power, the ratio of controls to cases as 1, percentage of controls exposed as 90.25 and percentage of cases with exposure as 96.6.

Data collection: Data collection tool consisted of socio-demographic profile like age, gender, occupation, per-capita income, etc.; epidemiological correlates like source of drinking water, change in taste of water, boiling water before drinking, using chlorine tablet, etc.; and environmental determinants like open defecation, place of hand washing, waste disposal, waste accumulation, sanitary latrine, presence of flies, etc. The data collection tool was validated with the help of face validation and content validation methods.

Statistical analysis: Simple proportions were calculated. T-test and chi-square test was applied for quantitative and qualitative variables respectively. Odds Ratios with 95% CI were calculated. Multiple logistic regression (MLR) was used for identifying the variables independently predicting acute gastroenteritis. Statistical Package for Social Sciences (SPSS version 22, evaluation copy) was used for statistical analysis. Difference was said to be significant when p-value <0.05.

Socio-economic classification: For socio-economic status, Modified Prasad's classification was used taking All India Consumer Price Index for Industrial Workers (AICPI-IW) value of 254 for the month of January 2015.[3,4]

RESULTS

The mean age of the cases was 38.5 ($\pm$17) years and that of the controls was 41 ($\pm$16) years. This difference was statistically insignificant [$t(474) = -1.6$, $p=0.111$]. As illustrated in table 1, there was no statistically significant difference in the age, gender,

literacy status, marital status and occupation as farmer between the cases and the controls. Respondents having secondary and graduate education were more likely to have an attack of acute gastroenteritis than those who were illiterate, which was an incongruous finding. Another inconsistent finding was that those belonging to lower socio-economic classes (class IV and V) were less likely to suffer from acute gastroenteritis than those belonging to upper socio-economic class (class I). Those respondents whose occupation required travel outside the village were 2.5 times more likely to suffer from acute gastroenteritis than those whose occupation did not require travel outside the village (P <0.001).

As evidenced in Table 2, taking water through ladle (water dipper), boiling water before drinking and using water filter at home were not significantly associated with acute gastroenteritis. Those residents who drank water supplied from well of 'new' Rajpara village were 2.8 times more likely to suffer from acute gastroenteritis than those who drank water supplied from well of 'old' Rajpara village (P <0.001). Change in colour of water (OR=20.2), change in taste of water (OR=25.8), change in odour of water (OR=25.8), using chlorine tablet (OR=3.8) and travel outside village in the last one week (OR=2.7) were significantly associated with the occurrence of acute gastroenteritis in the village (P< 0.001). The statistically significant association between use of chlorine tablets and occurrence of acute gastroenteritis seems to be a spurious one. The spurt in the number of acute gastroenteritis cases might have led to an extensive distribution of chlorine tablets among the community by the grass root level workers. The spuriously significant association being the result of greater acceptance and use of chlorine tablets by those suffering from acute gastroenteritis.

As illustrated in Table 3, open defecation, hand washing after defecation, keeping prepared food covered and eating stale food were not significantly associated with development of acute gastroenteritis. Another family member been affected with acute gastroenteritis (OR=5.7, P <0.001), using common utensil with water for hand washing (OR=2.04, P <0.001), hand washing before eating (OR=1.8, P=0.002), ate food from outside in the last one week (OR=2.9, P <0.001), sanitary latrine at home (OR=1.5, P=0.027), waste disposal in common dump rather than at home (OR=9.6, P <0.001), waste accumulation around the house (OR=13.2, P<0.001) and flies inside the house (OR=2.7, P <0.001) were significantly associated with occurrence of acute gastroenteritis in the village. Contradictory findings among these variables were hand washing before eating and having a sanitary latrine at home being significantly associated with the occurrence of acute gastroenteritis.

Multiple logistic regression was carried out by "Enter" method, considering acute gastroenteritis as the dependent variable (with 2 outcomes namely acute gastroenteritis present and acute gastroenteritis absent) and entering the following variables as the independent variables (predictors predicting presence of acute gastroenteritis) in Step 1: age of patient in years, gender (male or female), literacy status (literate or illiterate), socio-economic group (upper or lower), source of drinking water (well of new Rajpara village or well of old Rajpara village), change in taste of water (yes or no), using chlorine tablets (yes or no), another family member affected (yes or no), using common utensil with water for hand washing (yes or using wash basin), hand washing before eating (yes or no), ate food from outside in the last one week (yes or no), sanitary latrine at home (yes or no), waste disposal in common dump (yes or at home), waste accumulation around house (yes or no) and flies inside house (yes or no). Multi-collinearity among the variables entered in Step 1 was ruled out by Collinearity Diagnostics statistics (the tolerance values of all variables was >0.1 and the Variance Inflation Factor values of all variables was <10).

