DEMOGRAPHIC SOCIO-ECONOMIC AND ENVIRONMENTAL FACTORS ASSOCIATED WITH DIARRHOEA MORBIDITY IN CHILDREN UNDER-FIVE IN RURAL ODISHA: A STUDY OF RAYAGADA DISTRICT INDIA

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ABSTRACT: According to the UNICEF report, pneumonia and diarrhoea, the two biggest killers of children, killed about 2,197,000 children less than 5 years of age in 2010, making up 29 percent of all child deaths under age five worldwide. With 609,000 deaths, India topped the list of the 75 countries with the highest mortality burden attributed to the two diseases. A cross-sectional study was carried out in the severely diarrhoea affected blocks of the Rayagada district to find out the association between socio-economic, environmental and demographic factors with diarrhoea among under 5-year-old children on February and March, 2013. The study based on the primary information obtained from the mothers of the under five children. Quantitative research methodology was applied. Data analysis was done by using binary logistic regression with statistical significance of each analysis against the p-value of 0.2. The study revealed that 630 (42%) children had diarrhoea within last two months of the study. Factors like mother's education, age of the child, child's immunization status, breast feeding status, source of drinking water, its treatment and cooking place has association in diarrhoea outcome of under 5-year-old children. The study also found that factors like age of the child and source of drinking water and separate room for cooking were highly associated with diarrhoea. Considering the high prevalence of the diarrhoea continued efforts to promote hygienic practices in child care, special attention in the care of children within the age group 7-12 months, treatment of both water source and awareness about treatment of water before consumption and availability of anti-diarrhoeal medicines at the village level round the year, prolonged breast feeding and promotion of health education are recommended.

Keywords: Demographic factors, Socio-economic factors, Environmental factors, Under Five Children, Diarrhoea, India

INTRODUCTION

Reduction of child mortality by two thirds between 1990 and 2015 is one of the major targets of the Millennium Development Goal (MDG). But as the targeted year is approaching a review of literature says though progress has been made to address the issue still there lies a huge gap with much more still to be done. According to the report of World Health Organization (WHO) every year around nine million under five children die across the globe. The analysis of causes of such huge number of deaths reveal that out of all factors only pneumonia and diarrhoea contributes to 29% of all deaths worldwide. According to the United Nation's Children Fund (UNICEF) report, pneumonia and diarrhoea, the two biggest killers of children, killed about 2,197,000 children less than five years of age in 2010, making up 29 percent of all child deaths under age 5 worldwide. The report also noted that about half the world's deaths due to pneumonia and diarrhoea occur in just five mostly poor and populous countries such as India, Nigeria, Democratic Republic of the Congo, Pakistan and Ethiopia. About 609,000 deaths India topped the list of the 75 countries with the highest mortality burden attributed to the two diseases [1].

Though a lot of studies have been conducted to assess the various determinants of diarrhoea no specific study has been done in one of the most backward district like Rayagada to assess the association between socio-economic, environmental and demographic factors with occurrence of diarrhoea among under 5-year-old children.

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Rayagada has a history of diarrhoeal epidemic. Though lot of steps have been taken by district administration to combat the cases every year still during the rainy season some part of the district face high diarrhoea outbreaks. Though every year the situation is not like epidemic but still in two or three years the epidemic reoccurs and the deaths tolls due to diarrhoea remains to be biggest health problem for the Health Department and for the whole district and state administration. It is obvious that the district administration has invested a lot in increasing the access of drinking water amongst the community residing in the hilly and terrain areas of the district still the unsafe drinking water and contaminated water sources were found to be predominant reasons for the cause of diarrhoea epidemic in 2010 which resulted in 41 lives loss.

