Prevalence and Costs of Childhood Diarrhoea in the Slums of Dhaka

M. JAHANGIR ALAM

Department of Economics and Social Sciences (ESS)
BRAC University
Dhaka, Bangladesh

November 2009

South Asian Network for Development and Environmental Economics (SANDEE)
PO Box 8975, EPC 1056
Kathmandu, Nepal

SANDEE Working Paper No. 46-09

Published by the South Asian Network for Development and Environmental Economics (SANDEE)
PO Box 8975, EPC 1056 Kathmandu, Nepal.
Telephone: 977-1-5003222 Fax: 977-1-5003277

SANDEE research reports are the output of research projects supported by the South Asian Network for Development and Environmental Economics. The reports have been peer reviewed and edited. A summary of the findings of SANDEE reports are also available as SANDEE Policy Briefs.

National Library of Nepal Catalogue Service:

M. Jahangir Alam
Prevalence and Costs of Childhood Diarrhoea in the Slums of Dhaka
(SANDEE Working Papers, ISSN 1893-1891; 2009- WP 46)

ISBN: 978 - 9937 -8218 - 0 - 3

Key words:

1. Diarrhoea
2. Child
3. Cost
4. Behavioural factors
5. Hurdle Model

The South Asian Network for Development and Environmental Economics

The South Asian Network for Development and Environmental Economics (SANDEE) is a regional network that brings together analysts from different countries in South Asia to address environment-development problems. SANDEE's activities include research support, training, and information dissemination. Please see **www.sandeeonline.org** for further information about SANDEE.

SANDEE is financially supported by International Development Research Center (IDRC), The Ford Foundation, Swedish International Development Cooperation Agency (SIDA), the World Bank and the Norwegian Agency for Development Cooperation (NORAD). The opinions expressed in this paper are the author's and do not necessarily represent those of SANDEE's donors.

The Working Paper series is based on research funded by SANDEE and supported with technical assistance from network members, SANDEE staff and advisors.

Comments should be sent to M. Jahangir Alam, Department of Economics and Social Sciences (ESS), BRAC University, Dhaka, Bangladesh, Email: jahangir@bracu.ac.bd

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Abstract

Diarrhoea is a common water-borne disease among slum children in Bangladesh. This study seeks to identify the engineering, behavioural and socio-economic determinants of childhood diarrhoea and its duration and to compute the resulting costs borne by slum dwellers. The study is based on a survey of 480 households in 32 slums in Dhaka. Nearly 50 percent of slum households reported diarrhoea episodes during the recall period of 15 days, with an average duration of 3.76 days of diarrhoea. The cost of child diarrhoea per episode ranges from BDT 124 (USD 1.81) to BDT 276 (USD 4). The annual cost of child diarrhoea for a representative child ranges from BDT 296 (USD 4.29) to BDT 656 (USD 9.51) based on assumptions about the value of leisure time lost by care givers. The yearly cost of child diarrhoea for a representative household ranges from BDT 378 (USD 5.49) to BDT 837 (USD12.15) or 0.6 percent to 1.3 percent of annual household income. Participation in NGO hygiene awareness activities, owning a radio and television, the mother's education level and hand washing reduce the probability of childhood diarrhoea while participation in NGO hygiene awareness activities, adoption of hand washing practices, and residence in a semi-*pucca* house structure reduce the duration of childhood diarrhoea. Our study suggests that more focus on water storage and hand washing in NGO and media campaigns and more concerted efforts by the state to provide clean water 24 hours a day to slum communities would go a long way towards controlling the incidence of childhood diarrhoea.

Keywords: Diarrhoea, Child, Cost, Behavioural factors, Hurdle Model

JEL Classifications: I12, I18, Q51, Q53

Prevalence and Costs of Childhood Diarrhoea in the Slums of Dhaka

M. Jahangir Alam

1. Introduction

Diarrhoeal disease is one of the five leading causes of morbidity and mortality among children aged between 0 and 5 years. Global estimates show that deaths due to diarrhoea[1] have declined from 4.6 million in the 1980s (Snyder and Merson, 1982) and 3.3 million in the 1990s (Bern *et al.*, 1992) to 2.5 million by the year 2000 (Kosek *et al.*, 2003). Much of the decline is possibly due to improvements in the treatment and management of diarrhoeal disease and increased use of oral rehydration therapy (ORT) in the developing countries (WHO, 2004). However, morbidity has not shown a parallel decline despite improvements in infrastructural facilities in developing countries. This is probably because of limited changes in behavioural factors when it comes to personal hygiene such as hand washing and low levels of awareness on disease prevention. The incidence of diarrhoea attacks among children per year in the developing countries was at 3.2 episodes per child in 2000 (Kosek *et al.*, 2003).

In Bangladesh diarrhoeal diseases continue to play a significant role among the causes of death among children below 5 years of age according to the Interim Poverty Reduction Strategy Paper (PRSP) published by the Government of Bangladesh in 2002. These children are malnourished and therefore vulnerable to diarrhoea related deaths. Around 125,000 children under five die each year from diarrhoea, i.e. 342 children per day as per the PRSP report.

As Bangladesh is a riverine country, floods are a common natural hazard. Although diarrhoeal diseases are prevalent throughout the year, epidemics of diarrhoeal diseases and cholera mainly occur twice a year – during the hot and humid summer months of April-May, and during and after the monsoon floods from July to September (HSB, 2004). For example, from 30 July to 26 August 2007, 104,846 cases of diarrhoea and 20 deaths were recorded in the flood affected areas of Bangladesh (Case Fatality Rate = 0.02 percent) (WHO, 2007). During the same period, 19,190 diarrhoea cases were admitted to the specialized hospital, International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), from flood affected areas across Dhaka (WHO, 2007).

[1] A standard definition of diarrhoea could be the passing of three or more liquid stools in a 24-hour period, with twelve or more loose or watery stools for a breast-fed baby. Diarrhoea is generally characterized as "acute watery", "persistent" or "dysentery". Acute watery diarrhoea has an abrupt beginning and lasts less than 14 days. Persistent diarrhoea lasts more than 14 days, which generally results in significant weight loss and nutritional problems. Dysentery is diarrhoea in which blood is obviously seen in the faeces (WHO, 2007)

Researchers find the worst cases of diarrhoea in the urban slums[2] of Dhaka. In these slums, overcrowding and poor basic amenities coupled with inadequate attention to personal hygiene result in a greater risk of infection. Water quality at the point-of-use is often worse than that at the point-of-source because drinking water can become contaminated due to storage and behavioural activities (Alam, 2007). In fact, in the Dhaka slums, 27 percent of all deaths are attributable to diarrhoea (Hussain, 1999). Furthermore, dehydration resulting from diarrhoea causes other health related complications in children.

In this study, we seek to understand the prevalence of diarrhoeal diseases among children in the urban slums of Dhaka and to identify interventions that would improve the situation. The study has two major objectives. The first is to identify the risk and duration of child diarrhoea and their relationship to engineering, behavioural and socio-economic factors. The second objective is to compute the economic costs to slum households from diarrhoea. Very few studies so far have examined the impacts of diarrhoeal disease on slum dwellers. We hope to make a contribution to poverty reduction strategies in Bangladesh by examining the health status of slum children and the costs borne by slum households with regard to sick children. Our study contributes to current literature on diarrhoeal costs by examining more carefully the opportunity costs associated with child care during diarrhoea.

2. Determinants and Costs of Child Diarrhoea: The Background to the Study

Diarrhoea is usually attributed to ingestion of water or foods contaminated with faecal coliforms or other pathogens, or faecal-oral contamination. Unsafe water supply, inadequate sanitation facilities, and lack of awareness on personal hygiene cause 88 percent of diarrhoea attacks (WHO, 2004). Age, nutritional status, diet, drugs, immunologic status, use of rehydration fluids, methods of water storage and hand feeding practices are the major factors affecting the duration of diarrhoea episodes (Mirza *et al.*, 1997). Diarrhoea is almost preventable with hygiene interventions that reduce contamination of hands, food and water as well as the better management of water and sanitation facilities (Fewtrell *et al*., 2005).

Alberini *et al.* (1996) uses the terms behavioural and engineering to categorize factors linked with the incidence and severity of diarrhoea. The engineering factors refer mainly to clean water sources and sanitation services (Checkley *et al.*, 2004). Behavioural factors focus on household behaviours and hygiene practices such as use of soap, hand washing practices by mother and children before meals and after defecation, the use of a lid while carrying and storing water and boiling/treating water (Alberini *et al.*, 1996; Han and Hliang, 1989; Knight *et al.*, 1992; Hoque *et al.*, 1999; and Jalan *et al.*, 2003). All these factors lead to changes in the exposure to risks associated with diarrhoea.

In order to understand the implications of diarrhoeal diseases, we need to estimate the costs borne by households. Researchers can use economic models that take into account the behavioural responses of households in order to carefully estimate the monetary value of the cost

[2] A slum is a cluster of compact settlements of 5 or more households which generally grow very unsystematically and haphazardly on government or private vacant land and contain unhealthy living conditions and atmosphere.

of diarrhoeal attacks. Using such models, it is possible to show that an individual's willingness to pay (WTP) for a small reduction in exposure of children to diarrhoea (Harrington and Portney, 1987) comprises lost earnings due to diarrhoea, the marginal cost of averting activities, the marginal medical expenditures and the monetary value of disutility caused by exposure of children to diarrhoea. For children, sick days during diarrhoeal illness have no real implication in terms of loss of income[3] but during the period of sick days the attending parent(s) might lose income and/or leisure, which should be included in the cost estimations. It is not possible however to directly estimate the value of the disutility due to sickness in children and their parents. Thus, in practice, researchers generally classify the WTP for diarrhoea reductions or, alternatively, the costs associated with diarrhoea, into treatment costs, averting costs in terms of actions taken to avoid sickness, and opportunity costs in terms of lost time.

The cost of treatment of diarrhoea in developing countries varies considerably because of diverse health care systems, differences in hospital capacity, scope and sources of funding, the pricing policy on drugs, and differences in per capita income (Phelps, 1992; Mohaghan and Mohaghan, 1996). There are several studies that estimate diarrhoeal costs. Patel *et al.* (2003), for instance, estimate that the average cost (direct medical, non-medical and indirect costs) of treating diarrhoea per child in urban India to be USD 14 per episode. Two other studies from India offer slightly different estimates. Dasgupta (2004) finds the annual cost of illness due to diarrhoea in urban Delhi to be Rs.1,094 (USD 25.41[4]) while in Pune, Gokhale (1999) estimates costs to be USD 5.64 (but includes only the direct medical costs) for an average duration of 2.01 days per episode of diarrhoea. In the Philippines, the average medical costs per episode of diarrhoea are estimated at USD 9 and USD 7 respectively for urban and rural areas when the patient receives treatment at a private health centre (WHO, 2001). In Indonesia, studies have estimated diarrhoeal costs at USD 2.27 per child (Lerman *et al.*, 1985). Table 1 provides some estimates of the costs of child diarrhoea in the developing countries. From this, we can see that the cost per child per episode of diarrhoea ranges from USD 1.94 to USD 14 in Asia.