By "Enter" method, at step 1, the following variables were found to be significant independent predictors of presence of acute gastroenteritis: change in taste of water, waste disposal in common dump, another family member affected, waste accumulation around house, socio-economic group and ate food from outside in last one week. Table 4 shows the description of variables at step 1 and the expected sign of each variable.

Table 5 gives the Adjusted Odds Ratios and their 95% CIs of the variables predicting the presence of acute gastroenteritis. It can be illustrated from the table that acute gastroenteritis is 21 times more likely to occur when there is a change in taste of water. Acute gastroenteritis is 11.5 times more likely to occur where the waste disposal is being done in a common dump, rather than at house. If one family member is affected with acute gastroenteritis then another family member is 11 times more likely to suffer from acute gastroenteritis. Waste accumulation around the house is 9.6 times more likely to result in acute gastroenteritis among the residents. Residents who ate food from outside in the last week were 3 times more likely to have acute gastroenteritis. A contradictory finding that evolved from our analysis was that residents belonging to higher socio-economic group were 3 times more likely to have acute gastroenteritis.

The Wald criterion demonstrated that change in taste of water (P<0.001), waste disposal in a common dump (P=0.012), another family member affected with

acute gastroenteritis (P<0.001), waste accumulation around house (P<0.001), higher socio-economic status (P=0.002) and eating outside food (P=0.011) made a significant contribution to prediction. Age of patient, gender, literacy status, source of drinking water, using chlorine tablets, washing hands in a common utensil with water, hand washing before eating, having a sanitary latrine at home and house-flies were not significant predictors.

DISCUSSION

The current study highlights the socio-demographic, epidemiological and environmental determinants of acute gastroenteritis in Bhavnagar district following an outbreak in a village. Water and Sanitation Hygiene (WASH) plays a significant role in the control of water-borne diseases. According to Census 2011,[5] the access to improved sanitation facility in India was 46.9% only; 53.1% Indians did not have a sanitary latrine within their premises and 33% of Indians had an open drainage facility leading to waste accumulation around their houses. The same data for rural Gujarat stands at only 33% access to improved sanitation facility; 42.7% did not have a sanitary latrine within their premises and 9.4% households had an open drainage facility.[5] Access to improved sanitation facility in rural Bhavnagar was only 32.1%; 67.9% did not have a sanitary latrine within their premises and 10.2% had an open drainage. Well was the main source of drinking water in India in 11% of the households and that in rural Gujarat was 7.1% and that in rural Bhavnagar was 14.1%.[6]

The present study found that change in taste of drinking water is the first cue towards an impending occurrence of an outbreak of acute gastroenteritis. Change in colour of the water and that in the odour of drinking water might also indicate contamination of drinking water with sewage waste water. A study conducted in slum children reported access to safe water, improved toilet and improved hygienic conditions as the main factors affecting prevalence of diarrhea.[7] They also highlighted that safe drinking water reduces the likelihood of getting diarrhea by about 19%. Their research also reported that gender and socio-economic status did not have a binding on the prevalence of diarrhea. The present study's findings supported the evidence generated from their research. Another evidence from a research conducted by Jadhav et al. suggested that the odds of suffering from diarrhea is significantly associated with the quality of drinking water.[8] Waste disposal in a common dump was also significantly associated with the occurrence of acute gastroenteritis. The distance of the common dump from the houses was not taken into account in the current study, but this waste disposal might be leading to waste accumulation around the house. This in turn leading to breeding of house-flies in the waste and finally turning into an outbreak of acute gastroenteritis. Mapping of areas of the village with such breeding places should be taken up by the district authorities in order to contain the spread of the disease and to prevent future outbreaks.