MATERIALS AND METHODS

A cross-sectional (descriptive and analytical) study was carried out in the severely diarrhea affected blocks of the Rayagada district (as per the distinction made by the district vulnerability assessment report) to find out the association between socio-economic, environmental and demographic factors with diarrhoea among under five children. Quantitative research methodology will be applied for this study. The study was based on the primary information obtained from the mothers of the under five children by questionnaire. In addition to the use of a questionnaire, data were collected by two other methods;

- Measurement of height and weight of the children
- Verifying the register of the local health worker and local ICDS center

By using district vulnerability map for 2010 diarrhoea affected blocks, five blocks were selected out of the 11 blocks of the districts which were severely affected during the Diarrhoea epidemic. The blocks were B.cuttack, Kashipur, K.singhpur, J.pentha and Gudari blocks of Rayagada district**.** The study was carried out in the month of February and March, 2013. Diarrhoea morbidity, referred as presence or absence of diarrhoea in children within two months of the date of the interview. Diarrhoea was the passage of 3 or more loose or liquid stools per day, or more frequently than is normal for the individual (as per WHO) within two month of the date of the interview**.** The population in this study was the pair of under age 5 children and his/her mother or care takers. All the children those were less than five years of the age living in the study area were eligible for the study. If more than one under five children was found in the household then, only the youngest child with mother/caretaker present during the study was recruited for the purpose of the study. Children having any other chronic disease during the time of interview and whose mothers/care takers were not present during the time of interview were excluded from the study. The total sample size for the study was 630. It was calculated by using the UN statistical handbook for household survey [2]. The formula is;

$$n_h = (z^2)(r)(1-r)(f)(k)/(p)(n)(e^2), \text{ where}$$

n_h is the parameter to be calculated and is the sample size in terms of number of Households to be selected;

Z is the statistic that defines the level of confidence desired;
R is an estimate of a key indicator to be measured by the survey;
F is the sample design effect, deff. assumed to be 2.0 (default value);
K is a multiplier to account for the anticipated rate of non-response;
P is the proportion of the total population accounted for by the target Population and upon which the parameter, r, is based;
N is the average household size (number of persons per household);
E is the margin of error to be attained.

Thirty villages (clusters) were selected by using probability proportion to size (PPS) method. In each village cluster the selection of the first household was done randomly. A structured questionnaire was developed by extracting relevant questions from the National Family Health Survey 3 (NFHS3) for the purpose of the survey. As all the questions for the survey were extracted from the previously validated questionnaire the questionnaire were not validated further for the present study [3]. Ten research assistants currently working as Multi Purpose Health Worker (MPHW) two from each study block were recruited for conducting the household survey. They were oriented about the research through 1day training at the DPMU office. Prior to the actual study the pretesting of the questionnaire was done among 10 mothers of under five children in a village whose characteristics is similar to that of the study site and which will not fall under the study site. Ethical clearance was obtained from the Research and Ethics Committee, Department of Health and Family Welfare, Government of Odisha. Prior to the interview, all the interviewees were explained about the research including purposes and questionnaires. Written consent was obtained from each and every respondent. Their names were not

Table 1 Association between independent variables and diarrhoea in children under five