Most studies (Lerman *et. al.*, 1985; Dasgupta, 2004) calculate the cost of child diarrhoea without valuing the opportunity cost to the care-giving family members. Moreover, studies often do not identify risk factors associated with the prevalence and duration of diarrhoea in urban slums. This study not only identifies these risk factors but also calculates the treatment cost (home and medical) along with the indirect opportunity costs of time associated with child diarrhoea in the urban slums in Dhaka, Bangladesh. However, the costs estimated in this study do not include averting costs or the value of disutility from sickness. Thus, this study provides a lower bound estimate of household WTP to reduce diarrhoea. Nonetheless, such an estimate of the costs of diarrhoea is useful in justifying public investments and education campaigns to prevent and reduce diarrhoeal incidence in slums.

[3] However, children can incur costs from diarrhoea if it leads to stunted growth, physically or mentally. For example, if children that suffer from diarrhoea grow up to be weaker than others in their age cohort, then they might collect lower wages (as field labour, for instance) as adults.

[4] USD 1 = Rs. 43.05

3. Study Area and Sampling

There are a total of 1,925[5] slums with 267,065 households within the Dhaka Metropolitan Area (DMA). Approximately 95 percent of the slums contain fewer than 500 households. In 50 percent of the slums the primary water source is the tap.[6] In the case of the other slum-dwellers, 2.6 percent rely on tube wells, 0.4 percent on ponds, 1.3 percent on rivers, and 0.1 percent on other sources for drinking water. The remaining 46 percent of the slums have no specified water source with households from these slums having to search for a water source on a daily basis. With regard to sanitation facilities, 12.3 percent of the slums possess water-sealed latrines, 21.5 and 22.6 percent possess open and pit latrines respectively while the remaining 43.6 percent have no specified sanitation system.

The Dhaka Metropolitan Area (DMA), which is the site for this study (see Appendix 1), is divided into eight equal zones. We randomly selected four slums from each zone to undertake the household survey. On average, each slum had 142 households and we randomly selected 15 households from each slum. We conducted a household survey from 26 May, 2007, to 12 June, 2007. We collected data on a total of 480 households from 32 slums.

We used a constant skipping factor (*k*) to determine the number of households to be skipped in order to select households for the interview. We obtained the value of the skipping factor by dividing the total number of households within the particular slum by the sub-sample size, which was fixed at 15. The enumerator selected the first household at random on the basis of the completed interview or the unwillingness of the selected household to participate in the survey. The enumerator then skipped *k* households to the left and selected the next household and subsequently skipped another *k* households and so on until the enumerator was able to complete 15 interviews.

In our study, we define households as a group of individuals related by blood or marriage living on the same premises and sharing one set of cooking utensils. The principal respondents to questionnaire were women because we felt they were more aware of the children's health condition compared to the men of the household. We excluded households without any child between 0-5 years from the survey.

We divided the household survey into several sub-components. We collected data on household members, household status, household information on diarrhoea, the opportunity cost of diarrhoea, water system, water collection and storage, behavioural factors related to water use, sanitation facility, sanitation use, awareness of and practices relating to personal hygiene.

Table 2 presents summary statistics from our household survey. The average age of respondents (females) and the heads of the household were 27 and 34 years respectively. The 480 households

[5] While the author collected the data on the slum characteristics, water source and sanitation facility from the Local Government Engineering Department, the calculations were his own.

[6] Dhaka Water Supply and Sewerage Authority (DWASA) currently supplies water to 75% of the city area. 82% is in the form of ground water sources which are tapped through Deep Tube Wells (DTW), and the remaining 18% is sourced from the water treatment plants (in Saidabad and Chandnighat) and two other smaller units in Narayanganj (Haque et al., 2006)

in our sample had a total of 2,142 members. The average, maximum and minimum size of a household was 4.46, 12 and 2 respectively. The average monthly household income was BDT 5,330 (USD 76)[7]. On average each household had more than 1 child below the age of 5 years with the maximum reported number being 3 children.

613 children were below the age of 5 years in the surveyed households with an average age of 2.65 years. Of the 613 children in the sample, 298 had suffered from diarrhoeal attacks within the recall period of 15 days with the average duration of a diarrhoea episode per child being 3.76 days. Figure 1(a) shows the duration of child diarrhoea and the percentage of children with diarrhoea among the total number of children. The figure shows that 51 percent of the total number of children had no episodes of diarrhoea during the recall period. Approximately 12 percent of the children suffered from diarrhoeal attacks lasting 2 days while approximately 13 percent had an episode lasting for 3 days.

Figure 1(b) shows the percentage of children with episodes of diarrhoea and the duration of those episodes within the recall period of 15 days. As Figure 1(b) shows, the duration of child diarrhoea is mostly between 2 and 3 days with 27 percent of the children suffering from diarrhoea for 2 days and 28 percent for 3 days. Approximately 5.7, 2 and 1 percent respectively of the children surveyed suffered from diarrhoea for 7, 10 and 15 days.

4. Methods of Estimation

4.1 The Econometric Model

There are two aspects to the problem of diarrhoea in slum households. Firstly, we need to study the factors that influence the probability of diarrhoeal occurrence. Secondly, we need to examine how different factors affect the duration of the diarrhoeal episode. The probability of having diarrhoea and the duration of the diarrhoeal episode are generally the result of two different stochastic processes. While it is possible to explain the two processes by the same set of explanatory variables, these variables need to be interpreted differently for each case. In estimating the prevalence and duration of diarrhoea, we note that the variable child diarrhoea is binary in nature while we need to treat the data on the duration of diarrhoea as count data. In order to figure out how to estimate the determinants of these two variables, we need to consider a variety of models.

We estimate the probability or prevalence of child diarrhoea by using a Logit Model and the duration of diarrhoea by using count data models. In order to estimate the duration of diarrhoea, we first use a Poisson Regression Model and test for over dispersion. This is because if over dispersion is found in the data, it is better to use a Negative Binomial Regression Model. However, both the Poisson and Negative Binomial Models have a limitation in that they do not consider the zero outcomes of the data generating process as qualitatively different from the positive ones (Greene, 2007; Mullahy, 1986). Scholars have proposed the Hurdle Model as an alternative

[7] USD 1 = BDT 68.87

model to overcome this limitation (Mullahy, 1986). In this formulation, a binary probability model determines whether a zero or non-zero outcome occurs. In the latter case, a (truncated) Poisson or Negative Binomial distribution describes the positive outcomes (Green, 2007). We follow this approach and use a model similar to that of Noronha and Andrade (2002).

In this study, therefore, we construct a hurdle or two-part model where we specify two parametrically independent likelihood functions, each representing a stage in the estimation procedure. We base the first likelihood function on the whole sample, representing the binary process whether the child is affected by diarrhoea or not. A vector of parameters ($\hat{a}_1$,$\acute{a}_1$) estimated using a Logit Model determines this process. We base the second likelihood function on the sub-sample given the count data (number of sick days) of children who suffered from diarrhoea. A vector of parameters ($\hat{a}_2$,$\acute{a}_2$) estimated using a Negative Binomial Model determines this process.

4.2 Model Specification Test

We carried out specification tests of the different count data models in order to justify our use of Negative Binomial Hurdle Model against other available models. We used the likelihood ratio test (LR Test) for this purpose (Green, 2007; Cameron and Trivedi, 2005). Our hypotheses testing procedures are as follows. First, we test the existence of over dispersion in our data so as to select our model specification between the Poisson type count data models (Poisson Model and Poisson Hurdle Model) and the Negative Binomial type count data models (Negative Binomial Model and Negative Binomial Hurdle Model). If the over dispersion parameter equals zero, then the Negative Binomial Model and the Negative Binomial Hurdle Model reduce to the Poisson Model and the Poisson Hurdle Model respectively. Hence, we use the LR test to test the following: (1) H_0: Poisson Model against H_A: Negative Binomial Model, and (2) H_0: Poisson Hurdle Model against H_A: Negative Binomial Hurdle Model.

Second, in order to choose our model specification between the non-Hurdle count data models (Poisson Model and Negative Binomial Model) and the Hurdle count data models (Poisson Hurdle Model and Negative Binomial Hurdle Model), we test two additional hypotheses. Since the non-Hurdle count data models and Hurdle count data models are not nested with each other in our model specification, we use the LR test to test the following: (3) H_o: Poisson Model against H_A: Poisson Hurdle Model, and (4) H_0: Negative Binomial Model against H_A: Negative Binomial Hurdle Model.

4.3 Dependent Variables

Our objective is to identify the determinants of child diarrhoea and the duration of diarrhoea. The first dependent variable diarrhoea takes a value of 1 if the child suffers from diarrhoea within the recall period of 15 days and 0 otherwise. The second dependent variable duration explains the number of sick days the child suffers from diarrhoea only if the first dependent variable takes the value of 1. We assume here that the factors determining child diarrhoea and its duration may or may not be the same.

4.4 Independent Variables

As previously stated, factors that influence the incidence of child diarrhoea and its duration are related to behavioural responses such as washing hands with soap after defecation (Mirza *et al.*, 1997; Han and Hlaing, 1989), using strainers to purify drinking water, and the level of awareness about the advantages of paying attention to the quality of drinking water, personal hygiene and sanitation (Fewtrell *et al.*, 2005). Engineering factors such as water source and sanitation also affect diarrhoea occurrence and prevalence (Fewtrell *et al.*, 2005). Based on our assessment of the literature (see Appendix 1), we therefore use the following independent variables.

For the purposes of our study, we have considered a set of engineering, behavioural and socio-economic variables. The engineering variables considered are water availability for 24 hours and pit[8] latrine. The behavioural variables are the use of narrow-necked container, strainer and cloth, and hand washing after defecation. Variables such as owning a radio and television, mothers' education and age, prevalence of adult diarrhoea, the number of household members, participation in NGO hygiene related awareness activities, residence in semi-*pucca* house, location and the perception that contaminated water causes diarrhoea are the socio-economic variables we have used in our model. In Table 3, we present the hypothesis related to how the various risk factors affect the probability of diarrhoeal occurrence and its duration. What follows is a description of the variables used in our analysis.

4.4.1 Engineering Variables

Water availability is a dummy variable that takes the value 1 if water is available for 24 hours and zero otherwise. We expect the coefficient of this variable to be negative explaining its negative association with the occurrence of child diarrhoea and its duration.

The variable pit is a dummy variable that takes the value 1 if the household has a pit latrine and 0 otherwise. We expect this variable to have a negative association with both dependent variables.

4.4.2 Behavioural Variables

The variable narrow-necked container takes a value 1 if the household uses a narrow-necked container to store water and 0 otherwise. We expect it to have a negative association with both dependent variables.

The strainer and cloth variable explains whether the household uses a strainer or cloth as a straining instrument, in which case it takes a value 1, and 0 otherwise; we expect the relationship with the dependent variables to be again negative. If the households know the proper way to use the strainer and cloth as straining instrument, then we obtain a negative association.

[8] The pit latrine has a slab and stools remain in the pan below most of the time.

To measure the hygiene practices of the household respondent, we take the variable hand washing, which takes the value 1 if the respondents wash at least one hand with soap after defecation and 0 otherwise. We expect this hygiene variable to be negatively associated with diarrhoea and its duration.

4.4.3 Socio-economic Variables

The variable radio and television is a dummy variable which takes the value of 1 if the household owns both a radio and television and 0 otherwise. We expect a negative link between households owning radio and television with diarrhoea prevalence and duration since exposure to media enables respondents to have more knowledge and awareness about hygiene practices and disease prevention.

Mother's education is a dummy variable taking the value 1 if the mother's education is higher than primary level (class five) and zero otherwise. We expect educated mothers to minimize both their children's exposure to diarrhoea and its duration in case of infection.

