ISSN Online: 2709-7625
ISSN Print: 2709-7615
Vol.02 No.1 2019

Risk Factors of Diarrhea Among Under Five Years Children: Evidence from Pakistan

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Abstract

The purpose of our study was to determine the potential socio-economic and demographic risk factors of diarrhea among children under five years. We analyzed data of Pakistan demographic and Health Survey 2012-13; total numbers of respondents were 13558 whereas only those females were selected who have children under five years of age that reduced the sample to 7461 while 7049 were reported their children had experienced of diarrhea in last two weeks. The socioeconomic and demographic risk factors associated to respondents were compared among groups using logistic model and odd ratio. It was explored that respondents belonged to less hygienic household facilities (traditional source of cooking, traditional toilet facility and shared toilet facility) have reported diarrhea exposure among their children under the age of five years. It was found that children whose parents were using impure source of drinking water (OR=0.85, 95% CI, 0.70-1.03), traditional toilet facility (OR=0.79, 95% CI, 0.70-0.90), traditional cooking oil (OR= 0.80,95% CI, 0.71-0.89), have low or zero education (OR=1.40, 95% CI = 1.17-1.68), have less exposure to media (OR=0.80, 95% CI = 0.71-0.89), have toilet sharing attitude (OR=0.71, 95% CI = 0.60-0.85), living in urban areas (OR=0.84, 95% CI = 0.75-0.93), particularly in Baluchistan (OR = 0.50, 95% CI = 0.38-0.66) and Gilgit Baltistan (OR = 0.74, 95% CI = 0.56-0.98) are prone to the diarrhea exposure. A great deal of combined program including diarrhea awareness and availability of modern facilities are suggested to ensure in Pakistan particularly in Baluchistan and Gilgit Baltistan

Keywords: diarrhea; household characteristics; socioeconomic status; Pakistan demographic and health survey

1. Introduction

Diarrhea is becoming one of the most dangerous diseases all around the globe. Being second leading cause of death, almost 1.9 million children under 5 years of age are dying due to the disease (Boschi-Pinto, Velebit & Shibuya, 2007). Astonishingly, it caused more than the combined death rate of AIDS and Malaria (United Nations Children's Fund [UNICEF], 2008).

Diarrhea is caused by different sources especially by facial-oral transmission of pathogens (infectious agents) from the environment to victim (Shier, et al., 1996; Arif & Ibrahim, 1998). There are different ways through which it occurs. First, unimproved water sources such as streams, rivers and open walls become dirty, these pathogens mixed in them and then consumption of such water can lead to diarrhea. Another cause of diarrhea is poor sanitary conditions. Children may directly come in contact with fecal matter or through flies which carry these pathogens and move them from feces to food or to children's hands or faces. Eating food without hand washing after defecation, before eating and meal preparation can also lead to diarrhea.

Esrey, et. al. (1991) reviewed 144 studies and measured the impact of water quality on diarrheal incidents. The study showed that improvement in water quality leads to reduce in diarrheal cases. Mboyne (2004) conducted a study to know about the trends of diarrhea among children under 2 years in the Sembabule, district of Uganda. He found by using logistic regression analysis that the use of rivers and streams water increase the chances of diarrhea by 2.2 times than drinking water from the borehole. The results also revealed that drinking water from stagnant pond increase the risk of diarrhea by 2.8 times than drinking water from a pound.

In Ghana, Ahiadeke (2000) found that breastfeeding is a protective agent of diarrhea. This protection occurs through, both, protective agents in breast milk and minimization of exposure to contaminated food and liquids. He found that infants either only breastfed or mixed fed i.e., fed by both breast milk and other food or liquids) have lower incidents of diarrhea than non-breastfed infants.

Studies showed that demographic variables also play important role in diarrhea prevalence. Ahiadeke (2000) study showed that children of educated mothers have lower chances of diarrhea than children of educated mothers. However, primary education was not significant in this study. Some other demographic variables associated with diarrhea are higher family income (Boadi & Kuitunen, 2005), children's age, urban residence (Arif & Ibrahim, 1998) and female (VanDerslice & Briscoe, 1995; Arif & Ibrahim, 1998). Finally, diarrhea prevalence has been found to be significantly higher in the rainy season relative to other seasons (Arif & Ibrahim, 1998).