Factors	Diarrhoea in past two months		X^2	*p-value*
	Yes	No		
	N (%)	N (%)		
Attendance of school by mother				
Yes	78(47.6%)	86(52.4%)	2.143	.143
No	191(41.0%)	275(59%)		
Level of mother's education				
Primary	30(41.1%)	43(58.9%)		
Upper Primary	48(52.7%)	43(47.3%)	4.310	.111
Illiterate	191(41%)	275(59%)		
Caste				
Schedule Tribe (ST)	136(43.7%)	178(56.7%)		
Schedule Cast (SC)	84(38.7%)	133(61.3%)	3.329	.189
Others	49(42.7%)	50(53.7%)		
Age of the child in months				
Up to 6 months	34(31.2%)	75(68.8%)		
7 months-1 yr	65(54.6%)	54(45.4%)	12.84	.002
More than 1 yr	170(42.3%)	232(57.7%)		
Vitamin-A *(crosschecked from register of female health worker) n=493*				
Vit-A given	182(44.4%)	228(55.6%)	3.675	.055
Vit-A not given	27(32.9%)	55(67.1%)		
Main source of drinking water				
Public piped system	53(60.9%)	34(39.1%)		
Hand pump	27(30.3%)	62(69.7%)	18.37	.000
Bore well	168(42.4%)	228(57.6%)		
Other sources	21(36.2%)	37(63.8%)		
Distance of the water source				
Less than 10 minutes	216(45.4%)	260(54.6%)	5.715	.017
More than 10 minutes	53(34.4%)	101(65.6%)		
Methods of treatment				
Boil	58(51.3%)	56(49.1%)		
Others	14(46.7%)	16(53.3%)	4.240	.120
Don't treat	197(59.5%)	289(40.5%)		
Place of cooking				
In the house	220(44.4%)	276(55.6%)	2.615	.106
Outside the house	49(36.6%)	85(63.4%)		
Separate room for cooking				
Yes	121(50.8%)	117(49.2%)	10.364	.001
No	148(37.8%)	244(62.2%)		

recorded for the confidentiality and the data was coded for analysis.

Data analysis

All the independent variables which were under nominal and ordinal scale were presented through frequency and percentage. Strength of association between dependent and independent variables was seen using Chi-square and Fisher exact test*. Multivariable analysis was also done using logistic regression for all those variables whose *p-value* ≤0.2 in bivariate analysis and those variables whose *p-value* is > 0.2 but has been significantly associated with under 5 diarrhoeal morbidity in several other previous studies. From the analysis it was observed that all the caretakers were mothers so the interpretations were made from the point of view of mother's characteristics. All the analysis was done with statistical significance set at ≤0.05. All the data was analyzed by using SPSS 17 for Windows (licensed for Chulalongkorn University).

RESULTS

It was found that out of all the children participated in the study 42% had diarrhoea within last two months of the study. Out of all the children who had diarrhoea within last two months 53% were male and 46% were female. All the factors whose *p-value* was found to be <0.2 were shown. It's found of that out of all the independent variables the following variables had some association with

Table 2 Multivariate analysis for diarrhoea (excluding measles and vitamin A)

Variables	B	Sig.	Adjusted OR	95% CI	
				Lower	Upper
Attendance of school by mother	-0.062	0.821	0.940	0.549	1.610
Level of mother's education					
Primary[(R)]		0.185			
Upper Primary	0.452	0.185	1.571	0.805	3.066
Illiterate	0.093	0.356	1.097	0.901	1.337
Caste					
ST[(R)]		0.552			
SC	-0.206	0.300	0.814	0.551	1.202
Others	-0.002	0.994	0.998	0.599	1.663
Age of the child					
0-6 months[(R)]		0.001			
7 months-12 months	1.064	0.000	2.899	1.650	5.096
More than 1 year	0.835	0.001	2.304	1.390	3.819
Breast feeding	-0.469	0.274	0.626	0.270	1.450.
Breast feeding months for those who are not feeding currently	-0.006	0.976	0.994	0.659	1.489
Weight counselling	-0.031	0.891	0.969	0.619	1.518
Drinking water source					
Public piped system[(R)]		0.045			
Hand pump	-0.994	0.007	0.370	0.180	0.762
Bore well	-0.469	0.082	0.625	0.368	1.062
Others	-0.724	0.057	0.485	0.230	1.022
Distance to water source	-0.276	0.198	0.759	0.499	1.155
Treatment of water	0.328	0.574	1.388	0.442	4.359
Method of water treatment	-0.043	0.923	0.958	0.400	2.296
Child faeces disposal	0.019	0.933	1.019	0.651	1.596
Cooking place	-0.217	0.371	0.805	0.500	1.295
Separate room for cooking	0.393	0.058	1.481	0.987	2.223
Wasting	0.325	0.124	1.384	0.915	2.094

[(R)]: Reference Group

diarrhoea in under-five children (Table 1).