The age variable is a dummy variable taking the value 1 if the child is older than 2 years[9] and zero otherwise. We anticipate age to be negatively correlated with both the dependent variables. As children grow, their disease prevention power increases; hence, we expect a negative association.

The adult diarrhoea variable is a dummy variable that takes the value 1 if there is any adult member other than the child suffering from diarrhoea in the household and zero otherwise. We expect it to be positively related with both diarrhoea and its duration.

The member variable accounts for the total number of people in the household. We are uncertain about its association with the prevalence of diarrhoea and its duration. On the positive side, more household members might mean a more efficient division of labours among the members when it comes to household tasks. On the flip side, more members mean that more people share the same living quarters so that if one member falls sick, there is a higher likelihood of the transmission of the disease to other members. Moreover, households with a higher number of occupants may also be poorer or may not necessarily lead to a more efficient distribution of household tasks if such households also contain a disproportionately high number of young children.

The participation variable is a dummy variable taking the value 1 if the mother of the child participated in any hygiene awareness activities undertaken by NGOs and the value 0 otherwise. Participation in hygiene activities indicates that the respondent has sufficient knowledge about the importance of hygiene and what preventative or curative measures can be adopted to guard against particular diseases. We expect participation in NGO activities therefore to be negatively associated with the prevalence of diarrhoea and its duration.

The variable semi-*pucca* defines the structure of the house. We take this variable as a proxy of household income or wealth. It takes a value 1 if the house is made of cement walls and tin or

[9] The impact of diarrhoea and malnutrition is greatest for children under two years (Food and Nutrition Bulletin, 1982).

cement roof and 0 otherwise. We expect semi-*pucca* to be negatively linked with our dependent variables.

Perception is an awareness measuring variable. It takes a value 1 if the household respondents perceive that drinking contaminated water causes diarrhoea and 0 otherwise. We anticipate it to have a negative relation with both of our dependent variables.

Location is a dummy variable, which take a value 1 if the slum that the household resides in is situated near a river and 0 otherwise. We anticipate households that are near rivers to be more affected by diarrhoea as well as to suffer for longer durations. The location variable helps us to see slum fixed effects.

5. Results and Discussions

5.1 Mean Test between Affected and Unaffected Households

In our sample, 49 percent of the households were affected by diarrhoea and the average duration of child diarrhoea was 3.76 days. Table 4 discusses access to clean water, sanitation and other characteristics of the affected and unaffected households and identify the significant differences. Variables such as narrow-necked container, hand washing, owning radio and television, child's age, mother's education and adult diarrhoea make a significant difference between the affected and unaffected households in terms of the occurrence of diarrhoea.

Table 4 shows the differences between affected and unaffected households when it comes to a variety of factors. About 40 percent of the affected households had water available for 24 hours a day while 45 percent for the unaffected households had the same facility. With regard to important behavioural factors, 80 percent of the affected households and 86 percent of the unaffected households used a narrow-necked container. Among households with diarrhoea, 51 percent of the respondents said that they washed at least one hand with soap after defecation while it was higher at 63 percent for unaffected households.

About 29 percent of the households having child diarrhoea had at least one adult member suffering from diarrhoea, which was significantly different from the 21 percent of the households that had no child diarrhoea but had at least one adult member suffer from the illness. Only 2 percent of the respondents from the affected households participated in hygiene related awareness activities undertaken by NGOs while it was higher at 5 percent for unaffected households. 10 percent of the unaffected household respondents had the perception that drinking contaminated water causes diarrhoea while it was 8 percent for affected households. Of the affected households, 63 percent lived in slums situated near a river.

5.2 Empirical Results

As Figure 2 shows, the results from our specification tests favour the Negative Binomial Hurdle Model against all other specifications considered. The LR test statistic for hypothesis (1) for the Poisson Model against the Negative Binomial Model is $\chi^2_{(1)} = 560.88$, and it rejects the Poisson Model at 1 percent level of significance. The LR statistic for testing hypothesis (2) for the Poisson Hurdle Model against the Negative Binomial Hurdle Model is $\chi^2_{(1)} = 20.35$. Again, the

test rejects the Poisson Hurdle Model at 1 percent significance level. Furthermore, the LR test statistic for testing hypothesis (3) for the Poisson Model against the Poisson Hurdle Model is $\chi^2_{(15)} = 683.96$, which allows us to reject the Poisson Model. The test which tests hypothesis (4) for the Negative Binomial Model against the Negative Binomial Hurdle Model, $\chi^2_{(15)} = 143.42$, rejects the Negative Binomial Model at 1 percent significance level. Given that our specification tests favour the Negative Binomial Hurdle Model, we base our analysis on the estimates of parameters of this model.

We present below results which show the factors affecting the prevalence of child diarrhoea and those that affect the duration of the disease. Unless otherwise specified, we indicate the correlations and associations to be statistically significant if the level of significance is 10 percent or lower.

Table 5 shows the econometric results. We found narrow-necked container, strainer and cloth, hand washing, radio and television, mother's education, age, adult diarrhoea, number of household members and perception to be significantly associated with the prevalence of diarrhoea. When it comes to the duration of diarrhoea, we found a significant association with hand washing, adult diarrhoea, participation in NGO hygiene awareness activities and semi-*pucca* house.

5.2.1 Prevalence of Child Diarrhoea

As anticipated, we found that the use of a narrow-necked container to store water reduces the incidence of child diarrhoea (by 11 percent) because dirt and flies cannot quickly enter the stored water.

Strangely, the use of strainer showed a positive relation with child diarrhoeal attacks. However, it could be due to incorrect use of strainers by households. For example, households using a folded-cloth as a strainer must ensure that the cloth is clean and in the case of metallic or plastic strainers that they are purified before use. Our qualitative evaluation during the household surveys suggested that households did not adopt these vital hygiene practices.

We found attention to personal hygiene such as represented by washing hands with soap after defecation to be negatively associated with the prevalence of diarrhoea. We need to mention here that in 97 percent of the cases the respondent was the mother of the child in the household. The probability of diarrhoea falls by 12 percent if the respondents washed at least one hand after defecation using soap.

The ownership of radio and television reduces the probability of suffering from diarrhoea. This implies that respondents paid attention to the hygiene and health-related awareness messages heard and seen over radio and television respectively and adopted the practices advocated over the media in their day-to-day lives. The probability of the child contracting diarrhoea falls by 13 percent if the child's mother has received an education higher than primary level. This may be because a higher level of education helps respondents to develop basic ideas about health and hygiene. The age of the child is also a significant variable suggesting that with age the children either become more careful or develop some degree of immunity to diarrhoeal attacks.

As expected the probability of diarrhoeal attacks falls by 21 percent if the respondent (the child's mother) participated in hygiene related awareness activities undertaken by NGOs.

5.2.2 Duration of Child Diarrhoea Episode

In order to interpret the coefficients of the Negative Binomial Model, we use the following equation: $(e^b - 1) * 100$ (Cameron *et al.*, 1988) where we interpret the resulting number as the percentage change in the dependent variable for a unit change in the independent variable. Whether the change is an increase or decrease depends on the sign of the resulting number derived from the equation. For example, the coefficient of water availability is 0.057 and taking its exponential gives the number 1.06. Plugging this number in the equation gives us a resulting number of 6%. This means that as the water availability variable changes from 0 to 1, the duration of diarrhoea reduces by 6 percent.

As expected, washing at least one hand with soap after defecation reduces the duration of the diarrhoea episode. The duration of diarrhoea reduces by 26 percent for respondents who wash at least one hand as compared with those who do not.

The duration of diarrhoea for children whose mothers participate in any NGO hygiene awareness activities is 31 percent less than in the case of children whose mothers do not participate in such activities. Mothers who participate in NGO hygiene activities have better knowledge about hygiene and preventative measures to guard against diseases than those who do not participate. Application of the knowledge garnered in their day to day life enables households to reduce the duration of diarrhoea.

Several variables that we expected to be significantly associated with either the prevalence of diarrhoea or its duration did not confirm our expectations. They are water availability, pit latrine and people's perceptions regarding the link between contaminated drinking water and diarrhoea.

From the econometric estimation we can sequentially identify important variables for reducing child diarrhoea – participation in NGO hygiene activities, owning a radio and television, mother's education, and the practice of hand washing. When it comes to duration, we found participation in NGO hygiene awareness activities, hand washing and semi-*pucca* houses to be the important variables. From the above econometric estimation, we can clearly state that behavioural factors contribute more to reducing the probability of being both affected by diarrhoea and the duration of the attack as compared to engineering factors[10].

[10] An anonymous reviewer suggested that variables such as hand washing, participation in NGO hygiene activities, perception of the water-diarrhoea link and adult diarrhoea were potentially endogenous. To check for endogeneity case by case, we performed a Durbin-Wu-Hausman test on a regression of the original model but in addition included the residuals of each endogenous right hand side variable, which we estimated as a function of all exogenous variables (Davidson and MacKinnon, 1993), and one instrumental variable. We also undertook the endogeneity test jointly by including all four predicted residuals as right hand side variables along with the regular variables of the original model. We used distance between the sanitation and water source for sanitation purpose and the occupation of the respondent as instruments for hand washing. For NGO participation, the instrumental variable was whether the respondent is a housewife; for perception, the instruments were flood affected slum, distance from market and level of education of household members. For adult diarrhoea the instrument was the total number of day labourers in the household. The results show no endogeneity in any of the suspected variables.

5.3 Cost and Sensitivity Analysis of Child Diarrhoea

In order to calculate the cost of diarrhoea, we considered only households which had a child suffering from diarrhoea within the recall period of 15 days (see Table 6). Households incurred different types of direct costs once a child suffered from a diarrhoea attack. We classified these into cost of treatment at home; cost of medical treatment in a hospital; and cost of transportation. Home treatment costs included the cost of medicine, cost of oral rehydration saline (ORS) from local shop, and cost of home-made oral saline. Medical treatment costs included hospital admission fee, boarding charge, doctor's fee, and the cost of diagnosis and medication. Transport cost included costs for travelling to the medical centre.

Adding the direct costs to the costs of work and leisure time lost to the care-giver gives the total cost of the diarrhoea attack. The cost of lost work-time and/or leisure-time is the opportunity cost of the person taking care of the child during illness. We calculated the opportunity cost to the care-giver by multiplying the total hours of work-time and leisure-time spent nursing the affected child and the wage rate of the care-giver in case of an earning member. In case of non-earning members, we use the average hourly income of the family. This gives us the total cost of a child diarrhoea episode for an average slum household in Dhaka to be BDT 276.

Since a major proportion of the cost of each episode of diarrhoea attack is attributable to the value assigned to the leisure-time of the care-giver, we conducted a sensitivity analysis of these costs. The analyses used different weights for the hours spent for diarrhoea care by earning and non-earning members of the family (see Table 7). In the case of an earning member, we took the wage rate while in the case of non-earning members we took the hourly household income in order to calculate the opportunity cost of leisure lost.

The value of leisure time lost to care-giver may not be equal to the value of work time. Where we consider the leisure time lost to the care-giver as equal to his/her value in working time, we give the weight of 1; when we value leisure time as equal to half the value of working time, the weight is 0.5. When we assume leisure has no value, the weight is 0. With these different weights for the cost of leisure time, we find that the total cost of each episode of child diarrhoea attack ranges from BDT 124 to BDT 276 (see Table 7).