Acute gastroenteritis being a contagious disease, one family member being affected with it led to the subsequent spread of the disease among the family members itself. There is a pressing need to create awareness regarding hygienic practices to be followed in the household to prevent the spread of water-borne diseases among family members. The present study also stressed upon the importance of eating home cooked food. Those villagers who had the habit of eating food from outside were 3 times more likely to experience an attack of acute gastroenteritis. A conflicting evidence generated in the present study was that residents belonging to higher socio-economic group were 3 times more likely to have acute gastroenteritis. Residents belonging to higher socio-economic groups generally maintain cleanliness and hygiene in their surroundings than those belonging to lower socio-economic groups. They can also afford to install a Reverse Osmosis (RO) water filter in their houses to avail pure drinking water. Hand washing practices are also better followed in this class of people. Surprisingly, the study postulated that residents of lower socio-economic groups were protected against water-borne infections. The study did not take into account their individual nutritional status or immunity status, so the exact reason behind this discrepancy could not be found out.

CONCLUSIONS

Socio-demographic factors (higher socio-economic status), epidemiological correlates (change in taste of water, another family member been affected with acute gastroenteritis and eating outside food) and environmental determinants (waste disposal in a common dump and waste accumulation around house) significantly determines the occurrence of cases of acute gastroenteritis.

ACKNOWLEDGEMENTS

Dr. Vikas Sinha (Dean, Government Medical College Bhavnagar), Dr. H. F. Patel (Chief District Health Officer Bhavnagar) and Dr. Hiren Vyas (District Epidemiologist Bhavnagar) for providing technical assistance in this research.

Table 1. Association of socio-demographic variables with acute gastroenteritis (n = 476).

Socio-demographic variables	Case (%)	Control (%)	Total (%)	Chi-square	P-value	Odds Ratio (95% CI)
Age of patient by 40 years cut off						
Age <40 years	129 (53.3)	113 (46.7)	242 (100)	2.152	0.142	1.3 (0.91 – 1.87)
Age ≥40 years	109 (46.6)	125 (53.4)	234 (100)			
Total	238 (50)	238 (50)	476 (100)			
Gender						
Male	163 (48.4)	174 (51.6)	337 (100)	1.23	0.267	0.8 (0.59 – 1.18)
Female	75 (54)	64 (46)	139 (100)			
Total	238 (50)	238 (50)	476 (100)			
Education						
Illiterate	105 (46.9)	119 (53.1)	224 (100)			Taking reference OR of Illiterate as 1
Just literate	22 (41.5)	31 (58.5)	53 (100)			0.8 (0.44-1.47)
Primary (passed 5th std.)	51 (48.1)	55 (51.9)	106 (100)			1.1 (0.66-1.67)
Middle (passed 8th std.)	13 (54.2)	11 (45.8)	24 (100)	13.42	0.037	1.3 (0.58-3.1)
Secondary (passed 10th std.)	25 (69.4)	11 (30.6)	36 (100)			2.6 (1.21-5.49)
Higher secondary (passed 12th std.)	5 (50)	5 (50)	10 (100)			1.1 (0.31-4.02)
Graduate and above	17 (73.9)	6 (26.1)	23 (100)			3.2 (1.22-8.45)
Total	238 (50)	238 (50)	476 (100)			
Literacy status						
Illiterate	105 (46.9)	119 (53.1)	224 (100)	2.314	0.128	1.76 (0.84 – 3.69)
Literate	133 (52.8)	119 (47.2)	252 (100)			
Total	238 (50)	238 (50)	476 (100)			
Marital status						
Married	201 (49.9)	202 (50.1)	403 (100)	0.0003	1	0.97 (0.59 – 1.59)
Single	37 (50.7)	36 (49.3)	73 (100)			
Total	238 (50)	238 (50)	476 (100)			
Socio-economic class as per Modified Prasad's classification						
I	13 (86.7)	2 (13.3)	15 (100)			Taking reference OR of Class I as 1
II	32 (69.6)	14 (30.4)	46 (100)			0.35 (0.06-1.77)
III	60 (65.9)	31 (34.1)	91 (100)	34.74	<0.001	0.29 (0.06-1.4)
IV	66 (41.3)	94 (58.8)	160 (100)			0.108 (0.023-0.494)
V	67 (40.9)	97 (59.1)	164 (100)			0.106 (0.023-0.486)
Total	238 (50)	238 (50)	476 (100)			
Socio-economic class grouped into upper and lower						
Upper (I,II)	45 (73.8)	16 (26.2)	61 (100)	15.81	<0.001	3.23 (1.77 – 5.9)
Lower (III,IV,V)	193 (46.5)	222 (53.5)	415 (100)			
Total	238 (50)	238 (50)	476 (100)			
Occupation as farmer						
Farmer	57 (52.8)	51 (47.2)	108 (100)	0.431	0.511	1.2 (0.75-1.77)
Others	181 (49.2)	187 (50.8)	368 (100)			
Total	238 (50)	238 (50)	476 (100)			
Occupation requiring travel outside village						
Yes	128 (63.1)	75 (36.9)	203 (100)	24.12	<0.001	2.53 (1.74 – 3.68)
No	110 (40.3)	163 (59.7)	273 (100)			
Total	238 (50)	238 (50)	476 (100)			