Results obtained from bivariate analysis were used to construct multivariable model for multivariable analysis. This multivariable model, included variables for which *p-value* was less than or equal to 0.2 in bivariate analysis and wasting whose *p-value* was not found to be <.05 in this study but it was found to be associated with diarrhoea in under five children in previous pool of studies. Two logistic regression models were formulated to analyze the data in a systematic manner. In the first model all the independent variables were included except measles and vitamin A, because there were 137 children who were not eligible to get measles or vitamin A as they were below 9 months of age during the time of interview.

Table 2 illustrates that at 95% CI children within the age group of 7-12 months are 2.8 more likely to develop diarrhoea as compared to the children in the age group of 0-6 months and children in the household who use hand pump or bore well are .3 and .6 less likely to develop diarrhoea as compared to children whose household use public piped system.

Table 3 illustrates that at 95% CI children of the household who has separate room for cooking are 1.7 more likely to develop diarrhoea as compared to the children whose household doesn't have separate room for cooking.

DISCUSSION

The two month prevalence of diarrhoea in the study population was found to be 42% (269 out of 630). The observed prevalence of diarrhoea in the current study was found to be unusually higher as compared to previous studies. Considering the present study was not conducted in the rainy season the prevalence of diarrhoea reported in the study is alarmingly high. Almost all the studies on diarrhoea have been conducted in the dry season which makes it difficult to make meaningful and reasonable comparison of the prevalence. However, although

slightly higher, the prevalence in the current study is not far removed from the findings of some other

Table 3 Multivariate analysis for diarrhoea (including measles and vitamin A)

Variables	B	Sig.	Adjusted OR	95% CI	
				Lower	Upper
Attendance of school by mother	-0.136	0.674	0.873	0.462	1.647
Level of mother's education					
Primary[(R)]		0.337			
Upper Primary	0.382	0.337	1.465	0.672	3.193
Illiterate	0.017	.284	1.071	0.986	1.048
Caste					
ST[(R)]		0.299			
SC	-0.357	0.120	0.700	0.446	1.098
Others	-0.145	0.635	0.865	0.475	1.575
Age of the child					
0-6 months[(R)]		0.938			
7 months-12 months	-0.100	0.878	0.905	0.254	3.229
More than 1 year	0.002	0.998	1.002	0.294	3.410
Breast feeding	-0.515	0.237	0.597	0.254	1.403
Breast feeding months for those who are not feeding currently	-0.037	0.863	0.964	0.693	1.461
Weight counselling	0.214	0.427	1.238	0.731	2.099
Drinking water Source					
Public piped system[(R)]		0.195			
Hand pump	-0.925	0.032	0.397	0.170	0.923
Bore well	-0.395	0.228	0.673	0.354	1.280
Others	-0.374	0.398	0.688	0.289	1.638
Distance to water source	-0.359	0.136	0.698	0.435	1.120
Treatment of water	-0.036	0.958	0.964	0.245	3.790
Method of water treatment	0.417	0.443	1.518	0.522	4.409
Child feces disposal	0.010	0.971	1.010	0.608	1.676
Cooking place	-0.015	0.955	0.985	0.580	1.672
Separate room for cooking	0.569	0.021	1.767	1.091	2.862
Wasting	0.314	0.189	1.369	0.856	2.189
Measles	0.281	0.507	1.325	0.578	3.038
Vitamin-A	-0.468	0.260	0.626	0.278	1.412

[(R)]: Reference Group

studies which had considered either one month or more preceding the study period as the time period of evaluation**.** There might be two prime reasons**,** firstly the present study considered two months prior to the study as the evaluation period which might have contributed to high number of cases**.** Secondly the findings (from the study) showed that overall poor sanitation/rubbish action disposal, water and food hygiene- related practices was not satisfactory in the study area and this could have enhanced prevalence of diarrhoea even during the non peak period as demonstrated by some other studies [1,4].