Diarrhoea is common in slum areas throughout the year and households therefore have to bear these costs at different time periods throughout the year. We can calculate the annual costs of diarrhoea for a child and for a household based on information about monthly diarrhoea attacks and the estimated costs of diarrhoea for the recall period of 15 days using the following equation:

Yearly expected cost of a representative child for diarrhoeal disease

$$= \sum_{i=1...,12} 2W_i(\lambda\alpha_c\beta_c)C_{jk}$$

where, W_i is the monthly weighting factors[11]. We obtained the weighting factor data on monthly prevalence of diarrhoea from the clinic of INTERVIDA BANGLADESH[12]. λ is the probability of observing child diarrhoea in each household surveyed, calculated by dividing the number of affected households by the total number of surveyed households. α_c denotes the probability of being a child of the affected household, which we calculated by dividing the total number of children of the affected household by the total member of the affected households. represents the probability of suffering from diarrhoea if the individual concerned is a child from an affected household, which we derived through dividing the number of children affected by diarrhoea by the total number of child members of the affected households (see Table 8). C_{jk} is the weight that we have given to the care giving person's leisure lost, with and without job, where j is the weight for non-earning member and k is the weight for earning member.

In order to compute the weighting factor (W_i), we first obtained the average prevalence of diarrhoea in May and June (which was the data collection period). For example, the figures for May and June were 21 and 18, and the average of the cases for these two months is [(21+18)/2] = 19.5. From INTERVIDA BANGLADESH, we found the average number of child diarrhoea cases for January to be 6.85. Thus the weighting factor for January ($W_{i=1}$) was (6.85/19.5) = 0.35. We then multiplied this weight ($W_{i=1}$) with (ë á$_c$ â$_c$) – a scalar to compute the 15 days' weight. The resulting figure is [0.35*(0.675*0.281*0.716)] = 0.05. As the recall period of the survey was 15 days, we multiplied that by 2 to compute it monthly. Therefore the monthly weight for January is (0.05*2) = 0.10.

β_c

Using the sensitivity on the value of leisure time of the care-giver for earning and non-earning members, we calculate the cost of an episode of child diarrhoea to be BDT 276. Multiplying this with monthly weights provides the estimate for each month. Summing these monthly costs for all months gives the annual cost of diarrhoea attacks of a child. Thus, we estimate the cost of diarrhoea attacks per child per year to be BDT 656 (see Table 9 and Table 10), which gives a weight of 100 percent to both the leisure lost of the earning member and non-earning member who take care of the child during illness. This cost ranges from BDT 296 to BDT 656 depending on the weight given to the leisure loss of caregivers (see Table 10).

We also estimate the annual cost of child diarrhoea attacks for a representative household. We calculate this by multiplying the monthly cost of diarrhoea per child by the average number of children per household and then summing this monthly cost over all months of the year. We thus estimate the annual cost of diarrhoea attacks per household to be BDT 837 with 100 percent weight to the leisure lost of both earning and non-earning member (see Table 9 and Table 11). The yearly cost of diarrhoea for a representative household varied from BDT 378 to BDT 837 depending on the weights given to the leisure loss of the earning member and the non-earning member (see Table 11).

---

[11] Where i = 1 for January, i = 12 for December. The rate of occurrence of diarrhoeal diseases in different months is different.

[12] INTERVIDA BANGLADESH is an NGO primarily providing education at the slum level. They have over thirty educational centres in the Dhaka city slums and three primary health care centres. The enrolled students and their family members are entitled to receive treatment free of cost from these three primary health care centres.

6. Conclusions and Policy Recommendations

In this study, we examine the prevalence of child diarrhoea in the slums of Dhaka. We find that socio-economic variables such as owning a radio and television, education of the mother, and participation in NGO hygiene awareness activities reduce the probability of diarrhoea prevalence. Participation in NGO hygiene awareness activities and residing in semi-*pucca* houses moreover contribute to a reduction in the duration of childhood diarrhoea. Behavioural factors, such as the use of narrow-necked container, reduce the probability of child diarrhoea while washing hands with soap after defecation reduces both the probability of diarrhoea and the duration of child diarrhoea. For example, the probability of diarrhoea in children falls by 12 percent if the respondents washed at least one hand with soap after defecation. Thus, our study suggests that NGO and media campaigns should focus on raising awareness among slum-dwellers regarding the importance of hand washing practices and adopting proper methods for water storage.

We found the role of the mother to be very important in stemming childhood diarrhoea. Although this is a finding that emerges from many studies on the subject, it is worth reiterating for the crucial role it plays in the incidence of child diarrhoea. Our study suggests that primary education of mothers contributes to a 13 percent reduction in the prevalence of diarrhoea while participation of the respondent (in 97 percent of the cases the respondents were the mother of the child) in NGO hygiene awareness activities reduces the average duration of diarrhoea by 31 percent. Moreover, diarrhoea prevalence falls significantly if the mother practices good hygiene herself such as washing her own hands after defecation.

It is noteworthy that on average only 10 percent of the unaffected household respondents perceived that drinking contaminated water causes diarrhoea. There is clearly an urgent need to increase awareness about the link between water contamination and diarrhoea. Health and hygiene awareness campaigns by the NGOs and the media should work to get this message across swiftly to communities at risk in order to reduce the burden of diarrhoea on children.

The study estimates the average duration of an episode of child diarrhoea in Dhaka slums to be 3.76 days. The direct cost per episode of child diarrhoea, which includes the cost of home treatment, medical treatment and transport costs, is BDT 100. However, if we take into account the opportunity cost of the time spent by the caregiver of the sick child during an episode of diarrhoea, then the average cost per episode of child diarrhoea comes to BDT 276 (USD 4).

The cost of diarrhoea per episode varies according to assumptions made about the value of leisure time. We therefore estimate that the costs could vary between BDT 124 (USD 1.81) to BDT 276 (USD 4) per episode of child diarrhoea. Using the same set of assumptions, the expected annual cost of child diarrhoea attacks ranges from BDT 296 (USD 4.29) to BDT 656 (USD 9.52) while the annual cost of child diarrhoea for a representative household ranges from BDT 378 (USD 5.49) or about 0.6 percent of household income to BDT 837 (USD 12.15) or 1.31 percent of household income.

How do these costs compare with child diarrhoea cost estimates from other studies? As indicated in the initial literature review, few studies take into account the opportunity cost of time. Dasgupta (2004) found the direct cost of child diarrhoea to be USD 1.94 per episode in India while

Gokhale (1999) had calculated it to be USD 5.64 per episode for the same country. In Indonesia, Larman *et al.* (1985) estimated it to be USD 2.27. If we take only the direct costs and the opportunity cost of working hours lost by the caregiver into account, the current study estimates the cost of child diarrhoea to be USD 1.81 (BDT124) per episode, which falls only slightly below the range reported by previous studies. However, if we take into account the cost of leisure loss to the care giver, the cost of child diarrhoea comes to USD 4, which falls within the range arrived at in previous studies.

Our analysis of factors that affect diarrhoea prevalence suggests that behavioural factors have more influence on the potential occurrence of child diarrhoea attacks and their duration than engineering factors. Therefore, policy measures should focus on promoting hygiene-related awareness activities that focus on issues such as the use of narrow-necked containers and the washing of hands with soap after defecation.

7. Acknowledgements

I acknowledge with gratitude the financial support from South Asian Network for Development and Environmental Economics (SANDEE). In addition to financial support, I greatly appreciate the mentoring by members of the SANDEE advisory board such as Subhrendu K. Pattanayak, E. Somanathan, Enamul Haque, M. N. Murty and Priya Shyamsundar. I am grateful too to Anwarul Hoque, Wasiqur Rahman Khan, Minhaj Uddin Mahmud and Mani Nepal and to an anonymous reviewer for their valuable comments. I would like to thank INTERVIDA BANGLADESH for providing data on diarrhoea, which was useful in calculating the yearly cost. Comments from participants at the Australian Health Economics Society Conference 2007 and European Association of Environmental and Resource Economists Conference 2008 were also useful in writing this paper. I wish to thank the SANDEE Secretariat for their support and Mohammad Nasir Uddin Khan and Fahim Subhan Chowdhury for their excellent research assistance.

References

Alam, M. J. (2007), 'Water quality tests and behavioural factors of child diarrhoea in Dhaka slums', *BRAC University Journal* IV(1): 103-109.

Alberini, A., G. S. Eskeland, A. Krupnick and G. McGranahan (1996), 'Determinants of diarrhoeal disease in Jakarta', Policy Research Working Paper No. 1568, Policy Research Department, Public Economics Division, World Bank, Washington, D.C.

Bern, C., J. Martines, I. de Zoysa and R. I. Glass (1992), 'The magnitude of the global problem of diarrhoeal disease: a ten-year update', *Bulletin of the World Health Organization* 70: 705-14.

Cameron, A. C. and P. K. Trivedi (2005), *Supplement to Microeconometrics: Methods and Applications*, New York: Cambridge University Press.

Cameron, A. C. and P. K. Trivedi (1986), 'Econometrics models based on count data comparison and applications of some estimators and tests', *Journal of Applied Econometrics* 1: 29-53.

Cameron, A.C., P. K. Trivedi, F. Milne and J. Piggott (1988), 'A microeconometric model of the demand for health care and health insurance in Australia', *Review of Economics Studies* 55: 85-106

Checkley, W., R. H. Gilman, R. E. Black, L. D. Epstein, L. Cabrera, C. Sterling and L. Moulton (2004), 'Effect of water and sanitation on childhood health in a poor Peruvian peri-urban community', *Lancet* 363: 112-118.

Dasgupta, P. (2004), 'Valuing health damages from water pollution in urban Delhi, India: A health production function approach', *Environment and Development Economics* 9: 83-106.

Davidson, R. and J.G. MacKinnon (1993), *Estimation and Inference in Econometrics*, New York: Oxford University Press.

Fewtrell, L., R. B. Kaufmann, D. Ray, W. Enanoria, H. Laurence and J. M. Colford Jr. (2005), 'Water, sanitation and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis', *Lancet Infectious Diseases* 5: 42-52.

Food and Nutrition Bulletin (1982), 'The prevention and control of diarrhoeal diseases', The United Nations University Press, 4(1). http://www.unu.edu/Unupress/food/8F041e/8F041E04.htm [accessed on 04.04.08]

Gokhale, R. M., A.K. Pratinidhi and S.C. Garad, (1999), 'Cost analysis of diarrhoea treatment in the infectious diseases hospital in Pune city', *Indian Journal of Community Medicine* 24(3): 104-10.

Gomez, J. A., S. Nates, N. R. de Castagnaro, C. Espul, A. Borsa and R. I. Glass (1998), 'Anticipating rotavirus vaccines: review of epidemiologic studies or rotavirus diarrhoea in Argentina', *Rev Panam Salud Publica* 3(2): 69-78.

Greene, W. H. (2007), *Econometric Analysis*, 5th Edition, New Delhi: Pearson Education.

Han, A. and T. Hlaing (1989), 'Prevention of diarrhoea and dysentery by hand washing', *Transactions of the Royal Society of Tropical Medicine and Hygiene* 83: 128-131.

Haque, A. K. E., M. Chaudhury and P. K. Abbasi (2007), 'Demand for water in DWASA Zones (2005–2030)', Research Monograph, Institute of Water Modelling, Dhaka.

Harrington, W. and P. R. Portney (1987), 'Valuing the Benefits of Health and Safety Regulation', *Journal of Urban Economics* 22(1): 101-12.

