Socio-Economic Determinants of Diarrhoeal Morbidity among Children in Tanzania

Innocent Pantaleo† and George Temba††

Abstract

This paper uses a restricted sample of children under five years of age (0-4) of the 2009-2010 and 2015-2016 Tanzania Demographic and Health Survey (TDHS) data to determine the socio-economic factors of diarrhoea morbidity among the sampled children. Using a t-test mean comparison and a logit model to estimate and analyze factors influencing the probability of occurrence of diarrhea, the paper finds that there is a significant difference in socioeconomic determinants between urban dwellers and rural dwellers as well as between male headed and female headed households. Child's age and parents' education level were found to be negatively associated with diarrhea morbidity. Contrary to expectations, age at first birth was found to be significant only in one dataset. It is further revealed that in preventing and reducing the incidence of diarrhoea among children, sanitation facilities is of importance than the supply of drinking water. The results imply that building the capacity and providing basic health and hygiene education to parents is more important for reducing diarrhoea morbidity among children. Specifically, promotion of both breastfeeding, and of personal hygiene, while preparing the supplementary foods for these children, seems to be the right way to control diarrhoea.

Keywords: diarrhea, morbidity, socio-economic, determinants

JEL:I 12, I 15

---

† Department of Economics, University of Dar es Salaam, Tanzania. Contact: P.O.Box 35045, Dar es Salaam, Phone-+255754846421, Email- innopanta@yahoo.co.uk/innopanta@gmail.com

†† Department of Economics, University of Dar es Salaam, Tanzania. Contact: P.O.Box 35045, Dar es Salaam, georgeraphael92@yahoo.com

1.0 INTRODUCTION

Diarrhoea disease is one of the important public health problems among under-five children in developing countries. Global estimates of the mortality rate due to diarrhoea have shown a firmly fixed decline since the 1980s. However, diarrhoeal diseases continue to be the key cause of morbidity and mortality among children worldwide in spite of all advances in health technology, improved management, and increased use of oral rehydration in the past ten years. Morbidity due to diarrhoea has not shown a parallel decline in comparison to mortality trends (WHO, 2017). Despite Millennium Development Goal (MDG) 4 aiming at reducing mortality to children of young age by 2/3 by the end of the year 2015, some studies, however, shown that there was minimal progress (Kumar & Subita, 2012, pp. 83-88).

As of 2015, the MDGs have been replaced by the UN Sustainable Development Goals (SDGs) for 2030, which despite considering Child Health no longer a headline goal, child morbidity still remains an indicator under the Health SDG number 3. However, in the context of survival and strong early childhood development (ECD), global, public and private, inclusive policy support, 'surviving and thriving' (nutrition, sanitation, cognitive and social-emotional stimulation), are the necessary foundations upon which to address this crucial treatment initiative (Baker et al, 2017:1). Exposure to diarrhea disease-causing agents is frequently a result of the use of contaminated water and unhygienic practices in food preparation and disposal of excreta. Feeding practice of the mother also was reported to be of major concern in causing diarrhea morbidity among young children in Tanzania (NBS, 2011: 151-156). Among the poor Tanzanian households, the impact is much greater: the 10 percent (in rural-household) of children die before they reach their fifth birthday. Diarrhoeal disease, a preventable illness, is the second and third leading causes of child death in developing especially Tanzania, accounting for 21 and 17 percent of child deaths, respectively (NBS, 2016: 198-201).

The economic viewpoint of diarrhoeal morbidity in Tanzania lies mostly in poverty or lack of income to acquire basic needs such as clean water and food, shelter and clothing. Poverty is more closely related to poor housing facilities, crowding (huge number of households), dirty floors, lack of access to sufficient clean water or to the waste disposal and sanitation, living with domestic animals that may carry human pathogens and a lack of refrigerated storage for food. All the above-mentioned characteristics and others are perceived to increase the frequency and spread of diarrhoea to children under five years of age. Theoretically, poverty restricts the ability to provide age-appropriate, nutritionally balanced diets or to modify diets when diarrhoea develops so as to mitigate and repair nutrient losses. The impact is worsened by the lack of adequate, available, and affordable medical care. Thus, children suffer from an apparently never-ending sequence of infections, rarely receive appropriate preventive care, and too often encounter the health care system when they are already severely ill (Chang et al, 2017).

Poverty also causes some families deprived at meeting the cost of doctors' fees, which in most cases people use out-of-pocket, cost of drugs and transport to reach a health centre, hence in the worst cases, this burden of illness may mean that families sell their property, take children out of school to earn a living or even start begging. In some other cases, this burden of caring is often taken on by a female relative, who may have to give up her education as a result or take on waged work to help meet the household's costs (HPA, 2017: 1).

The need for studying diarrhoea morbidity emanates from the life-cycle consequences of illness and disability in which poor health in childhood has a long-term and negative impact on adulthood outcomes, such as adult health, earning potential, and productivity (Sachs, 2002: 143-144). Poor childhood nutrition can reduce cognitive ability, school attendance, and academic achievement (Bloom & Canning, 2008: 53-75), resulting in relatively less-educated and lower-earning adults. Poor health and poor early school performance also reduce opportunities (and incentives) to invest in secondary and tertiary education in later years (Lorentzen, McMillan, & Wacziang, 2008: 81-124).