This study focused on socioeconomic and demographic risk factors of diarrhea in Pakistan. The study has broader scope because of its generalizability over all children under the age of five years in the country. Furthermore, it incorporated several socio-demographic variables e.g., wealth index, education, province, toilet facility etc. to measure their association with the prevalence of diarrhea. Although, the study primarily focused on socio-demographic factors, yet we did not neglect water source to include into logistic model. However, we used source of water instead of laboratory reports on sampled water. It has two major causes, the first one is related to scope and prime objective of the study that signify the predictor as one of the socio-demographic variables and secondly, Pakistan Demographic and Health Survey (2012-13) data, the data we used in the study, did not measure water characteristics by laboratory tests that also signified one of the limitations of the study.

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2. Research Methodology

The present study was based on "Pakistan Demographic and Health Survey (PDHS)" conducted with the collaboration of The National Institute of Population Study (NIPS) and ICF International. We used third national survey 2012-13 conducted as a part of PDHS program. Data was collected from household members by trained interviewers who verbally managed and conducted the whole survey. The total sample size of PDHS data was 13861 however we selected those females who have at least one baby in last 5 years and their children have experienced diarrhea in last two weeks before the survey, thereby the sample size of the study reduced to 7061 respondents. PDHS data has several demographic and health variables, but we selected almost all risk factors of diarrhea and excluded all other variables we considered irrelevant to diarrhea. The selected variables can be categorized as socioeconomic and demographic risk factors of diarrhea. The selected socioeconomic risk factors were education, wealth index of the mother, exposure to print media and living area of respondent whereas demographic risk factors include household characteristics that was comprised of sources of drinking water, types of toilet facility and sharing of the facility with other household members, and type of cooking fuel.

The predictors in the study were sources of drinking water, type of toilet facility, toilet sharing, type of cooking fuel and exposure to print and electronic media. Each exposure variable was categorized according to its nature in the survey. Sources of drinking water was categorized into two possible options i.e., pure and impure source of drinking water e.g., water pump or canal respectively. Similarly, availability of toilet facility was characterized by modern and tradition toilet e.g., commode or pit respectively. The sharing attitude of the facility measured whether available toilet facility was being shared with other family members? Cooking fuel was categorized into two options: adoption of modern and traditional source of cooking fuel e.g., modern gas stove or wood stove. Awareness through print and electronic media was measured through frequency of watching television and reading newspaper. Diarrhea exposure was outcome variable. Mothers of children were assessed by a question about children diarrheal episode that whether their children had experienced diarrhea in last two week? Children who experienced diarrhea was codded 1 and who did not experience diarrhea was codded 0.

We used binary logistic regression owing to predictors and outcome categorization. The predictors and outcome were categorical variables which can best be analyzed by logit model. Logit model (OR) have advantage of odd ratio on ordinary least square regression (OLS) coefficients. Odd ratio is difficult to interpret than OLS coefficients, yet it revealed the magnitude of effect among variable categories that OLS is unable to perform.

While considering the limitations of the study, it is needed to add a few more questions in the future surveys concerning water storage pattern in homes, breast-feeding practices, and timings and types of weaning food. The data of this study has limited generalization. Moreover, the analysis was based on self-reported diarrhea morbidity reported by care giver which could be subjected to recall bias. However, the cross-sectional nature of the study restricted to draw causal inferences from association between predictors and outcome.

3. Analysis and Results

Table 1: Characteristics of females who have at least one child in last 5 years and social risk factors of diarrhea among children of under 5 years prior to Pakistan Demographic and Health Survey. 2012-2013.

Variable	N	(%)
Births in last five years		
One	3983	53.4
Two	2730	36.6
Three	675	9.0
Four	73	1.0
Region		
Punjab	2008	26.9
Sindh	1591	21.3
Khyber Pakhtunkhwa	1532	20.5
Baluchistan	1149	15.4
Gilgit Baltistan	709	9.5
Islamabad (ICT)	472	6.3
Type of place of residence		
Urban	3278	43.9
Rural	4183	56.1
Highest Educational Level		
No education	4121	55.2
Primary	1065	14.3
Secondary	1373	18.4
Higher	902	12.1
Wealth index		
Poorest	1623	21.8
Poorer	1483	19.9
Middle	1429	19.2
Richer	1423	19.1
Richest	1503	20.1
Source of drinking water		
Pure source of drinking water	6376	92.0
Impure source of drinking water	557	8.0
Type of Toilet facility		
Modern source of toilet facility	5279	76.8
Traditional source of toilet facility	1592	23.2

Toilet facilities shared with other households		
No	5242	88.0
Yes	716	12.0
Type of cooking fuel		
Modern source of cooking fuel	2765	38.5
Traditional source of cooking fuel	4423	61.5
Exposure of print and electronic Media		
No at all	2226	30.0
At least once a week	4642	62.5
Daily	562	7.6
Had diarrhea recently		
No	5275	74.8
Yes last two week	1774	25.2

Note: Owing to incomplete survey data, the number of participants available for analysis was not uniform across all variables.