Luby, S. P., P. Thorpe and M. S. I. Molla (2004), 'Documenting effects of the July-August floods of 2004 and ICDDR,B's response', *Health and Science Bulletin* 2(3): 1-6

Hussain, A., S. M. K. Ali and G. Kvale (1999), 'Determinants of mortality among children in the urban slums of Dhaka City, Bangladesh', *Tropical Medicine and International Health* 4(2): 758-764.

Hoque, B. A., J. Chakraborty, J. T. Chowdhury, U. K. Chowdhury, M. Ali, S. Arifeen and

R. B. Sack (1999), 'Effects of environmental factors on child survival in Bangladesh: a case control study', *Public Health* 113(2): 57-64.

Jalan, J. and M. Ravallion (2003), 'Does piped water reduce diarrhoea for children in rural India?' *Journal of Econometrics* 112: 153-173.

Knight, S. M., W. Toodayan, W. C. Caique, W. Kyin, A. Barnes and P. Desmarchelier (1992), 'Risk factors for the transmission of diarrhoea in children: a case-control study in rural Malaysia', *International Journal of Epidemiology* 21(4): 812-818.

Kosek, M., C. Bern and R. Guerrant (2003), 'The global burden of diarrhoeal disease, estimated from studies published between 1992 and 2000', *Bulletin of the World Health Organization* 81: 197-204.

Lerman, S. J., D. S. Shepard and R. A. Cash (1985), 'Treatment of diarrhoea in Indonesian children: what it costs and who pays for it', *Lancet* 21: 651-654.

Mirza, N. M., L. E. Caulfield, R. E. Black and W. M. Macharia (1997), 'Risk factors for diarrhoeal duration', *American Journal of Epidemiology* 146(9): 776-785.

Mullahy, J. (1986), 'Specification and testing of some modified count data models', *Journal of Econometrics* 33: 341-365.

Mohaghan, M. J. and M. S. Mohaghan (1996), 'Do market components account for higher U.S. prescription prices?' *The Annals of Pharmacotherapy* 30: 1429-1494.

Noronha, K.V.M. and M. V. Andrade (2002), 'Social inequality in the access to healthcare services in Brazil', *Belo Horizonte*, CEDEPLAR, UFMG 33:614(1)

Patel, A. B., L. A. Dhande and M. S. Rawat (2003), 'Economic evaluation of zinc and copper use in treating acute diarrhoea in children: A randomized controlled trial', *Cost Effectiveness and Resource Allocation* 1:7

Phelps, C. E. (1992), *Health Economics*, New York, Harper Collins Publisher Inc.

Pohlmeier, W. and V. Ulrich (1995), 'An econometric model of the two-part decision making process in the demand for health care', *The Journal of Human Resources* 30.2: 339-361.

De Soárez, P. C., J. Valentim, A. M. C. Sartori and H. M. D. Novaes (2008), 'Cost-effectiveness analysis of routine rotavirus vaccination in Brazil', *Rev Panam Salud Publica* 23(4): 221–30.

Snyder, J. D. and M. H. Merson (1982), 'The magnitude of the global problem of acute diarrhoeal disease: a review of active surveillance data', *Bulletin of the World Health Organization* 60: 605-13.

World Health Organization (WHO) (2007), 'SITREP – Floods in Bangladesh' http://www.reliefweb.int/rw/RWFiles2007.nsf/FilesByRWDocUnidFilename/LSGZ-76GDJK-full_report.pdf/$File/full_report.pdf [Accessed on 12.09.07]

World Health Organization (WHO) (2007), 'Cholera'http://www.who.int/topics/cholera/en/ [Accessed on 03.02.07]

World Health Organization (WHO) (2001), 'Review of treatment cost protocol studies' http://www.who.int/vaccines-documents/DocsPDF01/www601.pdf [Accessed on 14.02.08]

World Health Organization (WHO) (2004), 'Facts and figures: Water, sanitation and hygiene links to health' http://www.who.int/water_sanitation_health/publications/factsfigures04/en/ [Accessed on 03.04.07].

LIST OF TABLES

Table 1: Cost of Child Diarrhoea per Child per Episode

Author (Year)	Location	Cost per Episode		Age Group	Cost Components
		Local Currency	US (USD)		
Lerman *et al.*,(1985)	Indonesia	-	USD 2.27	Below 5 years	· Health centre, hospital and private expenditure
Gokhale (1999)	India	Rs 276.23	USD 5.64		· Direct medical costs
Patel *et al.*, (2003)	India	Rs 500	USD 14	6-59 months	· Direct medical costs (the medical personnel services, the medications, type of service provided in general or intensive care and the laboratory investigations). · Direct non-medical costs (travelling cost to the physician or the hospital, cost of food to the family and patient, hospitalization and other incidental costs. · Indirect costs (wage loss of employed guardians attending to the child).
Dasgupta (2004)	India	Rs 83.33	USD 1.94	Below 15 years	· Treatment costs
Gomez, *et al.*, (1998)	Argentina	-	USD 30	0 – 23 months	· Average cost of a doctor or clinic visit, transportation, parent/guardian time lost from work.
De Soarez *et al.*, (2008)	Brazil	-	USD 53	Below 5 years	· Direct costs (cost of medical visit, hospitalization, medications, laboratory tests, extra expenses and travel to obtain medical care) · Indirect costs (foregone earnings of caregiver, lifetime productivity loss of a dying child)

Table 2: Socio-Economic Conditions of Slum Households

	Variable	Obs	Mean	Std. Dev.	Min	Max
Household Variables	Age of respondent (Years)	480	27	7	16	60
	Age of household head (Years)	480	34	8	18	70
	Household member	480	4.46	1.31	2	12
	Household monthly income (BDT)[Y]	480	5,330	2,468	400	23,500
	Number of Children (28 days to 5 years)	480	1.28	0.49	1	3
Children Variables	Age of child (Years)	613	2.65	1.52	0	5
	Diarrhoea	613	0.49	0.50	0	1
	Duration of diarrhoea (Days)	298	3.76	2.37	1	15
	Exchange rate- USD 1 = BDT 68.87					

[Y] Exchange rate- USD 1 = BDT 68.87

Table 3: Variable Explanations and Expected Sign

Independent Variables	Dependent Variables	
	Diarrhoea (=1 if yes; otherwise – 0)	**Duration (Duration of child diarrhoea in days)**
Water Availability (=1 if water from all sources is available for 24 hours; 0 – otherwise)	-	-
Pit (=1 if sanitation type is pit; otherwise – 0)	-	-
Narrow-necked Container (=1 if collection container is narrow-necked; otherwise – 0)	-	-
Strainer & Cloth (=1 if household uses cloth or strainer as straining instrument; 0 – otherwise)	-	-
Hand Wash (= 1 if household respondent washed at least one hand after defecation; 0 – otherwise)	-	-
Radio & TV (= 1 if household owns a radio and television; otherwise - 0)	-	-
Mother's Education (= 1 if mother's education is greater than class five; otherwise - 0)	-	-
Age (=1 if child age greater than 2 years; 0 – otherwise)	-	-
Adult Diarrhoea (= 1 if there is household member having diarrhoea other than the child; 0 – otherwise)	+	+
Member (number of household members)	?	?
Participation (= 1 if household respondent participated in any hygiene related activities undertaken by NGO; 0 – otherwise)	-	-
Semi-*pucca* (=1 if cement wall and tin or cement roof; 0 – otherwise)	-	-
Perception (=1 if respondent has the perception that contaminated water causes diarrhoea; 0 – otherwise)	-	-
Location (= 1 if the slum is located near river; 0 – otherwise)	+	+

Table 4: Descriptive Statistics

Variables	Overall (obs. = 613)	With Diarrhoea (obs. = 298)	Without Diarrhoea (obs. = 315)	Equity Mean Test	
	Mean (Std. Dev.)	Mean (Std. Dev.)	Mean (Std. Dev.)	Mean Difference (Std. Error)	t-stat
Diarrhoea	0.49(0.50	1.00(0.00)	-	-	-
Duration	1.83(2.51)	3.76(2.37)	-	-	-
Water Availability	0.42(0.49)	0.40(0.49)	0.45(0.50)	-0.05(0.04)	-1.37
Pit	0.39(0.49)	0.39(0.49)	0.40(0.49)	-0.02(0.04)	-0.44
Narrow-necked Container	0.83(0.38)	0.80(0.40)	0.86(0.35)	-0.06*(0.03)	-1.82
Strainer & Cloth	0.10(0.31)	0.12(0.33)	0.09(0.29)	0.03(0.02)	1.29
Hand Wash	0.57(0.50)	0.51(0.50)	0.63(0.48)	-0.11**(0.04)	-2.81
Radio & TV	0.10(0.30)	0.07(0.25)	0.12(0.33)	-0.06*(0.02)	-2.39
Mother's Education	0.10(0.30)	0.08(0.27)	0.12(0.33)	-0.05*(0.02)	-1.92
Age	0.56(0.50)	0.52(0.50)	0.60(0.49)	-0.08**(0.04)	-2.08
Adult Diarrhoea	0.25(0.43)	0.29(0.45)	0.21(0.41)	0.08**(0.03)	2.27
Member	4.64(1.41)	4.57(1.28)	4.71(1.52)	-0.14(0.11)	-1.27
Participation	0.04(0.19)	0.02(0.15)	0.05(0.21)	-0.02(0.02)	-1.61
Semi-*pucca*	0.05(0.22)	0.06(0.23)	0.05(0.21)	0.01(0.02)	0.52
Perception	0.09(0.29)	0.08(0.27)	0.10(0.30)	-0.02(0.02)	-1.06
Location	0.61(0.49)	0.63(0.48)	0.60(0.49)	0.03(0.04)	0.86

Notes:
*** indicates significance level at 1 percent or lower,
** indicates significance level at 5 percent, and
* indicates significance level at 10 percent

Table 5: Negative Binomial-Logit Hurdle Regression of the Prevalence of Child Diarrhoea and Duration

Variables	Logit Regression (Diarrhoea)		Negative Binomial (Duration)		
	Marginal	Z	Coef.	z	Exp (Coef)
Water Availability	-0.068	-1.38	0.057	0.670	1.06
Pit	0.008	0.22	0.101	1.130	1.11
Narrow-necked Container	-0.109*	-1.83	0.046	0.380	1.05
Strainer & Cloth	0.145**	2.19	0.159	1.240	1.17
Hand Wash	-0.122***	-3.03	-0.298***	-3.660	0.74***
Radio & TV	-0.143***	-3.29	-0.088	-0.630	0.92
Mother ‘s Education	-0.131*	-1.86	-0.080	-0.710	0.92
Age	-0.085*	-1.92	-0.033	-0.400	0.97
Adult Diarrhoea	0.091*	1.80	0.215*	1.830	1.24*
Member	-0.027*	-1.85	-0.021	-0.650	0.98
Participation	-0.213**	-2.00	-0.372*	-1.650	0.69*
Semi-*pucca*	0.073	1.35	-0.223*	-1.900	0.80*
Perception	-0.077	-1.04	-0.074	-0.510	0.93
Location	0.035	0.68	0.061	0.610	1.06
_cons	0	0	1.336	6.810	3.80
/lnalpha	0	0	-2.176	-5.560	0.11

Notes:
*** indicates significance level at 1 percent or lower,
** indicates significance level at 5 percent, and
* indicates significance level at 10 percent

Table 6: Different Types of Cost of Child Diarrhoea (BDT) (15 days)