However, the success of any health policy or health care intervention depends upon a correct understanding of socio-economic factors which determine the occurrence of diseases and deaths. Hence, it is very important to see the relation and interaction of these factors in understanding child survival issues that may reduce diarrhoeal morbidity. Some works have already been done on this aspect both in Tanzania and other countries of outside Tanzania. However, to the best of our knowledge, those on Tanzania have either not used the methods for analysis that help in eliminating bias or have not explored the role of location and gender differences in controlling diarrhoea morbidity among children, a gap filled by this paper. Also, contrary to other similar studies on Tanzania, we use the nationally representative datasets.

On Tanzania, Kabhele et al (2018: 1-84) analyzed the prevalence and factors associated with diarrhoea among children between the age of 6 and 59 months in Mwanza city Tanzania using cross-sectional data to find out that unplanned settlement and sanitation behavior in food preparation was significantly associated with childhood diarrhoea. Sanitation influences was also observed by Mshida *et al* (2017: 1-8) in which children who consumed foods kept in kibuyu or used unboiled cows' milk or were drinking surface water in semi-pastoral communities of Arusha, Tanzania was strongly associated with diarrhoea.

Kakulu (2012) analyzed diarrhoea among under-five children and household water treatment and safe storage factors in Mkuranga district, Tanzania. Using cross-sectional data of 400 households found only 49.5% of households reporting treating water using any method. The observations on Tanzania are not much different with other countries, for instance, Hussein (2017: 1-53) using demographic health survey data of Nigeria 2013 and logistic regression found that maternal education, religion, age, working status, unprotected water source, main floor material, DPT3 and polio3 vaccination to be positively associated risk factors for childhood diarrhea.

Woldu et al (2016: 40) did a similar study for the nomadic population in northwest Ethiopia to find that the probability of diarrhea occurring being higher among household with two or more children compared to a household with only one child. Children diarrhea was also associated with educational status, being higher among children whose mother had no formal education compared with their counterparts and the occurrence of diarrhoea was 1.6 higher in economically poor households compared to medium income households.

Mahmood (2002: 975-995) analyzed the determinants of neonatal and post-neonatal mortality in Pakistan using Pakistan Demographic Health Survey data that include a total of 6492 births that occurred 5 years preceding the survey to 4061 women. The results of proportional hazard model analysis also show that families living in households connected with piped water in their houses have significantly lower post-neonatal mortality than those families who depend on wells for drinking water. The results are indicative of the importance of safe drinking water for improving post-neonatal mortality as well as children health in Pakistan. The results do not find evidence of improved child survival in households who have flush toilet facilities than those who do not.

Thus, this paper examines the socio-economic determinants of diarrhoeal morbidity among young children in Tanzania. Specifically, it assesses the effects of different socio-economic characteristics on diarrhoeal morbidity; assesses the effects of the interaction of different socio-economic characteristics on diarrhoeal morbidity; examines whether there are statistical gender and rural-urban differences in these socio-economic effects and lastly assesses the prevalence of diarrhoeal morbidity among children. The paper finds that location and gender differences among household heads plays big role in influencing the probability of occurrence of diarrhea. Parents' education level was also found to have a significant association with diarrhea morbidity.

The rest of the paper presents the theoretical and methodological issues followed by empirical analysis and discussions and finally we conclude.

2.0 THEORETICAL AND METHODOLOGICAL ISSUES

2.1 Theoretical Issues

This work is guided by the Health and Human capital theory. Health is regarded to be highly essential in promoting the well-being of an individual (child) and the economy as a whole, although in the process of its generation, it has impacts on the household, for example the breastfeeding time will affect mothers' time spent in working and thereafter reduce mother's income. Grossman (2000) pointed out that health is a good that people demand as either an investment or consumption good and an initial stock of health capital depreciates (declines) over time if not increased by investing on health it. The process of health generation can be traced within a household production function for health that captures the notion that household members use their time, knowledge and purchased goods and services to produce health. For example, the treatment of diarrhoea involves a mother making time and possibly money to obtain oral rehydration salts and then using knowledge to administer the salt to the child, resulting in an improvement of child health.

2.2 Methodological Issues

The logistic approach is used and can be expressed as follows:

(1) $$P_i = F(Z_i) = F(\beta_0 + \beta_n X_i) = 1/_{1+e^{-z_i}} = 1/_{1+e^{-(\beta_0+\beta_n X_i)}}$$

This function guarantees the probability ranges from 0 to 1 as the regression equation predicts values from negative infinity to positive infinity [(Gujarati, 1995: 597-614), (Cameron & Trivedi, 2005)]. Therefore, it can be simplified as:

(2) $$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_n X_i$$

The dependent variable in Equation 2 is the logarithm of the odds that a particular choice will be made. Logit predicts the odds or likelihood of an event's occurring within the range of the real line. Where p represents the probability of a child having diarrhoea morbidity, β_0 and β_n are estimated regression coefficients, and x_i in this case are the background characteristics, consisting of age and gender of child, mother's age at the time of birth, education, working status of mother, total number the children born, poverty status like poor and non-poor, income of household source of drinking water, toilet facilities and access to electricity. For rare events like diarrhoeal diseases, p is small and the odds ratio translates to a relative risk (Collett, 1991: 339). Specific model used for estimation in this study is as follows:

$$(3)\ \ln DM_i = \beta_0 + \beta_1 AC + \beta_2 GC + \beta_3 MATB + \beta_4 EDU + \beta_5 WSP + \beta_6 TNCB + \beta_7 PS + \beta_8 SDW + \beta_9 TF + \beta_{10} Sexhh + \varepsilon_i$$

Where; ln DM is the odds of diarrhoea morbidity, AC= Age of a child, GC= Gender of a child, MATB= Mother's age at the time of birth, EDU= Education, WSP= Working status of the parents, TNCB= Total number of children born, PS= Poverty status, SDW= Source of drinking water, TF= Toilet facilities and Sexhh=sex of head of household.