**CI-Confidence Interval; OR-Odds Ratio*

Table 2. Association of epidemiological correlates with acute gastroenteritis (n = 476).

Epidemiological correlates	Case (%)	Control (%)	Total (%)	Chi-square	P-value	Odds Ratio (95% CI)
Source of drinking water						
Well or bore-well of new Rajpara	134 (64.4)	74 (35.6)	208 (100)	30.74	<0.001	2.85 (1.96 – 4.16)
Well or bore-well of old Rajpara	104 (38.8)	164 (61.2)	268 (100)			
Total	238 (50)	238 (50)	476 (100)			
Change in colour of water						
Yes	61 (93.8)	4 (6.2)	65 (100)	57.89	<0.001	20.2 (7.2 – 56.5)
No	177 (43.1)	234 (56.9)	411 (100)			
Total	238 (50)	238 (50)	476 (100)			
Change in taste of water						
Yes	59 (95.2)	3 (4.8)	62 (100)	58.16	< 0.001	25.8 (7.9 – 83.7)
No	179 (43.2)	235 (56.8)	414 (100)			
Total	238 (50)	238 (50)	476 (100)			
Change in odour of water						
Yes	59 (95.2)	3 (4.8)	62 (100)	58.16	< 0.001	25.8 (7.9 – 83.7)
No	179 (43.2)	235 (56.8)	414 (100)			
Total	238 (50)	238 (50)	476 (100)			
Mode of taking water						
Through ladle or water dipper	12 (52.2)	11 (47.8)	23 (100)	0.046	0.831	1.1 (0.47-2.53)
Through glass directly dipped in water	226 (49.9)	227 (50.1)	453 (100)			
Total	238 (50)	238 (50)	476 (100)			
Boiling water before drinking						
Yes	29 (42)	40 (58)	69 (100)	2.051	0.152	0.69 (0.41-1.2)
No	209 (51.4)	198 (48.6)	407 (100)			
Total	238 (50)	238 (50)	476 (100)			
Using chlorine tablet						
Yes	221 (54.6)	184 (45.4)	405 (100)	22.66	<0.001	3.8 (2.14-6.8)
No	17 (23.9)	54 (76.1)	71 (100)			
Total	238 (50)	238 (50)	476 (100)			
Using water filter at home						
Yes	10 (62.5)	6 (37.5)	16 (100)	1.035	0.309	1.7 (0.6-4.74)
No	228 (49.6)	232 (50.4)	460 (100)			
Total	238 (50)	238 (50)	476 (100)			
Travel outside village in last one week						
Yes	109 (65.7)	57 (34.3)	166 (100)	25.01	<0.001	2.7 (1.81-3.97)
No	129 (41.6)	181 (58.4)	310 (100)			
Total	238 (50)	238 (50)	476 (100)			

**Confidence Interval*

Table 3. Association of environmental determinants with acute gastroenteritis (n = 476).