Variable	Obs	Mean	Std. Dev.	Min	Max
1. Home treatment cost (saline, doctor fee and medicine from local store)	261	92	127	3	1,000
2. Medical treatment cost (admission, sit, doctor fee, medicine)	12	140	136	5	450
3. Transport cost	13	56	80	10	300
Direct Cost (1+2+3)	264	100	139	3	1,000
4. Work lost due to child diarrhoea	72	148	135	6	667
5. Leisure lost due to child diarrhoea	298	152	165	7	1,346
Indirect Cost (4+5)	298	188	188	7	1,346
Total Cost of Child Diarrhoea (Direct and Indirect Cost)	298	276	273	13	1,790

Table 7: Sensitivity Analysis of the Cost of Child Diarrhoea (BDT) (15 days)

		Weight of Leisure Hours Lost (Earning Member)				
		1.00	0.75	0.50	0.25	0.00
Weight of Leisure Hours Lost (Non Earning Member)	**1.00**	**276**	269	262	255	249
	0.75	245	238	231	224	218
	0.50	214	207	200	193	186
	0.25	183	176	169	162	155
	0.00	152	145	138	131	**124**

Table 8: Probability of Diarrhoeal Attack for a Child

Variable Name	Explanation	Value
The probability of household being affected from diarrhoea (ë)	324/480	0.675
The probability of being a child from affected household ($á_c$)	416/1479	0.281
The probability of getting diarrhoea if the individual concerned is a child from an affected household ($â_c$)	298/416	0.716
Average child size in a family ($ä_c$)	613/480	1.28

Note:
324 – Number of households affected by child diarrhoea
416 – Number of children from the affected household
1479 – Total members of the 324 affected households
298 – Number of children affected by diarrhoea
613 – Total number of children from the surveyed households
480 – Number of households surveyed

Table 9: Yearly Cost of Child Diarrhoea

Month	Number of Children Affected by Diarrhoea[Φ]			Average Case	Weighting Factor (W_i)	15 Days Weight	Monthly Weight	Cost of a Representative Child[Ψ]	Cost of a Representative Household for Children[Ψ]
	2005	2006	2007						
January	6	5	10	6.85	0.35	0.05	0.10	26	34
February	7	10	6	7.49	0.38	0.05	0.10	29	37
March	9	13	11	10.87	0.56	0.08	0.15	42	54
April	9	17	26	17.52	0.90	0.12	0.24	68	86
May	17	15	31	21.21	1.09	0.15	0.30	82	104
June	21	16	16	17.73	0.91	0.12	0.25	68	87
July	24	14	21	19.67	1.01	0.14	0.27	76	97
August	10	9	20	12.98	0.67	0.09	0.18	50	64
September	24	8	14	15.07	0.77	0.11	0.21	58	74
October	20	20	10	16.39	0.84	0.11	0.23	63	81
November	11	13	19	14.39	0.74	0.10	0.20	55	71
December	17	8	5	9.98	0.51	0.07	0.14	38	49
Yearly	656	837							

[Φ] Data collected from health clinic in the slums of INTERVIDA BANGLADESH. Data corresponds to two slums for 2005 and 2006 and three slums for 2007. The data corresponding to the months shows the number of children seeking treatment from the health clinic suffering from diarrhoea in the respective years

[Ψ] 100 percent weights to leisure lost

Table 10*:* Yearly Expected Cost (BDT) of a Representative Child Diarrhoea

		Weight of Leisure Hours Lost (Earning Member)				
		1	**0.75**	**0.5**	**0.25**	**0**
Weight of Leisure Hours Lost (Earning Member)	**1**	**656**	639	623	607	591
	0.75	582	566	549	533	517
	0.5	508	492	476	459	443
	0.25	434	418	402	386	370
	0	361	344	328	312	**296**

Table 11: Yearly Expected Cost (BDT) for Children of a Representative Household

		Weight of Leisure Hours Lost (Not Earning Member)				
		1	0.75	0.5	0.25	0
Weight of Leisure Hours Lost (Earning Member)	**1**	**837**	817	796	775	754
	0.75	743	722	702	681	660
	0.5	649	628	608	587	566
	0.25	555	534	513	493	472
	0	461	440	419	398	**378**

FIGURES

Figure 1: Duration of Child Diarrhoea within the Recall Period of 15 days

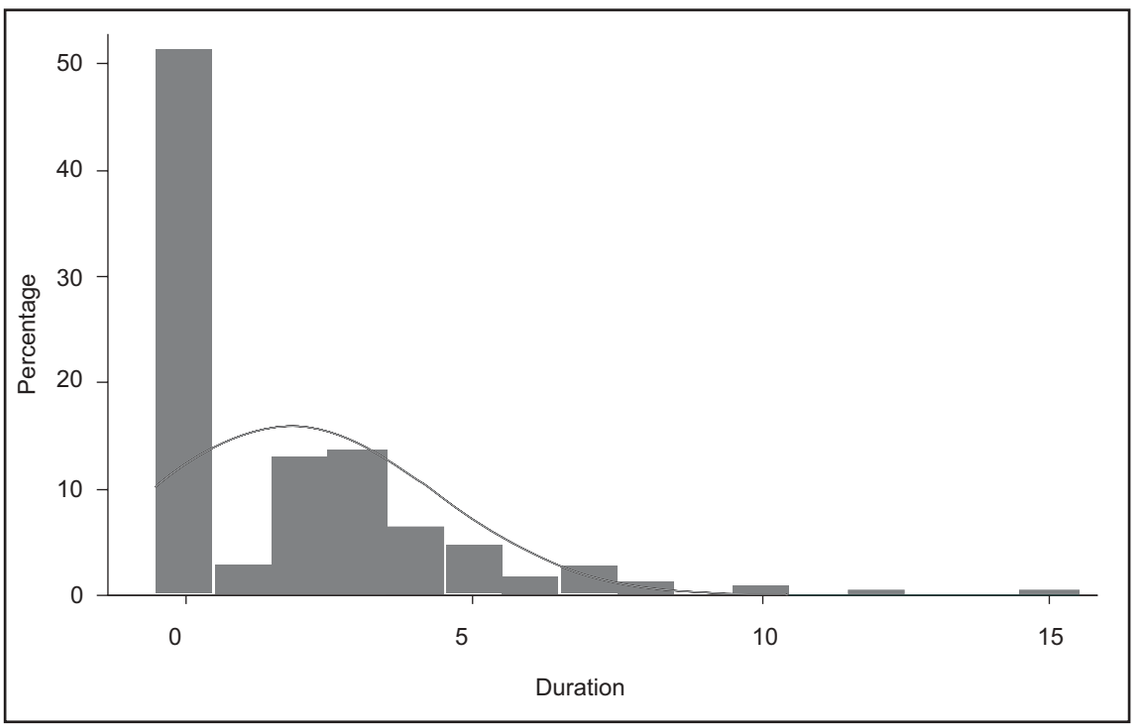


Figure 1(a) With and Without Diarrhoea

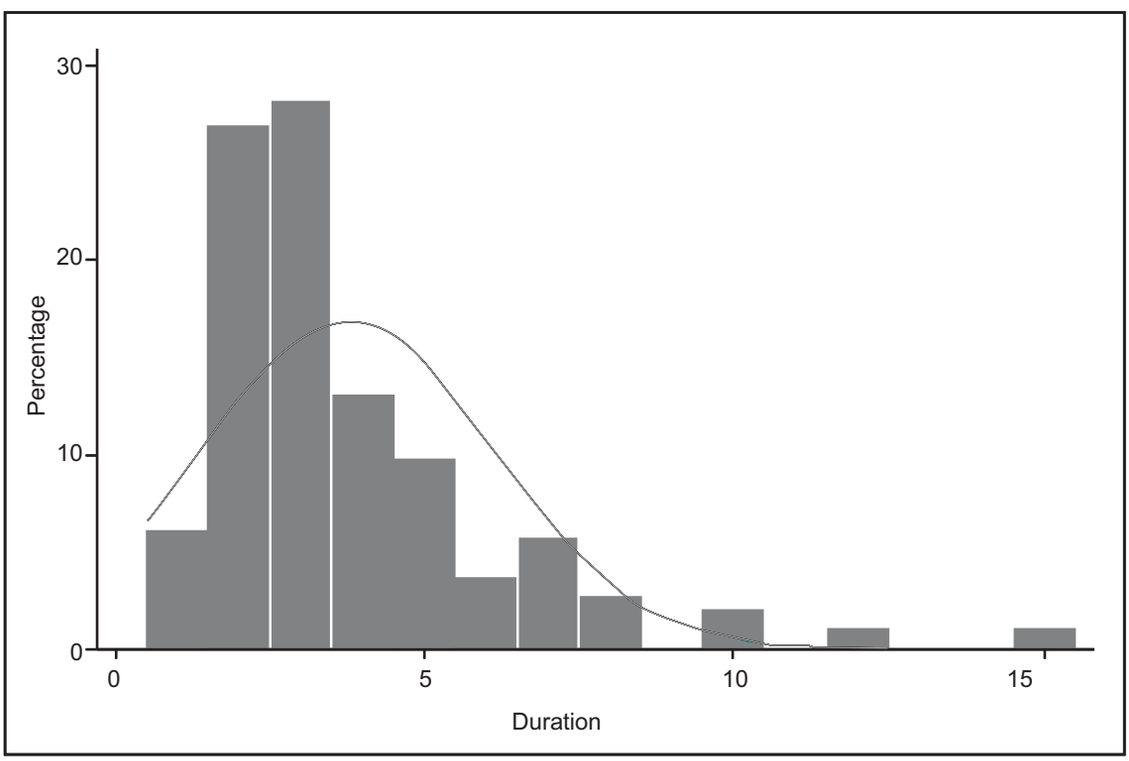
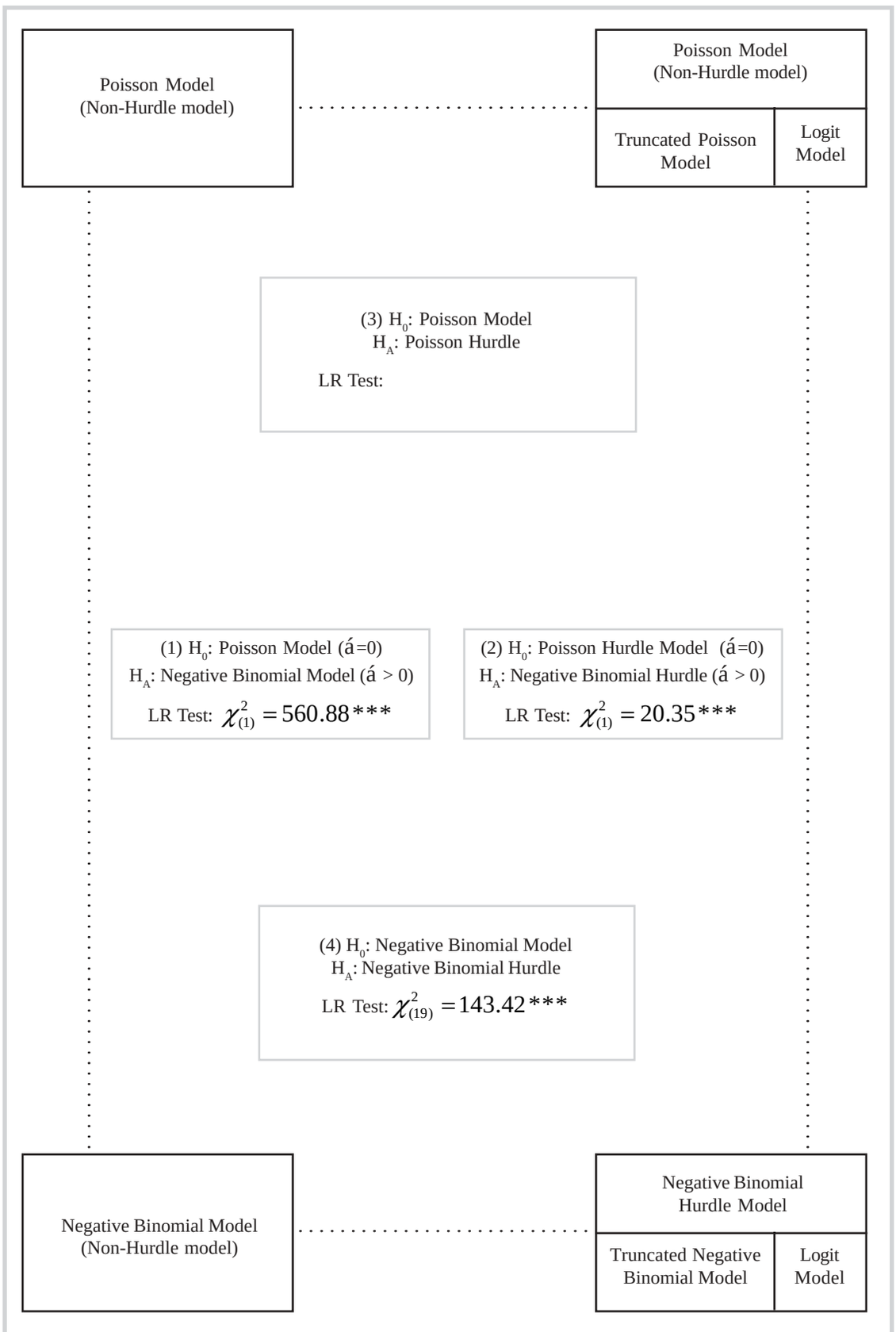