The same logit model was used to analyze the interaction of different socio-economic effects on diarrhoea. The interaction was made between independent variables. Two variables interact if a particular combination of variables leads to results that would not be anticipated on the basis of the main effect of the variable. An interaction model can be found by multiplying two ordinary predictors (Norton & Ai, 2004: 103-116). The interaction model is:

$$(4)\ \ln DM_i = \beta_0 + \beta_1 AC + \beta_2 GC + \beta_3 MATB + \beta_4 EDU + \beta_5 WSP + \beta_6 TNCB + \beta_7 PS + \beta_8 SDW + \beta_9 TF + \beta_{10} Resd + \beta_{11} sexhh + \beta_{12}(EDU * WSP) + \varepsilon_i$$

Where, $EDU * WSP$ is the interaction term. This study used this interaction term to see if parents who are (are not) working and have a certain level of education influence child diarrhoea morbidity in the household.

This paper used data from the Tanzania Demographic and Health Survey (TDHS) of 2010 and 2016. This survey dataset is available in a series of periodic surveys that were conducted after every five years by the National Bureau of Statistics (NBS) and other stakeholders such as Ministry of Health and Social Wealth in Tanzania and UNICEF. This paper uses a sample of 13,376 households in urban and rural. The main objective of the TDH survey is to provide high-quality data on fertility levels and preferences, family planning use, reproductive child and maternal health, nutritional status of young children and women, childhood illness, fistula, domestic violence, knowledge, and behavior regarding HIV/AIDS as well as maternal mortality.

3.0 EMPIRICAL ANALYSIS AND DISCUSSIONS

3.1 Descriptive Statistics of Variables

Table 1 below presents the results of the descriptive statistics. Most of the households are found to be living in rural areas, with for instance only 18.4 percent and 21.4 percent of the interviewed household in 2010 and 2016 respectively being urban residents and that majority of Tanzanians are middle-income earners. Most of those interviewed (about 63% and 61% in 2010 and 2016 respectively) are primary education leavers. This shows that human capital development is still low among Tanzanians. Majority of the household are male headed and for about 58 percent and 32.6 percent of the households in 2010 and 2016 respectively uses an open pit toilet (without slab) while 20.4 percent was reported to have no toilet facility at all. This proves that the majority of the people in Tanzania uses poor toilets facilities. Children reported having diarrhoea for the past two weeks of the interview were 11.0 percent in 2016 compared to the 12.7 percent reported in TDHS of 2010. Thus, prevalence rates are declining over time probably on account of improved sanitation and education status over time.

Table 1: Descriptive Statistics of the key variables

	2016				2010			
Variable	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Household Characteristics								
Number of children	2.057	1.409	0	16	2.119	1.304	0	13
Age at first birth	19.246	3.252	7	46	19.125	3.124	9	41
Child age	1.931	1.415	0	4	1.963	1.413	0	4
Sex of head of household(1=male)	0.835	0.371	0	1	0.842	0.365	0	1
Gender of child (1=male)	0.502	0.500	0	1	0.500	0.500	0	1
Edu_1(no education)	0.232	0.422	0	1	0.257	0.437	0	1
Edu_2(primary)	0.615	0.487	0	1	0.633	0.482	0	1
Edu_3(secondary)	0.147	0.354	0	1	0.107	0.310	0	1
Edu_4(higher)	0.006	0.078	0	1	0.002	0.044	0	1
Currently working	0.802	0.398	0	1	0.835	0.371	0	1
Residence (1=urban)	0.214	0.410	0	1	0.184	0.387	0	1
Wealth status(1=non-poor)	0.570	0.495	0	1	0.569	0.495	0	1
Source of drinking water								
Piped into dwelling	0.051	0.22	0	1	0.056	0.231	0	1
Piped to yard/plot	0.043	0.203	0	1	0.034	0.182	0	1
Public tap/standpipe	0.133	0.339	0	1	0.177	0.382	0	1
Neighbor's tap	0.118	0.322	0	1	0.068	0.252	0	1
Open well indwelling					0.005	0.068	0	1
Open well in yard/plot					0.014	0.117	0	1
Unprotected spring	0.010	0.101	0	1				
Unprotected well	0.006	0.076	0	1				
Open public well					0.225	0.418	0	1
Neighbor's open well	0.094	0.292	0	1	0.025	0.155	0	1
Protected well in yard/plot					0.005	0.072	0	1
Protected public well	0.002	0.044	0	1	0.119	0.324	0	1
Neighbor's borehole	0.018	0.134	0	1	0.014	0.119	0	1

	2016				2010			
Variable	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
River/dam/lake/ponds/stream/canal	0.073	0.260	0	1	0.177	0.382	0	1
Spring	0.101	0.302	0	1	0.064	0.245	0	1
Rainwater	0.050	0.218	0	1	0.005	0.069	0	1
Tanker truck	0.001	0.028	0	1	0.007	0.085	0	1
Cart with small tank	0.002	0.047	0	1	0.004	0.062	0	1
Type of toilet facility								
Flush to piped sewer	0.002	0.049	0	1	0.003	0.057	0	1
flush to septic tank	0.013	0.112	0	1	0.009	0.092	0	1
flush to pit latrine	0.080	0.272	0	1	0.061	0.240	0	1
Flush to somewhere else	0.007	0.084	0	1	0.006	0.080	0	1
ventilated improved pit	0.022	0.145	0	1	0.017	0.131	0	1
Pit latrine with slab	0.121	0.327	0	1	0.109	0.312	0	1
Pit latrine without slab	0.326	0.469	0	1	0.58	0.494	0	1
No facility	0.169	0.375	0	1	0.214	0.41	0	1
***N*=**	**18248**				**7618**			

Source: Author's computation from the TDHS 2010 and 2016

Socio-economic characteristics determining residential differences

The results in Table 2 below show that urban dwellers and rural dwellers significantly differ in the incidence of diarrhoea morbidity. That is, urban dwellers significantly differ from rural dwellers in many aspects except a few such as child age, gender, primary education and neighbor's open well. For instance, there have been significant changes in terms of country's investment in education since 2010 to both urban and rural dwellers, an element that may probably explain why primary education turns out to be significant in 2016 when compared to 2010.

Table 2: T-test mean comparison between urban dwellers and rural dwellers from TDHS of 2010 and 2016

	2010			2016		
	Urban	Rural		Urban	Rural	
Variables	**Mean**	**Mean**	**Mean Diff.**	**Mean**	**Mean**	**Mean Diff.**
Household Characteristics						
Age at first birth	19.8	18.97	0.826***	20.2	19.01	1.193***
Child age	1.976	1.959	0.017	1.893	1.935	-0.042
Number of children	1.659	2.224	-0.566***	1.696	2.219	-0.523***
Gender(1=male)	0.489	0.502	-0.014	0.52	0.499	0.020*
wealth status(1=poor)	0.066	0.514	-0.448***	0.92	0.456	0.464***
Currently working(1=yes)	0.723	0.861	-0.139***	0.711	0.806	-0.095***
Education						
Edu 1(no-education)	0.105	0.291	-0.186***	0.09	0.256	-0.166***
Edu 2(primary)	0.631	0.635	-0.003	0.566	0.618	-0.053***
Edu 3(secondary)	0.254	0.074	0.180***	0.314	0.124	0.190***
Edu 4(higher)	0.009	0	0.009***	0.03	0.002	0.028***
Source of Drinking Water						
Piped into dwelling	0.184	0.028	0.156***	0.106	0.035	0.071***
Piped to yard/plot	0.086	0.023	0.064***	0.155	0.023	0.132***
Public tap/standpipe	0.149	0.184	-0.035***	0.147	0.209	-0.062***
Neighbor's tap	0.226	0.034	0.192***	0.21	0.042	0.168***
Open well in dwelling	0.001	0.005	-0.005**			
Open well in yard/plot	0.008	0.015	-0.007**			
Open public well	0.093	0.255	-0.163***			
Neighbor's open well	0.027	0.024	0.003			
Protected well in yard/plot	0.009	0.004	0.005**			
Protected public well	0.081	0.128	-0.047***	0.14	0.136	0.004
Neighbor's borehole	0.044	0.008	0.036***	0.039	0.033	0.005
River/dam/lake/ponds/stream/canal	0.019	0.213	-0.194***	0.021	0.175	-0.154***
Spring	0.04	0.07	-0.030***	0.032	0.024	0.008**
Rainwater	0.009	0.004	0.005**	0.012	0.008	0.004*
Tanker truck	0.024	0.004	0.020***	0.022	0.002	0.020***
Unprotected well				0.059	0.23	-0.171***
Unprotected spring				0.027	0.08	-0.053***

	2010			2016		
	Urban	Rural		Urban	Rural	
Variables	Mean	Mean	Mean Diff.	Mean	Mean	Mean Diff.
Cart with small tank				0.015	0.001	0.015***
<u>Type of Toilet Facility</u>						
Flush-piped sewage	0.015	0.001	0.015***	0.006	0.001	0.005***
Flush - septic tank	0.042	0.001	0.041***	0.065	0.002	0.062***
Flush - pit latrine	0.243	0.02	0.223***	0.304	0.041	0.263***
Flush - somewhere	0.017	0.004	0.013***	0.016	0.006	0.011***
Pit latrine - ventilated improved pit	0.059	0.008	0.051***	0.059	0.017	0.042***
Pit latrine - with slab	0.155	0.098	0.057***	0.263	0.106	0.157***
Pit latrine – without slab	0.436	0.612	-0.176***	0.073	0.183	-0.111***
Pit latrine without slab non-washable				0.185	0.458	-0.272***
No facility	0.032	0.256	-0.224***	0.029	0.187	-0.157***

*Legends: ***, **, * represents significant difference at **1%**, **5%** and **10%** respectively.*

Source: Author's computation, TDHS 2010 and 2016

Results of the t-test for 2016 survey (see Table 3) show that urban dwellers and rural dwellers significantly differ on the incidence of diarrhoea morbidity. In all of the insignificant differences, the most possible explanation is that the variables in concern are not easily influenced by the behavior of individual household. For instance, access to the protected well which in most of the developing nations like Tanzania is still a big source of drinking water particularly to people living in both rural and urban areas causing difficulties to observe the difference.

On the other hand, household characteristics such as gender, age of the mother at first birth, education of the household head, wealth status, all categories of source of drinking (except tube well and protected well), number of children born and type of toilet facility shows significant differences in determining diarrhoea morbidity among children residing in urban and rural households. A study by Arif and Naheed (2012) found differences between urban and rural dweller hence advocating for analysis of the differential effect of location to various socioeconomic characteristics. Generally, urban dwellers had better results which probably can be accounted to easy access to proper socioeconomic activities such as clean water, well-constructed toilet facility, and education.

Socio-economic characteristics determining gender difference

The results in Table 3 show that there is a significant difference between male and female-headed households across different socio-economic factors determining diarrhoea morbidity among children. That is, the male head of household significantly differ from a household whose head is a female in many aspects except a few such as secondary education, some categories of the source of drinking water and some categories of toilet facility. The influence of household characteristics such as education of the household head and wealth status in determining diarrhoea morbidity among children significantly differ between the male and female-headed household. Most of the empirical works (such as Hussein (2017), Kabhele, New-Aaron, Kibusi, & Gesase (2018), Sik (2015) focus mostly on the gender of a child and how it impacts diarrhea morbidity but this paper has shown that there is a significant difference in determining diarrhoea morbidity among children between male household headed and female household headed.

Table 3: T-test mean comparison between the male and female head of the household for TDHS 2010 and 2016

	2010			**2016**		
	Male	**Female**		**Male**	**Female**	
Variables	**Mean**	**Mean**	**MeanDiff**	**Mean**	**Mean**	**MeanDiff**
Wealth status	0.419	0.496	-0.077***	0.572	0.559	0.014
Currently working	0.824	0.896	-0.072***	0.794	0.84	-0.046***
Gender of a child	0.501	0.493	0.008	0.502	0.5	0.002
Child age	1.948	2.043	-0.095**	1.922	1.981	-0.059**
Age at first birth	19.15	19.02	0.126	19.24	19.26	-0.016
Number of children	2.15	1.956	0.194***	2.11	1.786	0.324***

	2010			2016		
	Male	Female		Male	Female	
Variables	**Mean**	**Mean**	**MeanDiff**	**Mean**	**Mean**	**MeanDiff**
Edu 4(higher)	0.002	0.004	-0.003*	0.006	0.008	-0.003*
Edu 3(secondary)	0.108	0.101	0.007	0.144	0.161	-0.017**
Edu 2(primary)	0.628	0.663	-0.035**	0.612	0.632	-0.02**
Edu 1(no education)	0.262	0.231	0.031**	0.239	0.199	0.039***
Source of drinking water						
Piped into dwelling	0.057	0.052	0.006	0.053	0.04	0.014***
Piped to yard/plot	0.035	0.031	0.004	0.043	0.043	0
Piped to neighbor	0.065	0.087	-0.023***	0.116	0.127	-0.011*
Public tap/standpipe	0.178	0.174	0.004	0.133	0.13	0.003
Tube well or borehole	0.014	0.019	-0.006	0.018	0.021	-0.003
Protected well				0.002	0.004	-0.002***
Open well in dwelling	0.004	0.01	-0.006***			
Open well in yard/plot	0.014	0.012	0.002			
Unprotected well				0.006	0.005	0.001
Open public well	0.222	0.243	-0.021			
Protected spring	0.064	0.063	0.001	0.094	0.097	-0.003
Neighbor's open well	0.026	0.02	0.006			
Unprotected spring				0.011	0.008	0.003
Protected well in yard/plot	0.006	0.001	0.005**			
River/dam/ponds	0.181	0.157	0.023*	0.071	0.081	-0.01*
Protected public well	0.122	0.106	0.015			
Rainwater	0.004	0.007	-0.002	0.105	0.084	0.021***
Tanker truck	0.006	0.012	-0.006**	0.001	0	0.001
Cart with small tank	0.004	0.005	-0.001	0.003	0	0.002**
Bottled water				0.051	0.043	0.009**
Type of toilet facility						
Flush - piped sewer	0.002	0.008	-0.006***	0.002	0.005	-0.003***
Flush - septic tank	0.009	0.007	0.002	0.013	0.013	-0.001
Flush - pit latrine	0.063	0.053	0.009	0.08	0.081	-0.001

	2010			2016		
	Male	**Female**		**Male**	**Female**	
Variables	**Mean**	**Mean**	**MeanDiff**	**Mean**	**Mean**	**MeanDiff**
Flush - somewhere else	0.006	0.008	-0.002	0.007	0.007	0
Flush, don't know where				0	0	0
Ventilated improved pit	0.017	0.017	0	0.021	0.024	-0.003
Pit latrine with slab	0.108	0.112	-0.004	0.121	0.124	-0.003
Pit latrine without slab	0.581	0.572	0.009	0.33	0.307	0.023**
Pit latrine without slab non-washable				0.218	0.168	0.050***
No facility	0.213	0.222	-0.099	0.168	0.176	-0.008

*Legends: ***, **, * represents significant difference at **1%**, **5%** and **10%** respectively*

Socio-economic determinants of diarrhoea morbidity among children: Logistic Regression
To establish the causal relationship between diarrhoea morbidity and its determinants, Logistic regression was used for both 2010 and 2016 dataset to obtain the marginal effect of each independent variable on diarrhoea. The results of the logistic regression marginal effects are shown in Table 4.

Results in Table 6, 2016 data show that the number of children in the household had a significant negative impact on diarrhea morbidity among children indicating a decline in diarrhoea morbidity by 1.35 percent. However, despite these results being in line with Bennett (1999) and Preston (1978), they are contrary to the anticipated sign, that the smaller the number of children the easier it becomes to manage and provide basic needs hence healthier children, especially in developing countries.

Age of the mother at first birth was found to be significant in 2016 data set with a negative association with diarrhoea morbidity among children but did not show a significant effect on diarrhoea in the 2010 data set. This shows that children with older mothers have a low probability of diarrhoea morbidity compared to children with younger mothers and thus a year increase in mother's age decreases the likelihood of diarrhoea morbidity by -2.7 percent. This is probably a result of older mothers having more experienced and sufficient resources to care for the child compared to younger mothers. Sik (2015) relates these kinds of findings with financial constraints facing the young mothers and in most cases, at a young age, most of the mothers in developing countries are found to be having more young children to take care when compared to older mothers. (See Table 4)

Table 4: Marginal effect results from TDHS 2010 and TDHS 2016

	THDS 2010		THDS 2016	
Variable	**dy/dx**	**P>z**	**dy/dx**	**P>z**
Number of children	.000241	0.940	-.0135626	0.000***
Age at first birth	.0018232	0.140	-.0027901	0.002***
Child age	.0071366	0.038	.012564	0.052*
Sex head of household(1=male) *	-.0188547	0.088*	-.0142295	0.056*
Gender of child(1=male) *	.008953	0.235	-.0011449	0.831
Education 1(1=no education) *	-.0955533	0.050**		
Education 2(1=primary) *	-.1371904	0.121	.0041766	0.544
Education 3(1=secondary) *	-.0905232	0.007***	.0023601	0.820
Education 4(1=higher) *			-.0697755	0.009***
Currently working(1=yes) *	.0204622	0.034**	.014776	0.025**
Residence(1=urban) *	.0351975	0.011**	.0261109	0.002***
Child age squared	-.0113585	0.000***	-.0085116	0.000***
Wealth status(1=rich) *	.0052718	0.560	.008066	0.224
Source of Drinking Water				
piped into dwelling	-.0546161	0.172	-.0450527	0.245
piped to yard/plot	.0309107	0.677	-.0001465	0.998
piped to neighbor	.0111916	0.859	-.0143828	0.755
public tap/standpipe	.0202079	0.766	-.0141621	0.758
tube well or borehole	-.043541	0.475	-.0244611	0.594
protected well	-.0194507	0.721	-.0109902	0.815

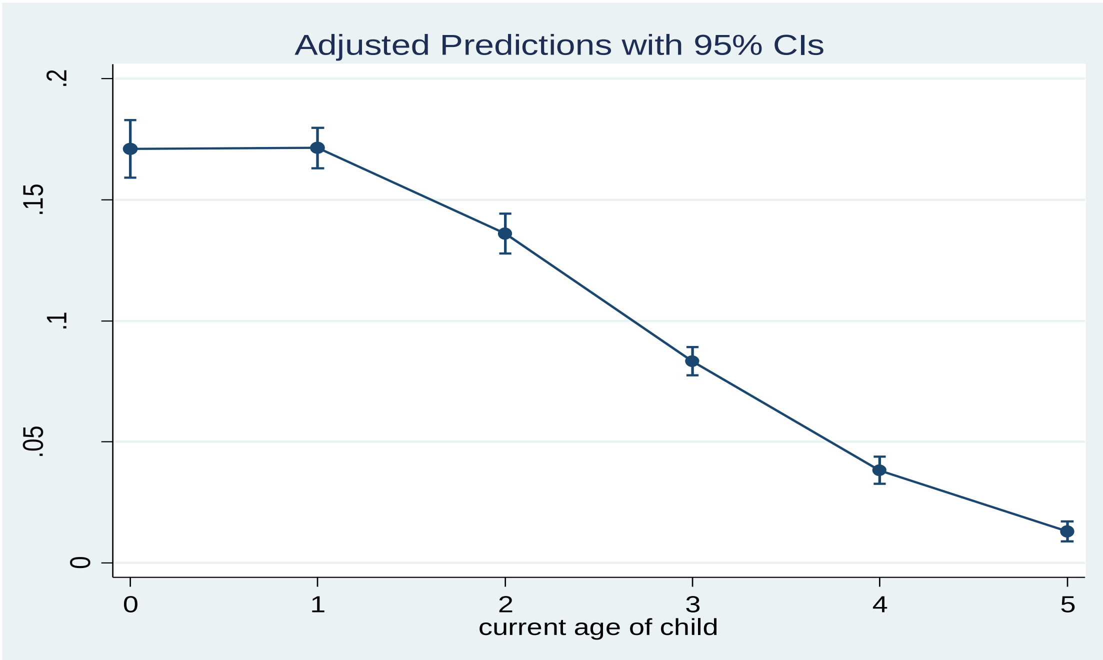
	THDS 2010		THDS 2016	
Variable	**dy/dx**	**P>z**	**dy/dx**	**P>z**
unprotected well	-.0175008	0.767	-.0169115	0.711
protected spring			-.0191392	0.691
unprotected spring			.0285376	0.617
rainwater			-.0168701	0.752
tanker truck			-.0177662	0.735
cart with small tank			.0006828	0.991
bottled water			.0427489	0.627
Type of toilet facility				
flush to piped sewer system	-.0773688	0.091*	-.0613149	0.033*
flush to septic tank	-.0211508	0.597	.0127551	0.818
flush to pit latrine	.0010315	0.960	.0046841	0.925
flush to somewhere else	.0967009	0.178	-.008055	0.884
flush, don't know where	.0225972	0.517	-.0415921	0.286
ventilated improved pit latrine (vip)	.0304021	0.086	.0092316	0.854
pit latrine with slab	.0302517	0.004*	-.0191392	0.691
pit latrine without slab/open pit			-.006497	0.890
pit latrine without slab non-washable			-.0345969	0.409
no facility/bush/field			-.0071115	0.879

Source: Author's computation using STATA

With regard to the sex of the household head, in both 2010 and 2016, it was statistically negative implying that male-headed households are more likely to have a high probability of children with diarrhoea morbidity compared to their counterparts. In a country like Tanzania is not surprising since normally women are the ones who do most of the household activities such as taking care of child health. However, further analysis may need to be considered to ascertain the role of wife to child health in male-headed households. The results show also that as the household head climb up the ladder of education the probability of diarrhoea morbidity declines, results supported by Kakulu (2012) who posits that the prevalence of diarrhoea decreases with higher education.

Having parents who are working turns out, in both data sets (2010 and 2016), to increase the probability of having high rates of diarrhoea among children. This is probably on account of the lack of enough time set for taking care of child health. Arif and Naheed (2012) also found that mothers who were working increased the chances of the children getting diarrhoea disease. Leaving in urban areas is found in both years to have a positive influence on diarrhea morbidity probably on account of congestion resulting in poor sanitation and waste disposal facilities. This result is in line with other empirical studies such as Woldu et al (2016) who found that the pattern of morbidity risk is higher for children living in another urban centre. This analysis can be summarized in a graph as shown in Figure 1.

Figure 1: Relation between Diarrhoea morbidity and child age from TDHS of 2010 and 2016



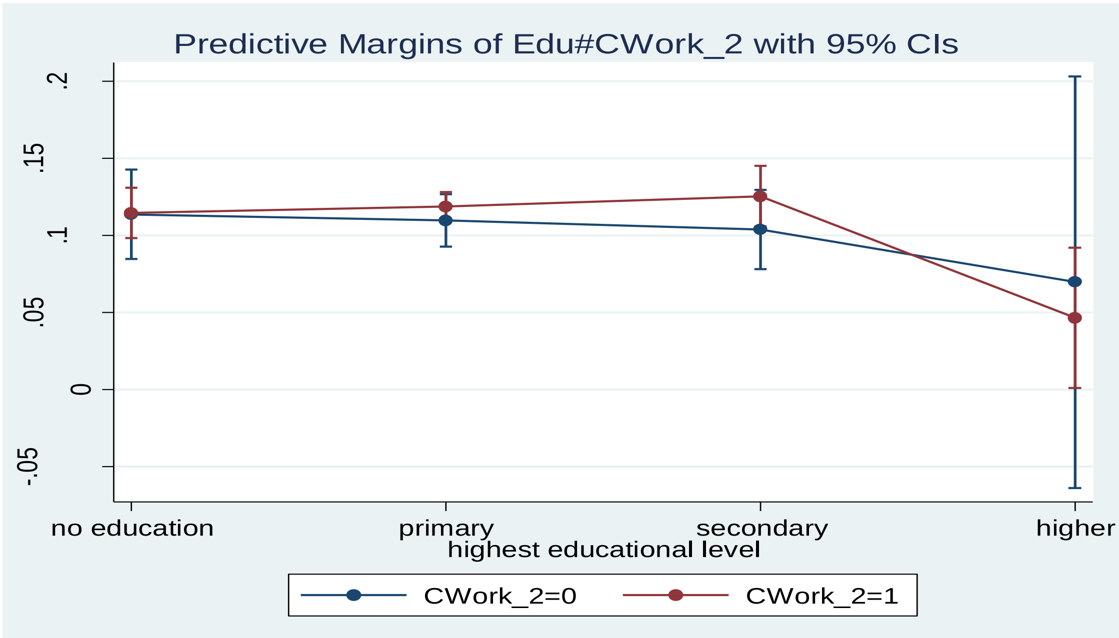
Source: Author's computation using STATA

Surprisingly, the source of drinking water did not show a significant association with diarrhea morbidity in 2010 dataset and 2016 dataset, though some of its dummy variables showed the expected sign. The quality and usage pattern of water in the household, not the purity of water at its source, which largely determines the impact on diarrhea morbidity. Even the water that is pure at its source may become polluted as it passes through the broken pipelines, a common phenomenon in urban localities where drinking-water is supplied through pipelines (UNICEF and WHO 2015). Repairing of these pipelines coupled with improvements in water storage patterns in the home can help reduce the water-borne transmission of pathogens that cause diarrhoea.

Toilet conditions especially living in a household with a flush to the piped sewer showed a negative significant result in 2010 data and insignificant in 2016 dataset. This result shows that children leaving in the household with flush toilet to piped sewer have a lesser probability of diarrhoea morbidity, with the chances of having diarrhoea disease decreasing by -7.7 percent. Also, in the 2010 data set, a pit latrine with slab showed a positive significant result. Meaning that children leaving in the households with pit latrine with slab increase the likelihood of getting diarrhoea disease by 3.02 percent. Mahmood (2002: 975-995) had similar results, that is, children living in houses having a well-established (flush system) water system were less likely to be sick due to diarrhoea than children with no such facilities.

Further exploration of the effects of education and working on diarrhoea morbidity was done by the interaction between education and working status of the household head (see figure 2**).** The interaction term shows that there is a long-run negative relationship between the interaction variable and diarrhoea morbidity. This means that, the probability of a child having diarrhoea decrease as the household increase education and is working. If parents are working and have secondary education or higher the probability of a child having diarrhoea decreases by 6.3 percent.

Figure 2: Interaction results between education and work status for TDHS 2016



Source: Author's computation using STATA

4.0 CONCLUSION

This paper discloses some important dimensions of diarrhoeal morbidity. The paper uses a restricted sample of children under five years of age (0-4) of the 2009-2010 and 2015-2016 Tanzania Demographic and Health Survey (TDHS) data to determine the socio-economic factors of diarrhoea morbidity among the sampled children. Rural and urban differences were tested along with testing whether there are statistical differences in diarrhea morbidity reduction among male and female-headed households. T-tests and logistic regressions are the estimation approaches used in this paper.

Child's own characteristics (gender and age), total number of children born, mother's characteristics (age at first birth), parent's education, environmental characteristics (sources of drinking water and type of toilet facility), economic characteristics (poverty status and working status) and geographical zones (rural and urban) are very important factors to explain diarrhoeal morbidity among children in Tanzania. Moreover, in the analysis, rural areas or zones and urban areas or zones have shown a positive association with diarrhoeal morbidity. The present study also found a negative association between toilet facility and the occurrence of diarrhoeal morbidity but its impact was more profound in rural zones.

Sanitation facilities (toilet facilities) were also closely related to the occurrence of diarrhoea. The better the sanitation facilities, the less likely the child was to get the diarrhoea disease. But this was different in 2016 data set, which showed that poor toilet sanitation causes diarrhoea morbidity regardless of the type of toilet used. These facilities in most parts of the country are far from satisfactory. Improvements in the existing poor sanitation conditions would bring about a significant drop in the incidence of diarrhoea. But on the contrary, water supply did not show any significant association with diarrhoea morbidity in both datasets. The observed results carry different policy implications including promotion of both breastfeeding and personal hygiene at all level and in both rural and urban areas.

References

Arif, G, and Naheed R. 2012. "Socio-economic determinants of Diarrhoeal Morbidity in Pakistan." *Academic Research International*, 2 (1), 398-432.

Baker et al. 2017. *Leadership in Reducing Diarrhea Mortality and Morbidity for Children Under Age 5: A Pressing Priority under the Sustainable Development Goals (SDGs).* December 13. https://www.apha.org/~/media/files/pdf/policy/2017/2017_a3.ashx.

Bloom, D E, and D. Canning. 2008. "Population Health and Economic Growth." *Health and Growth,* 53-75.

Cameron, C, and P. Trivedi. 2005. *Microeconometrics: Methods and Application.* New York: Cambridge University Press.

Chang et al. 2017. *Benefit Cost Analysis in Disease Control Priorities(Disease Control Priorities in Developing Countries No.22).* Washington: Economic Valuation for Health.

Collett, D. 1991. *Modelling Binary Data.* New York: Chapman and Hall. pp. 339.

Gujarati, D. N. 1995. *Basic Econometrics (3rd Ed.).* New York: McGraw-Hill Internation Editions. pp. 597-614.

HPA. 2017. "Key Facts: Poverty and Poor Health." *Health Poverty Action.* November 7. https://www.healthpovertyaction.org/info-and-resources/the-cycle-of-poverty-and-poor-health/key-facts/. pp. 1-2.

Hussein, H. 2017. "Prevalance of Diarrhoea and Associated Risk Factors In Children Under Five Years of Age in Northern Nigeria: A Secondary Data Analysis of Nigeria Demographic and Health Survey 2013." 1-53.

Kabhele, S, M New-Aaron, S Kibusi, and A Gesase. 2018. "Prevalance and Factors Associated with Diarrhoea among Children between 6 and 59 months of Age in Mwanza City Tanzania." *Journal of Tropical Pediatrics,* 1-84.

Kakulu, K. R. 2012. Diarrhoea Among Underfive Children And Household Water Treatment And Safe Storage Factors In Mkuranga District, Tanzania . Dar es Salaam: Muhimbili University of Health and Allied Sciences.

Kumar, S. G, and L. Subita. 2012. "Diarrhoeal Diseases in Developing Countries: A Situational Analysis." *Kathmandu University Medical Journal,* pp. 38(2), 83-88.

Lorentzen, P, J McMillan, and R. Wacziang. 2008. "Death and Development." *Journal of Economic Growth,* 13(2), 81-124.

Mahmood, M. A. 2002. "Determinants of Neonatal and Post-neonatal Mortality in Pakistan." *The Pakistan Development Review,* 975-995.

Mashinda et al. 2017. "Influence of Water, Sanitation, and Hygiene Practices on Common Infections among Under-Five Children in Longido and Monduli Districts of Arusha, Tanzania." *Journal of Environmental and Public Health,* 1-8.

NBS. 2011. *Tanzania Demographic and Health Survey 2010.* Tanzania: National Bureau of Statistics. pp. 151-156.

NBS. 2016. *Tanzania Service Provision Assessment Survey 2014-2015.* Dar es Salaam: National Bureau of Statistics. pp. 198-201.

Norton, EC, and C Ai. 2004. "Computing interaction effects and standard errors in logit and probit models." *The Stata Journal* 4(2):103-116.

Sachs, J. D. 2002. "Macroeconomics and health: investing in health for economic development." *Revista Panamericana de Salud Publica* 12(2), 143-144.

Sik, I. 2015. *Early Motherhood in Tanzania: Exploring the Education, health and Employment Challenges of Dar es Salaam's Adolescent Mothers.* Toronto: University of Toronto.

UNICEF, and WHO. 2015. *Progress on Sanitation andDrinkingWater.* New York: UNICEF/WHO.

WHO, World Health Organization. 2017. *World Health Organization.* May 16. Accessed march 4, 2018. http://www.who.int/mediacentre/factsheets/fs330/en/.

Woldu et al. 2016. "Socioeconomic Factors Associated with Diarrhoeal Diseases Among Under-five Children of the Nomadic population in Northeast Ethiopia." *Journal of Tropical Medicine and Health,* 44:40.