Table 1 depicts that among all the respondents of the study, selected through the criteria, the first group have maximum percentage (53.4%) who have one child in last five years whereas on the other hand only 73 (1.0%) females have four or more than four children in the last five years. Most of the respondents were from Punjab province (26.1%) due to its large number of populations. However, significant number of respondents were living in rural areas (56.1%) compared to urban areas (43.9%). The total literacy rate was very low in the country and majority of the population is living in rural setting therefore mostly respondents (55.2%) were literate. Although very few respondents have educational background, but they did not secure their primary certificate (5.4%). It was also explored that 21.8% of the respondents were poor and 19.1% were from richer group. The respondents who used pure drinking water have significant percentage (92.0%) while 8.0% of the respondents were using impure source of drinking water. The respondents who were using modern source of toilet facility at their homes have highest percentage (76.8%) while only 23.8% of the respondents were using traditional toilet facility at their home. The respondents who used traditional source of cooking fuel have significant percentage (61.5%). The respondents whose children did not experience diarrhea in last two week have significant percentage (74.8%). Table 2 comprised a comparison of children who experienced diarrhea and who did not experience diarrhea.

Table 2: Individual characteristics and diarrhea status among children under the age of five

Variables	Participants (N=7049) Diarrhea Status: Those who did not experience Diarrhea n=5275 N (%)	Participants (N=7049) Diarrhea Status: Those who experienced Diarrhea in last two weeks n=1774 N (%)	Total
Region			
Punjab	1388(26.3)	505(28.5)	1983
Sindh	1071(1071)	425(24.0)	1496
Khyber Pakhtunkhwa	1032(19.6)	440(24.8)	1472
Baluchistan	902(17.1)	153(8.6)	1055
Gilgit Baltistan	543(10.3)	136(7.7)	679
Islamabad (ICT)	339(6.4)	115(6.5)	454
Type of place of residence			
Urban	2401(45.5)	729(41.1)	3130
Rural	2874(54.5)	1045(58.9)	3919
Highest Educational Level			
No education	2860(54.2)	990(55.8)	3850
Primary	742(14.1)	270(15.2)	1012
Secondary	969(18.4)	340(19.2)	1309
Higher	704(13.3)	174(9.8)	878
Wealth index			
Poorest	1107(21.0)	396(22.3)	1503
Poorer	1003(19.0)	394(22.2)	1397
Middle	978(18.5)	361(20.3)	1339
Richer	1025(19.4)	338(19.1)	1363
Richest	1162(22.0)	285(16.1)	1447
Source of drinking water			
Pure source of drinking water	4517(92.2)	1504(90.9)	6021
Impure source of drinking water	382(7.8)	150(9.1)	532
Type of Toilet facility			
Modern source of toilet facility	3819(78.3)	1202(74.1)	5021
Traditional source of toilet facility	1058(21.7)	420(25.9)	1478
Toilet facilities shared with other households			
No	3815(89.0)	1167(85.2)	4982
Yes	472(11.0)	203(14.8)	675
Type of cooking fuel			
Modern source of cooking fuel	2051(40.3)	593(34.9)	2644
Traditional source of cooking fuel	3042(59.7)	1105(65.1)	4147
Exposure of print and electronic Media			
No at all	1542(29.3)	537(30.5)	2079
At least once a week	3307(62.9)	1096(62.2)	4403
Daily	408(7.8)	129(7.3)	537

ISSN Online: 2709-7625
ISSN Print: 2709-7615

Note: Owing to incomplete survey data, the number of participants available for analysis was not uniform across all variables.

Table 3 indicated the results of binary logistic regression on selected variables of the study to predict diarrhea prevalence among under five children. In the group of residence place, children from urban setting have higher chances to be victimized of diarrhea (OR=0.84, 95% CI = 0.75-0.93) compared with rural setting. Wealth index comparison showed that children in lower wealth index are highly likely to be diarrheal (OR=1.46, 95% CI = 1.23-1.73) as compared to the children in higher wealth index group. Similarly, the results also revealed that mother education is strong predictor of diarrhea prevalence among children because low or no education is highly associated with diarrhea prevalence among children (OR=1.40, 95% CI = 1.17-1.68) as compared to educated mother. As far as toilet facility and sharing attitude concern, it was found that children in the families who used tradition toilet facility (OR=0.79, 95% CI = 0.70-0.90), traditional cooking fuel (OR=0.80, 95% CI = 0.71-0.89), have toilet sharing attitude (OR=0.71, 95% CI = 0.60-0.85) and least media exposure (OR=0.80, 95% CI = 0.71-0.89) are exposed to diarrhea comparing with who used modern toilet, modern cooking fuel, did not share it and do have high media exposure respectively. Furthermore, related to the most important predictor of diarrhea i.e., source of drinking water, it was explored that impure drinking water caused diarrhea (OR=0.85, 95% CI = 0.70-1.03) among children. Overall, Balochistan (OR = 0.50, 95% CI = 0.38-0.66) and Gilgit Baltistan (OR = 0.74, 95% CI = 0.56-0.98) have higher number of diarrhea cases comparing with other provinces and capital of Pakistan.

Table 3: Binary logistic regression for the predictors associated with diarrhea among children under the age of five

Variables	Participants (N=7049)		OR (95%, CI)	AOR (95%, CI)
	Diarrhea Status			
	Those who did not experience Diarrhea n=5275 N (%)	Those who experienced Diarrhea in last two week n=1774 N (%)		
Region				
Punjab	1388(26.3)	505(28.5)	1.07(0.85-1.36)	0.88(0.68-1.14)
Sindh	1071(1071)	425(24.0)	1.17(0.92-1.49)	0.86(0.65-1.12)
Khyber Pakhtunkhwa	1032(19.6)	440(24.8)	1.26(0.99-1.60)	0.93(0.71-1.22)
Baluchistan	902(17.1)	153(8.6)	0.50(0.38-0.66)**	0.33(0.24-0.46)**
Gilgit Baltistan	543(10.3)	136(7.7)	0.74(0.56-0.98)*	0.52(0.37-0.72)**
Islamabad (ICT)	339(6.4)	115(6.5)	1	1
Place of residence				
Urban	2401(45.5)	729(41.1)	835(0.75-0.93)**	1.29(1.10-1.52)*
Rural	2874(54.5)	1045(58.9)	1	1
Highest Educational Level				
No education	2860(54.2)	990(55.8)	1.40(1.17-1.68)**	1.07(0.84-1.36)
Primary	266(5.0)	116(6.5)	1.76(1.34-2.32)**	1.25(0.97-1.61)
Secondary	433(8.2)	161(9.1)	1.50(1.17-1.92)**	1.27(1.01-1.59)*
Higher	704(13.3)	174(9.8)	1	1
Wealth index				
Poorest	1107(21.0)	396(22.3)	1.46(1.23-1.7)**	2.46(1.72-3.51)**
Poorer	1003(19.0)	394(22.2)	1.60(1.35-1.91)**	1.98(1.49-2.65)**
Middle	978(18.5)	361(20.3)	1.51(1.26-1.80)**	1.87(1.46-2.39)**
Richer	1025(19.4)	338(19.1)	1.34(1.13-1.61)**	1.40(1.14-1.73)**
Richest	1162(22.0)	285(16.1)	1	1
Source of drinking water				
Pure source of drinking water	4517(92.2)	1504(90.9)	0.85(0.70-1.03)	0.76(0.57-1.01)
Impure source of drinking water	382(7.8)	150(9.1)	1	1
Type of Toilet facility				
Modern source of toilet facility	3819(78.3)	1202(74.1)	0.79(0.70-0.90)**	0.93(0.72-1.20)
Traditional source of toilet facility	1058(21.7)	420(25.9)	1	1
Toilet facilities shared with other households				
No	3815(89.0)	1167(85.2)	0.71(0.60-0.85)**	0.85(0.69-1.03)
Yes	472(11.0)	203(14.8)	1	1
Type of cooking fuel				
Modern source of cooking fuel	2051(40.3)	593(34.9)	0.80(0.71-0.89)**	0.95(0.78-1.14)
Traditional source of cooking fuel	3042(59.7)	1105(65.1)	1	1
Exposure of print and electronic Media				
No at all	1542(29.3)	537(30.5)	1.10(0.88-1.37)*	0.75(0.56-1.00)*
At least once a week	3307(62.9)	1096(62.2)	1.05(0.85-1.29)	0.84(0.67-1.07)

Daily	408(7.8)	129(7.3)	1	1

Note: Owing to incomplete survey data, the number of participants available for analysis was not uniform across all variables. **p-value<0.01, *p-value<0.05

Table 3 indicated the results of binary logistic regression on selected variables of the study to predict diarrhea prevalence among under five children. In the group of residence place, children from urban setting have higher chances to be victimized of diarrhea (OR=0.84, 95% CI = 0.75-0.93) compared with rural setting. Wealth index comparison showed that children in lower wealth index are highly likely to be diarrheal (OR=1.46, 95% CI = 1.23-1.73) as compared to the children in higher wealth index group. Similarly, the results also revealed that mother education is strong predictor of diarrhea prevalence among children because low or no education is highly associated with diarrhea prevalence among children (OR=1.40, 95% CI = 1.17-1.68) as compared to educated mother. As far as toilet facility and sharing attitude concern, it was found that children in the families who used tradition toilet facility (OR=0.79, 95% CI = 0.70-0.90), traditional cooking fuel (OR=0.80, 95% CI = 0.71-0.89), have toilet sharing attitude (OR=0.71, 95% CI = 0.60-0.85) and least media exposure (OR=0.80, 95% CI = 0.71-0.89) are exposed to diarrhea comparing with who used modern toilet, modern cooking fuel, did not share it and do have high media exposure respectively. Furthermore, related to the most important predictor of diarrhea i.e., source of drinking water, it was explored that impure drinking water caused diarrhea (OR=0.85, 95% CI = 0.70-1.03) among children. Overall, Baluchistan (OR = 0.50, 95% CI = 0.38-0.66) and Gilgit Baltistan (OR = 0.74, 95% CI = 0.56-0.98) have higher number of diarrhea cases comparing with other provinces and capital of Pakistan.

Diarrhea is a contagious disease, and it has been found that people of urban areas are more sufferer of this disease than people of rural areas, the finding is contrary to the study of Arif & Naheed (2012) and Chen, Yao, Li, Shi, Dai & Lu, (1992). Illiterate people are more prone to diarrhea as of those who are less educated or highly qualified. This finding is parallel to the study of Mihrete, et al. (2014). The wealthier experience less diarrhea than poor people because they acquire high economic positions and can easily avail health facilities as elaborated in the study of Fuller, et al. (2014). It is also evident that people who lack facilities of safe and pure drinking water and having no proper water storage are more susceptible to diarrhea as compared to the people who are having all these facilities as mentioned in the findings of McMahon, et al., (2013), Heller, et. al. (2003) and Lule, et. al. (2005). People who use pit toilets or go for any open place are more prone to diarrhea then those who use modern and ventilated toilets, Koopman (1978) and WHO (2011) reported similar findings. Likewise, if these toilet facilities are shared, they can increase the risk of fatality to become victim of diarrhea. While the people who avoid sharing toilets are found less effected to this disease and similar findings are recounted in the studies of Roushdy, Sieverding & Radwan (2012) and Imran, Zahir, Khan, Pasha & Anjum (2013). Similarly, it is found that the use of traditional ways for cooking food e.g., biogas and firewood, became more hazardous and riskier to be more prone to diarrhea than the use of natural gas, LPG or other modern techniques, as we can find in the studies of WHO (2014) and Ahmad (2014). The study also revealed that there is a slight difference in the rate of diarrheal disease among the people using print or electronic media i.e., T.V. radio, and cinema and those who do not use print media at all, unlike the study of Rao, et. al. (1998).

4. Conclusion and Recommendations

In conclusion, the results revealed socioeconomic and demographic risk factors i.e., wealth index, education, cooking fuel, toilet facility and its sharing attitude, exposure to media, source of drinking water and living area are associated with prevalence of diarrhea. More generally, we can conclude that to reduce the incidence of diarrhea in Pakistan and most likely also in comparable countries, both household and context factors should be considered and that the effects of these factors depend on the specific situation at household and community level. Reducing diarrhea risk thus calls for an integrated approach in which improvement of water and sanitation facilities at household and community level goes hand in hand with improvement of socioeconomic and parents related, especially mother, factors. There is a need of a well-organized government program to ensure the continued supply of resources, training and education of health workers so that the mortality and morbidity related to diarrheal illness can be prevented in Pakistan.

The following health recommendations are forwarded based on the findings of the study:

1- Awareness campaigns should be started in urban and rural areas equally with specific intervals.
2- Awareness among mothers/caregivers on the seriousness of childhood diarrhea, particularly in urban areas through mass education programs or use of public health officials.
3- Education should be provided to all the people, rich or poor for mental as well as environmental development.
4- Water should be stored in clean containers, such containers be properly covered and cleaned regularly with dates mentioned on it and water should be boiled before use.
5- Repairing of these pipelines coupled with improvements in water storage patterns in home can help to reduce the water-borne transmission of pathogens that cause diarrhea.
6- Every house should have its own personal toilet facility in order to avoid open toileting use and all street drainage system should properly be maintained/ improved through government departments like public health / TMA.
7- Use the safe cooking fuels (Natural Gas, LPG etc.) if possible, and in case of biometric fuel for cooking, care should be made to wash hands with soap after using it.
8- Mothers should also be encouraged to feed the child well during episodes of diarrhea.

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