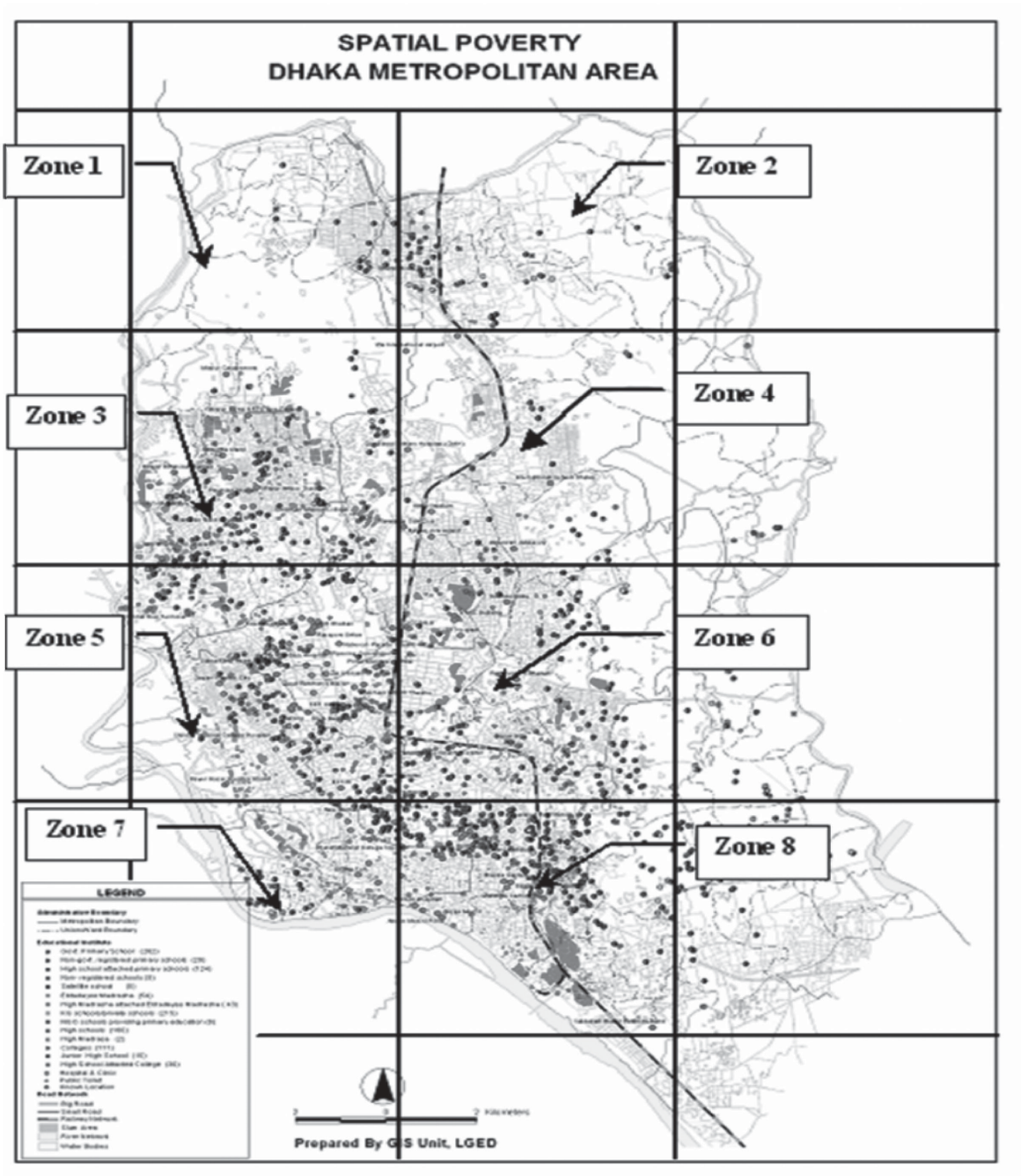
Figure 1(b) With Diarrhoea

Figure 2: Specification Test



APPENDICES

APPENDIX 1: DMA Map



APPENDIX 2: Literature Review

Authors and Year	Model Used	Dependent Variable	Engineering Variables	Behavioural Variables	Socio-Economic Variables	Others
Woldemicael (2001)	Logistic Regression	Diarrhoea	Toilet facility	-	Age of child, Number of children, Floor material, Mother's education, Household economic status, Location	-
Prakasam and Narveker (2005)	Logit	Diarrhoea	Water source	Water treatment	Age, Mother's education, Standard living index	-
Osumanu (2007)	Logistic Regression	Diarrhoea	Water source (depend on vendors, borehole, well or dugout)	Water container, Hand-washing after defecation, Hand-washing before cooking	Shared toilet	Buys prepared food from street vendors
Thankappan (2002)	Logistic Regression	Diarrhoea	Type of toilet (for child and adult)	Hand-washing	-	Eat out (child, adult)
Colwell *et al.* (2003)	Poisson	Cholera	-	Nylon filtration, Sari filtration	-	-
Alberini *et al.* (1996)	Bivariate Probit	Diarrhoea	Water source, Water interruption, Washbasin	-	Income	Using public toilet, Interaction (Income*Water interruption), Perception (problem with waste)
Dasgupta (2004)	Bivariate Probit	Diarrhoea	Water source, Water availability, Access to latrine	Income, Education	Income, Education, Location	Solid waste disposal, Foul smell in water, Sewerage facility
Knight *et al.* (1992)	Conditional Logistic Regression (CLR) and Matched Pair Analysis (MPA)	Diarrhoea	Sanitation, Washing water in latrine	Water treatment, Food storage, Breast and bottle feeding	-	Child drinks unboiled water, Animals in house
Jalan and Revallion (2001)	Propensity Score Matching	Diarrhoea and Duration	-	-	Income, Education	-
Mirza *et al.* (1997)	Cox Regression	Duration	-	Water container, Hand feeding, Fluids, Food	Ethnic group	-

APPENDIX 3: Questionnaire

SOUTH ASIAN NETWORK FOR DEVELOPMENT AND ENVIRONMENTAL ECONOMICS (SANDEE) SPONSORED RESEARCH PROJECT ON PREVALENCE AND COSTS OF CHILDHOOD DIARRHOEA IN THE SLUMS OF DHAKA

Economics and Social Sciences Department
BRAC University
66 Mohakhali
Dhaka-1212, Bangladesh

Greetings! We are conducting a research on 'Prevalence and Costs of Childhood Diarrhoea in the Slums of Dhaka' in the slum areas and need to conduct interviews with households to know about water and sanitation facilities and behavioural variables related to diarrhoea. This research is solely for academic purposes and all your responses will remain confidential. We will try our best to share the results of our research with you once we have completed our study. We will be extremely grateful if you agree to collaborate with us and give some of your time to answer a set of questions we have. The questions are designed to help us understand how you and your family are coping with diarrhoea. We thank you for your time and eagerly hope for your co-operation.

Would you like to participate in the interview?	Yes ☐	No ☐	→
Do you have any child (age 5 years or less) in the family?	Yes ☐	No ☐	Proceed to Q 1
Will you stay here for the next six months?	Yes ☐	No ☐	

O. Obseravations

1	What is the distance between home and disposal place of garbage ? (feet)	
2	Where is the disposal place of garbage ? (See code)	1- River/canal 2- Specific open area 3- Outside dwelling 4- Other (specify)
3	Is there any soap beside toilet ?	0-No, 1- Yes
4	Does stool mix with the water that is used to wash clothes and bathe in ?	0-No, 1- Yes
5	Are there slippers near or inside the toilet ?	0-No, 1- Yes
6	What is the distance between water collection centres and the nearest toilet ?	
7	Based on infrastructure, what type of toilet ?	1- Anywhere, 2- Open pit, 3- River release, 4- Ring slab (water sealed), 5- Ring slab (not water sealed), 6- Pit, 7- Other (specify)
8	Is there any lid on the container at the point of use where water is contained ?	0-No, 1- Yes
9	Is there any lid on the container at the point of source where water is stored ?	0-No, 1- Yes

G1. Interview Situation

1.1 Slum Name	
1.2 Address of slum	
1.3 Household address	
1.4 Name of household head	
1.5 Respondent's name	
1.6 Date of interview	
1.7 Time started	
1.8 Enumerator's name	

G2. HOUSEHOLD PROFILE:
(Age Greater Than 5 Years) people who live together in a single home and eat their food from the same cooking-pot)

Member ID **(M1= Household head)**	Name	Sex **(See code)**	Age **(years)**	Years of schooling	Occupation **(See code)**	Daily working hours	How do you receive your salary? **(See code)**	Income **(Taka) (Daily/Weekly/ Monthly)**	How many days does ID work per week? (If paid weekly)	How many days does ID work per month? (If paid monthly)	How many days before ID was last attacked by Diarrhoea?
2.1	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**	**2.7**	**2.8**	**2.9**	**2.10**	**2.11**	**2.12**
M1											
M2											
M3											
M4											
M5											
M6											
M7											
M8											
M9											
M0											

Sex 2.3
1 – Male
2- Female

Occupation: 2.7 & 2.8
1- Day labourer (rickshaw puller, taxi driver, street vendor, scavenger…..)
2- Employee (government, private, garment factory worker……)
3- Housewife
4- Shop owner/ own business
5- Domestic servant
6- Student
7- Unemployed
8- Unable to work
9- Other (specify) …

Income 2.8
1- Daily
2- Weekly
3- Monthly

G3. HOUSEHOLD PROFILE: (Child Age 5 Years or less) Household must have at least one child below 5 years of age. For this study a child is anyone aged 5 years or less.