Environmental determinants	Case (%)	Control (%)	Total (%)	Chi-square	P-value	Odds Ratio (95% CI)
Open defecation						
Yes	177 (52.7)	159 (47.3)	336 (100)	3.279	0.07	1.44 (0.97-2.14)
No	61 (43.6)	79 (56.4)	140 (100)			
Total	238 (50)	238 (50)	476 (100)			
Another family member affected						
Yes	138 (75)	46 (25)	184 (100)	74.98	<0.001	5.76 (3.82-8.7)
No	100 (34.2)	192 (65.8)	292 (100)			
Total	238 (50)	238 (50)	476 (100)			
Using common utensil with water for hand washing						
Yes	121 (60.2)	80 (39.8)	201 (100)	14.48	<0.001	2.04 (1.41-2.96)
No (washbasin)	117 (42.5)	158 (57.5)	275 (100)			
Total	238 (50)	238 (50)	476 (100)			
Hand washing after defecation						
Yes	171 (50.7)	166 (49.3)	337 (100)	0.254	0.614	1.11 (0.75-1.64)
No	67 (48.2)	72 (51.8)	139 (100)			
Total	238 (50)	238 (50)	476 (100)			
Hand washing before eating						
Yes	168 (55.3)	136 (44.7)	304 (100)	9.322	0.002	1.8 (1.23-2.63)
No	70 (40.7)	102 (59.3)	172 (100)			
Total	238 (50)	238 (50)	476 (100)			
Ate food from outside in last one week						
Yes	107 (66.9)	53 (33.1)	160 (100)	27.45	<0.001	2.9 (1.92-4.25)
No	131 (41.5)	185 (58.5)	316 (100)			
Total	238 (50)	238 (50)	476 (100)			
Sanitary latrine at home						
Yes	143 (54.6)	119 (45.4)	262 (100)	4.89	0.027	1.51 (1.047-2.164)
No	95 (44.4)	119 (55.6)	214 (100)			
Total	238 (50)	238 (50)	476 (100)			
Keeping prepared food covered						
Yes	232 (49.9)	233 (50.1)	465 (100)	0.093	0.76	0.83 (0.25-2.76)
No	6 (54.5)	5 (45.5)	11 (100)			
Total	238 (50)	238 (50)	476 (100)			
Eating stale food						
Yes	161 (53.3)	141 (46.7)	302 (100)	3.409	0.065	1.42 (0.978-2.072
No	77 (44.5)	96 (55.5)	173 (100)			
Total	238 (50)	237 (50)	475 (100)			
Waste disposal in common dump						
Yes	235 (52.6)	212 (47.4)	447 (100)	19.42	<0.001	9.6 (2.87-32.2)
No (at home)	3 (10.3)	26 (89.7)	29 (100)			
Total	238 (50)	238 (50)	476 (100)			
Waste accumulation around house						
Yes	209 (71.3)	84 (28.7)	293 (100)	138.7	<0.001	13.2 (8.25-21.2)
No	29 (15.8)	154 (84.2)	183 (100)			
Total	238 (50)	238 (50)	476 (100)			
Flies inside house						
Yes	208 (55)	170 (45)	378 (100)	18.55	<0.001	2.78 (1.73-4.46)
No	30 (30.6)	68 (69.4)	98 (100)			
Total	238 (50)	238 (50)	476 (100)			

**CI-Confidence Interval*

Table 4. Description of variables at step 1 of "Enter" method and expected sign of each variable.

Variable	Description	Mean (S.D)	Expected sign
Dependent variable Case of acute gastroenteritis	=1 if the respondent has acute gastroenteritis, =0, otherwise	0.5 (0.501)	-
Age in years	Age of the respondent in completed years	39.73 (16.75)	Positive
Gender	=1 if respondent is a male, =0, otherwise	0.71 (0.455)	Positive
Literacy status	=1 if the respondent is illiterate, =0, otherwise	0.47 (0.5)	Positive
Socio-economic group	=1 if the respondent is in upper socio-economic group, =0, otherwise	0.13 (0.335)	Negative
Source of drinking water	=1 if water supplied from well or bore-well of new Rajpara village, =0, if water supplied from old Rajpara village	0.44 (0.497)	Positive
Change in taste of water	=1 if the respondent experienced a change, =0, otherwise	0.13 (0.337)	Positive
Using chlorine tablets	=1 if the respondent is using chlorine tablet, =0, otherwise	0.85 (0.357)	Negative
Another family member affected	=1 if another family member affected, =0, otherwise	0.39 (0.487)	Positive
Using common utensil with water for hand washing	=1 if the respondent is using common utensil, =0, if the respondent is using washbasin	0.58 (0.494)	Positive
Hand washing before eating	=1 if the respondent is washing hands before eating, =0, otherwise	0.64 (0.481)	Negative
Ate food from outside in last one week	=1 if the respondent ate food from outside, =0, otherwise	0.34 (0.473)	Positive
Sanitary latrine at home	=1 if the respondent has sanitary latrine at home, =0, otherwise	0.55 (0.498)	Negative
Waste disposal in common dump	=1 if the respondent is disposing waste in a common dump, =0, if disposing at home	0.94 (0.239)	Positive
Waste accumulation around house	=1 if the respondent has accumulation of waste around house, =0, otherwise	0.62 (0.487)	Positive
Flies inside house	=1 if the respondent has flies inside house, =0, otherwise	0.79 (0.405)	Positive

**SD-Standard Deviation*

Table 5. Adjusted Odds Ratio of predictor variables predicting acute gastroenteritis by multiple logistic regression by "Enter" method* (n = 476).

Variables	Beta coefficients	Wald	Adjusted Odds Ratio	95% CI	P-value
Change in taste	3.075	18.96	21.64	5.42-86.4	<0.001
Waste disposal in common dump	2.441	6.253	11.5	1.7-77.8	0.012
Another family member affected	2.403	46.3	11.1	5.5-22.1	<0.001
Waste accumulation around home	2.261	44.48	9.6	4.9-18.6	<0.001
Socio-economic group	1.205	9.519	3.34	1.55-7.17	0.002
Ate food from outside in last one week	1.184	6.441	3.27	1.31-8.2	0.011
Using chlorine tablets	0.988	3.834	2.69	0.999-7.23	0.0502
Gender	0.575	3.829	1.78	0.999-3.16	0.0503
Source of drinking water	-0.608	3.859	0.544	0.297-0.999	0.0494
Age of patient in years	-0.005	0.318	0.995	0.979-1.012	0.573
Literacy status	-0.047	0.024	0.954	0.524-1.74	0.878
Flies inside house	-0.133	0.126	0.875	0.419-1.83	0.722
Hand washing before eating	-0.429	1.076	0.651	0.289-1.47	0.3
Place of hand washing	-0.476	1.142	0.622	0.26-1.49	0.285
Latrine at home	-0.684	2.731	0.505	0.224-1.136	0.098
Constant	-5.344	18.4	0.005	-	<0.001

**Omnibus test of model coefficients p-value <0.001; Hosmer Lemeshow test p-value=0.297; Nagelkerke R^2 value=0.601; Classification accuracy 81.5% (80.7% for controls and 82.4% for cases); CI-Confidence Interval*

REFERENCES

1. JHSPH (2015). Pneumonia and Diarrhea Progress Report 2015. Report of the John Hopkins School of Public Health, International Vaccine Access Centre, Baltimore. [online] 2015 November 24. Available from http://www.jhsph.edu/research/centers-and-institutes/ivac/resources/IVAC-2015-Pneumonia-Diarrhea-Progress-Report.pdf.
2. WHO/UNICEF (2013). Ending preventable child deaths from pneumonia and diarrhoea by 2025: The integrated Global Action Plan for Pneumonia and Diarrhoea (GAPPD). WHO Press 2013, World Health Organization, ISBN: 9789241505239, Geneva. [online] 2015 November 26. Available from http://apps.who.int/iris/bitstream/10665/79200/1/9789241505239_eng.pdf.
3. Kumar P. Social classification-need for constant updating. Indian J Community Med. 1993;18:60-61.
4. Labour Bureau India (2015). All-India Average Consumer Price Index (AICPI) Numbers for Industrial Workers. India: Labour statistics, Labour Bureau, Government of India. [online] 2015 March 25. Available from http://labourbureau.nic.in/indnum.htm.
5. CensusInfo India (2011). Houses, Household Amenities and Assets version 2.0. Total Sanitation. India: Office of the Registrar General and Census Commissioner, Ministry of Home Affairs, Government of India. [online] 2015 November 25. Available from http://www.devinfolive.info/censusinfodashboard/website/index.php/pages/sanitation/total/totallatrine/IND.
6. CensusInfo India (2011). Houses, Household Amenities and Assets version 2.0. Drinking Water. India: Office of the Registrar General and Census Commissioner, Ministry of Home Affairs, Government of India. [online] 2015 November 25. Available from http://www.devinfolive.info/censusinfodashboard/website/index.php/pages/drinking_water/Total/withinthepremises/IND.
7. Singh A, Singh MN. Diarrhoea and acute respiratory infections among under-five children in slums: Evidence from India. PeerJ PrePrints. 2014;2:e208v1 [online] 2015 November 20. Available from https://dx.doi.org/10.7287/peerj.preprints.208v1.
8. Jadhav J, Ravish KS, Gopinath D. A Study of Socio-Cultural Factors, Water Quality and Diarrhea in Bangalore. The Internet Journal of Public Health. 2009;1(1):1-3.