This study found a strong association between child's age and diarrhoea. It was observed that the higher risk of diarrhoea was among children aged more than 6 months (with the highest risk being among children aged 7-12 months). Similar relationships between age and child morbidity was also observed in a study in the Philippines [5]. A possible explanation for this is that children within the age group of 0-6 moths are taken special care by the parents and they are less exposed to the external environment as compared to the children of other age groups. They might also get the benefit from the protective effect of breast milk (if breastfed). Studies have also shown that the protective effects of breast milk drops dramatically after 6 months of a child's age [5].With increased awareness about breast feeding it may be believed that the mothers follow exclusive breast feeding till 6 months and from 6 months, children are introduced to a variety of foods. Moreover the child becomes more mobile and getting exposed to the external environment and thereby increasing their chances of contamination and infection (especially for

diarrhoea), as their immune system is still under developed. But with growing age, their adaptive immune system becomes strengthened resulting into fewer infection rates. This study also concurs with a study in which Turkey found higher diarrhoea incidences in children aged 6-11 months [6]. Similarly the findings are similar to that of a study conducted in India [7].where children in the age group 7-12 months had the highest prevalence of diarrhoea to the extent of 40.7% followed by the age group 13-24 months and 0-6 months.

This present study found that there is significant association between sources of drinking water and diarrhoea in under than five children. This finding is consistent with other studies who also emphasized the importance of drinking water in relation to diarrhoea morbidity in under-five children [8, 9].The present study found that the prevalence of diarrhoea was more in the household who use public piped water as compared to the households who use hand pump and bore well. This reason might be after the diarrheal epidemic the government has ensured the availability of safe drinking water through hand pump and bore well as these can be constructed quickly and need less infrastructural investment at the same time no investment was done to ensure the safety of existing public piped system as a result of which it has become an unsafe source of drinking water. Another reason which may be attributed to this is the unsafe water handling practice by the community.

The study found no significant association between place of cooking inside the house and outside the house and diarrhoea in under-five children. As the present study has not explored more about the cooking practice followed by the community which might be a probable reason for high prevalence of diarrhoea even after having separate kitchen, further studies need to be done to explore the hypothesis. The hypothesis needs to be supported by evaluation of fecal contamination (escherichia coli in the water, as well as enterococcus faecalis*)* in the kitchen and other cooking places.

Other factors associated with child like measles vaccination, ICDS service delivery and nutritional status of the child were not found to be significantly associated with diarrhoea in under-five children.

LIMITATION OF THE STUDY

As the study was conducted in one of the remote districts of the state which had previous history of diarrhoea result of the study cannot be generalized. Recall period for diarrhoea was two months in the present study which might have contributed to recall bias. The study did not include important health practices related variables like period for breast feeding and other behavioural aspects like hand washing which were considered important in many other diarrhoea related studies. As the study

is a cross sectional survey it doesn't establish the causation among other determinants of diarrhoea. Due to limitation of laboratory resources, funding and time the study could not investigate the agent's microorganisms that are the cause of diarrhoea in under- five children in the study area.

RECOMMENDATIONS

Special care for the children aged 7-12 months should be done as they have higher risk of getting diarrhoea. Considering the contamination of public piped system special focus should be given for maintenance of the system. Awareness about right water treatment methods should be emphasized. Emphasis should be given on imparting health education to mothers and care takers about diarrhoea in children. The local health workers, Anganwadi worker, ASHA worker should work in one unit to promote health education and anti-diarrhoeal medicines should be readily available with them all year round and not during rainy season only to avoid any epidemic situation. Considering the high burden of diarrhoea on the age group of 7-12 months mothers should be made aware about prolonged breast feeding. Other important factors like hand washing and period of exclusive breast feeding should be included in cross-sectional studies to have more realistic results. It is recommended to include the health seeking practice of the community in such studies to have a holistic idea about community's approach towards diarrhoea. Further research, in the form of longitudinal studies, is needed to understand the complete dynamics of diarrhoea in children and associated factors.

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