Child ID	Name of the Child	Sex **1-Male 2-Female**	Age **(years) (less than one year=0)**	Mother's name & ID	Who looks after the children? (Member Name)	How many days before ID was last attacked by Diarrhoea?
3.1	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.7**
C1						
C2						
C3						

G4. How many rooms are there in your house? ☐

G5. In your living room, what is the material of:

Floor: ☐

Wall: ☐

Roof: ☐

G. 6
1- Clay
2- Bamboo mat
3- Tin
4- Straw
5- Bamboo/ Wood
6- Brick /Cement
7- Other (specify).....

DIARRHOEA

D1. Household Information on Diarrhoea

	Name & ID (Having diarrhoea within last 15 days)	What type of diarrhoea did the ID suffer in the last 15 days? **(See code)**	How many days did the ID suffer in the last 15 days?	Where did ID take treatment? **(See code)**	Why didn't ID take any home treatment? **(See code)**	What type of home treatment did ID take? **(See code)**	How many days did ID take home treatment?	How much did you spend for home treatment (total)? **(Taka)**	Did ID go to medical centre?**(See code)**	How many days did ID stay in medical centre? **(if didn't stay then 0)**	How much did ID pay for transporta–tion? **(total) (Taka)**	What was the total cost of medicine in the medical centre? **(Taka)**	What was the total cost (without medicine) in the medical centre? (with doctor's fee) **(Taka)**
	1.1	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**1.10**	**1.11**	**1.12**	**1.13**
Child													
Adult													

Diarrhoea Type 1.2
1- Watery
2- Bloody

Medical advice: 1.4
1- Didn't seek any medical service
2- Govt. clinic
3- Private Doctor
4- Local hospital
5- NGO clinic
6- Local pharmacy
7- Herbal treatment
8- Other (specify)……

Reasons for avoiding home treatment: 1.5
1- Shortage of money/ Treatment is costly
2- There is no medical centre near the house
3- Home treatment is enough
4- Not necessary
5- Other (specify)

Type of home treatment: 1.6
1- Oral saline bought from local store
2- Home made saline
3- Other (specify)……..

Treatment: 1.9
1- Yes
0- No

Reason for not seeking medical advice: 2.0
1- Shortage of money
2- No medical facility close by
3- Took home treatment/home care is enough
4- Good treatment not available
5- Other (specify)……

D2. Opportunity Costs of Child Diarrhoea

Child's name	Which ID lost work or leisure hours due to child diarrhoea? **(Name & ID)**		How many days did ID lose work and leisure hours in the last 15 days due to child diarrhoea below 5 years of age?		How many work hours did ID lose per day in the last 15 days due to diarrhoea of child below 5 years of age?		How many leisure hours did ID lose per day in the last 15 days due to diarrhoea of child below 5 years of age?	
	Primary	**Secondary**	**Primary**	**Secondary**	**Primary**	**Secondary**	**Primary**	**Secondary**
2.1	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**	**2.7**	**2.8**	**2.9**

D2. Opportunity Costs of Child Diarrhoea

Adult name and ID	Which member lost work or leisure hours due to diarrhoea? **(Name and ID)**		How many work and leisure hours did member lose in the last 15 days while suffering from diarrhoea?		How many work hours did member lose per day in the last 15 days while suffering from diarrhoea?		How many leisure hours did member lose per day in the last 15 days while suffering from diarrhoea?		At the time of diarrhoea how many work and leisure hours did ID lose in the last 15 days while suffering from diarrhoea?	At the time of diarrhoea how many work hours did ID lose per day in the last 15 days while suffering from diarrhoea?	At the time of diarrhoea how many leisure hours did ID lose per day in the last 15 days while suffering from diarrhoea?	After diarrhoea how many work hours did ID lose?
	Primary	**Secondary**	**Primary**	**Secondary**	**Primary**	**Secondary**	**Primary**	**Secondary**				
3.1	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.7**	**3.8**	**3.9**	**3.10**	**3.11**	**3.12**	**3.13**

D4. What measures will you take to prevent household diarrhoea?

D4

1- None
2- Improving sanitation
3- Improving hygiene
4- Improving (treatment of) drinking water
5- Taking medication
6- Other (specify)…….

W1. Water: General Information

What is the water source? **(See code)**	How far is the source in minutes? **(One way)**	How many households share the facility?	Is sufficient water always available for collection at the source? **(See code)**	If not, then how long is water available per day? **(Hours)**	Is the source water stored in a storage system? **(See code)**	What is the type of storage system at the water source point? **(See code)**	After how many days is the container cleaned at the point-of-source? **(Days)**	How is water taken from the source? **(See code)**	Did you bear the water source installation cost? **(See code)**	How much did you pay for installation of the source? **(Taka)**	How much did you pay for maintenance? **(Taka)**
1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11	1.12

Water Source: 1.1
1- Community Tap
2- Tube well
3- Well
4- Pond/ Lake / River

1.4, 1.6, 2.0
1- Yes
0- No

Storage system: 1.7
1- Underground container
2- Open-space container
3- Other (specify).....

Water taken system: 1.9
1- Poured in
2- Vessel with handle dipped into source
3- Vessel without handle dipped into source

W2. Water: Collection Information

Who collects the drinking water? **(Member name and ID)**	How often is the water collected per day?	How long does ID have to wait in line per trip to collect the water?(**Minutes)**	Does ID use a lid during the water collection? **(See code)**	Does ID's hand come in contact with the water during water collection? **(See code)**	How much drinking water is collected per day? **(Litres)**	From collected water, how much is used for drinking? **(Litres)**	Do you use rain water for drinking? **(See code)**	What is the per day cost of water collection?
2.1	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**	**2.7**	**2.8**	**2.9**
W2_a1								
W2_b1								
W2_c1								

2.4, 2.5, 2.8
1- Yes
0- No

W3. Container Information:

Container and lid for drinking water	Type of container. **(See code)**	Size **(litres)**	Number of each	Price per unit (Taka)	How long will it last? **(years)**	Can you clean the "carrying/storage" container by inserting your hands? **(See code)**	Is drinking water stored in the same container that is used for carrying? **0- No1 - Yes (if 1 go to lid)**
	3.1	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.7**
Carrying 1							
Carrying 2							
Storing 1							
Storing 2							
Lid							

Container type: carrying & storing: 3.1

1- Jar
2- Bucket
3- Plastic bottle
4- Drum
5- Jug
6- Pot
7- Other (specify).....

3.6
1- Yes
0- No

W4. Point-of-Use: Behavioural Factor and Treatment Cost of Drinking Water

Where is the water stored? (See code)	What is the height of the main storage place from the floor? **(Feet)**	How is drinking water taken from the point of use? **(See code)**	Do your hands come in touch with the water during collection at the point of use? (0- No 1- Yes)	Do children below 10 years of age collect water from point of use? (0- No1-Yes)	What is the main thing you do to reduce water contamination		How much does it cost per day for treatment? (Taka)		Why don't you treat the water? **(See code)**	If strainer is used, what is the price of the strainer?	How long will the strainer last? **(years)**
					Is the source water stored in a storage system? (See code)	What is the type of storage system at the water source point? (See code)	After how many days is the container cleaned at the point-of-source? (Days)	How is water taken from the source? (See code)			
4.1	**4.2**	**4.3**	**4.4**	**4.5**	**4.6**	**4.7**	**4.8**	**4.9**	**4.10**	**4.11**	**4.12**

Storage place: 4.1
1- Living room
2- Bathroom
3- Veranda
4- Bedroom
5- No need to store

Water collection system: 4.3
1- Directly from source
2- Vessel with handle dipped into source
3- Vessel without handle dipped into source

Treatment: 4.4, 4.5
1- Yes
0- No

Treatment system: 4.6, 4.7
1- Not treated
2- Boiling
3- Pills/Filter
4- Strainer
5- Cloth
6- Other (specify).....

Reason of avoiding treatment: 4.10
1- Treatment is too costly
2- Water quality is good enough
3- Time consuming
4- Other (specify).....

W5. Does any warm-blooded animal or livestock (duck/hen/cat/dog, etc.) enter into your water storage room? [ ]

0 - No
1- Yes

W6. Do any of your children below 5 years of age touch these animals or livestock? [ ]

0 - No
1- Yes

S. Based on use what type of toilet do you use? [ ]

Types of Toilet
1- Shared with neighbours
2- Community/NGO provided
3- Private

A. Awareness

Question	Ans. code	Code
1. Have your children been given measles vaccine? **(See code)**		0- No, 1- Yes
2. Which major awareness programme is available through NGOs? **(See code)**		1- Safe drinking water 2- Proper sanitary disposal system 3- Health education 4- Hygiene promotion 5- Don't have any awareness program 6- Don't know
3. Did you participate in the awareness programmes? **(See code)**		0- No, 1- Yes
4. What is the main cause of diarrhoea? **(See code)**		1- Not washing hands properly after defecation 2- Not washing hands properly before meals 3- Eating stale food 4- Drinking bad quality water 5- Not disposing of faeces properly 6- Not having proper garbage disposal 7- Others (Specify) —-
5. What is the major symptom of diarrhoea? **(See code)**		1- Loose motion 2- Stomach cramps 3- Dizziness 4- Vomiting, 5. Others (Specify) —-
6. What is the major consequence of diarrhoea? **(See code)**		1- Dehydration 2- Weight loss 3- Internal bleeding (passing blood with stools) 4- Death, 5- Others (Specify) —-
7. How much do you think drinking bad quality water contributes to diarrhoeal disease?**(See code)**		1- Main cause, 2- Moderate cause, 3- Not a cause
8. Do you have a TV in your home?		0- No, 1- Yes
9. Do you have a Radio in your home?		0- No, 1- Yes
10. How many days do you watch TV per week?		
11. How many days do you listen to radio per week?		
12. Have you heard of Baby Zinc?		0- No, 1-Yes
13. Did you have Baby Zinc for your children when they were affected by diarrhoea?		0- No, 1- Yes

H. Hygiene

	Question	Ans. Code	Code
1.	Which hand washing material is used to wash your or child's (less than five years) hands before feeding **(See code)**?		Hand washing materia l: 1, 2
			1- Soap
			2- Mud 3- Ash
			4- Water only
			5- Not washing at all
2.	Which washing material is used to wash the hands and feet of the child after defecation? **(See code)**		
3.	Which hand washing material is used after defecation? **(See code)**		
4.	How many hands do you wash after defecation?		
5.	Do any children, less than five years, come in contact with garbage outside home while playing/walking/sitting?		(0- No, 1- Yes)
6.	After how many days do you cut your nails?		
7.	After how many days do you cut the nails of your children?		

P. Promt

		Code		Code
		First	Second	
1	At the point of use do your hands come in touch with the water during collection?			0- No, 1- Yes
2	How many hands do you wash after defecation?			
3	How many days do you watch TV per week?			
4	How many days do you listen to Radio per week?			
5	How often do you cut your nails?			
6	How often do you cut the nails of children?			
7	Do you wash the container before collection of water?			0- No, 1- Yes
8	Do you bathe everyday?			0- No, 1- Yes

Thank you,

· Time finished……..

The questionnaire is examined by…….

Signature of Supervisor: