FACTORS ASSOCIATED WITH DIARRHEA AMONG LESS THAN 5 YEAR AGED CHILDREN USING NIGERIAN DEMOGRAPHIC AND HEALTH SURVEY IN 2008

By

Hyunyi Choi

THESIS

Submitted to

KDI School of Public Policy and Management

in partial fulfillment of the requirements

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MASTER OF PUBLIC POLICY IN

ECONOMIC DEVELOPMENT

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Approval as of August, 2013

ABSTRACT

FACTORS ASSOCIATED WITH DIARRHEA AMONG LESS THAN 5 YEAR AGED CHILDREN USING NIGERIAN DEMOGRAPHIC AND HEALTH SURVEY IN 2008

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Diarrhea is one of the leading causes of mortality and morbidly among children in Sub-Saharan Africa. Nigeria is the country which has the second highest children mortality rate. Using Nigeria Demographic and Health Survey 2008, this paper explores to find out the key risk factors of having diarrhea incidence among children under 5 year age group with logistic regression. Among environmental factor, socio economic factor and nutrition factor of individual household survey, mother's education level has the most significant association of having diarrhea morbidity. Mother's education level lowers the probability of getting diarrhea by 1,92%, 3.3% and 4.3% respectively. The results suggest that children whose mothers were less educated were the most vulnerable. In order to reach the target of Millennium Development Goal and improve the status of children health, public health program along with mother's education should be mainstreamed.

Key words: water, sanitation, education, health, diarrhea

Dedicated to God

[Psalm 146]

Praise the LORD. Praise the LORD, O my soul. I will praise the LORD all my life; I will sing praise to my God as long as I live. Do not put your trust in princes, in mortal men, who cannot save. When their spirit departs, they return to the ground; on that very day their plans come to nothing. Blessed is he whose help is the God of Jacob, whose hope is in the LORD his God, the Maker of heaven and earth, the sea, and everything in them-- the LORD, who remains faithful forever. **He upholds the cause of the oppressed and gives food to the hungry. The LORD sets prisoners free, the LORD gives sight to the blind, the LORD lifts up those who are bowed down, the LORD loves the righteous.** The LORD watches over the alien and sustains the fatherless and the widow, but he frustrates the ways of the wicked. The LORD reigns forever, your God, O Zion, for all generations. Praise the LORD.

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I. Introduction

1.1 Purpose of this study

This study attempts to examine the factors associated with diarrhea among children under 5 year in Nigeria where has the second highest child mortality rate after India due to the disease of diarrhea (WHO, 2009). Diarrhea is one of the preventable disease among under five year old children and causes deaths of 6 million children (Parashar U. D. et., 2003). Children can be sick by various pathogens and transmit ion. Especially, lack of access to safe water and sanitation have increased risk of disease potential with viral, bacterial and parasitic pathogens among children in developing countries (Arvelo, 2010, N.A Kermani, 2010).

Each year, overall 2.5 billion cases of diarrhea incidence happen among under five year group and African region and southern asia account for more than 50 percent of childhood diarrhea incidence (UNICEF/WHO, 2009). Poor health systems and resource allocation on health sector also worsen the treatment of this disease and result in death or severe outcome. Diarrhea is the second cause of children mortality in Nigeria. It is important to investigate the rate of child mortality and child morbidity as one of the health factors represents the degree of social development and improvement. If we cannot see the improvement in these indicators in developing countries, it strongly demonstrates that a country lag far behind other developed countries in terms of economic and social development.

Data from the 2008 Nigerian demographic and health survey (DHS) conducted by USAID allows us to see the specifics pictures of poverty, education and health at household level will be analyzed to find out key risk factors associated with children diarrhea morbidity.

The challenges for policy options to reduce the incidence of children diarrhea also would be examined for the recommendation and policy implication.

1.2 Statement of the problem

For the past decades, child and infant mortality rate has been some progress in the world. Despite impressive achievements, each year approximately 9.7 million of the world's children die under the age of five from largely preventable diseases (UNICEF, 2007). Approximately one half of these child deaths take place in sub-Saharan Africa (SSA) despite the region having only one fifth of the world's children. A United Nations Millennium Development Goals set for 2015 is to decrease child mortality by two-thirds from 1990 (United Nations, 2008).

The Millennium Development Goals (MDG) was adopted to eradicate the extreme poverty. MDG outline the 8 key development goals that international community have to achieve development challenges and define a series of targets and progress measures. Goal 4 of the MDG is for the child health in order to reduce by two thirds of the mortality rate among children under five by 2015. Various health programs and policies have been adopted to decrease child mortality. South Asia and sub-Saharan Africa (SSA) still lag behind reducing child morality. In this regard, SSA should take a hold on a great reduction in child mortality. Of the 836 million people who live in the subcontinent, 153 million reside in Nigeria, Africa's most populous nation (Population Reference Bureau, 2009). Nigeria is one of the highest child mortality rates in the world, approximately 189 child deaths occur per 1,000 live births in Nigeria (UNICEF, 2009). For Sub Saharan Africa to meaningfully progress towards the UN Millennium Development Goals (MDG), child mortality should be targeted in Nigeria.

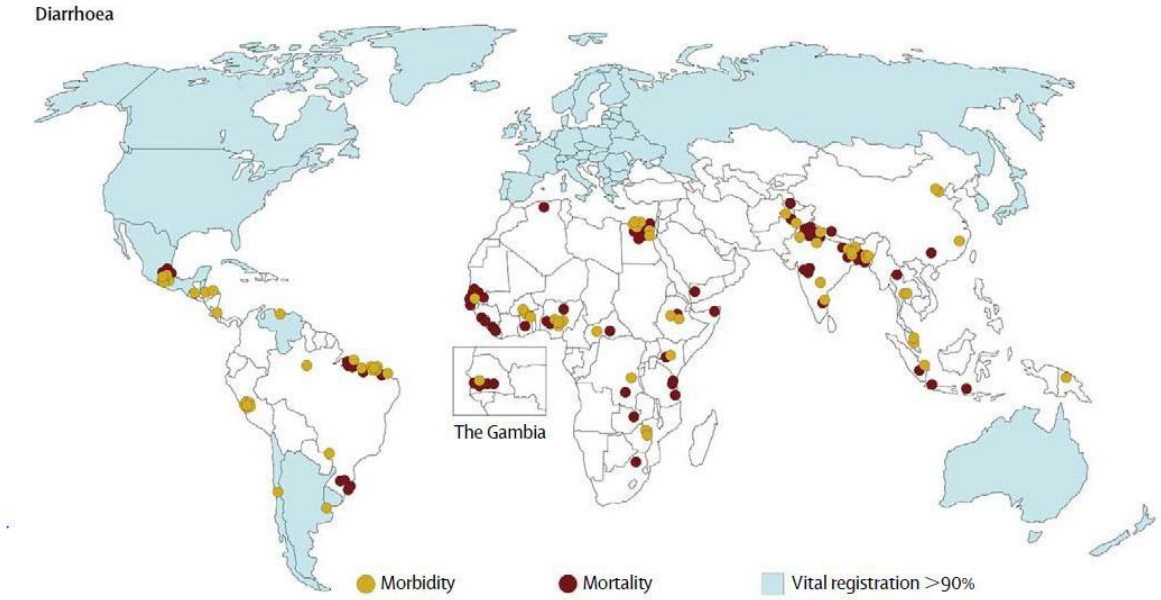
Table: 1 Countries that are three-quarters of deaths due to diarrhea in the developing countries in 2004[1]

Country	WHO sub-region	Deaths due to diarrhea (thousands)
India	SEAR D	535
Nigeria	AFR D	175
D.R Congo	AFR E	95
Ethiopia	AFR E	86
Pakistan	EMR D	77
China	WPR B	74
Bangladesh	SEAR D	69
Afghanistan	EMR D	65
Indonesia	SEAR B	39
Angola	AFR D	34
Niger	AFR D	33
Uganda	AFR E	28
Myanmar	SEAR D	26
United Republic of Tanzania	AFR E	25
Mali	AFR D	24
Total of 15 countries		1384

AFR is WHO African Region; AMR is WHO Region of the Americas; EMR is WHO Eastern Mediterranean Region; SEAR is WHO South-East Asia Region; WPR is Western Pacific Region. a WHO sub-regions are defined on the basis of levels of child and adult mortality: A, very low child and very low adult mortality; B, low child and low adult mortality; C, low child and high adult mortality; D, high child and high adult mortality; E, high child and very high adult mortality.

Nigerian government expressed the willingness to achieve the MDG by 2015 and followed up with a child survival strategy and implementation plan (2002) and child health policy 2006). However, the current levels of under-five mortality and mobility rate in Nigeria are still higher than other than the average of African countries rate.

Figure 1. Distribution of Diarrhea in epidemiological study



Source: Bulletin of the World Health Organization 2008

1.3 Importance of the issue

The fact that Nigerian children suffer from diarrhea and die because of this disease implies that if we examine key factors associated with diarrhea incidence, then we could make right direction of strategies and policies to reduce disease prevalence for children survival.

Child health outcome is associated with the well-being of population and taken as one of the development indication of health and socioeconomic status and a quality of life. As health issue is based on the basic human needs and dignity, it is conceived as the cause of poverty and result of it. Poverty generates the situation of lack of good hygiene and limit the access to clean and safe water, adequate sanitation facilities, sufficient nutrition and health services. In this regard, health status in bad condition could become obstacle and barriers to economic and social development of countries in a long term and generate poverty again. Therefore, child health outcome (mortality and morbidity) shows the status of child health and the level of country development as well.

We are going to investigate the considerable factors like environmental, socioeconomic and nutrition factor and what is more significant or powerful factor in order to develop the effective public health strategy on children health. By analyzing a household data, it will allow us to make articulated public health intervention and program.

1.4 Hypothesis and Methodology

Environmental, socioeconomic and nutrition factor is considered to effect on the children health status in this study. We are going to test hypothesis 1 to hypothesis 9 to measure the effect of each one variable separately on the children diarrhea mobility with logistic regression.

Environmental factors (H1, H2)

Hypothesis 1: If a household has the improved water facility[2], the probability of having diarrhea of children would be lowered compared to unimproved source of water[1]

[2] Classification of improved water facility and unimproved water facility is according to the WHO/UNICEF .

Hypothesis 2: If a household has the improved toilet facility[3], the probability of having diarrhea of children would be lowered compared to unimproved toilet facility[2] or no facility

Socioeconomic Factors (H3 ~ H6)

Hypothesis 3 : As mother's education level within household is increased, the probability of having diarrhea of children would be lowered compared to mothers without any education level.

Hypothesis 4 : As father's education level within household is increased, the probability of having diarrhea of children would be lowered compared to mothers without any education level.

Hypothesis 5 : If a household lives in urban area, the probability of having diarrhea of children would be lowered compared to the residence of rural area.

Hypothesis 6 : As wealth index level within household is increased, the probability of having diarrhea of children would be lowered compared to the household with lowest wealth index level.

Nutrition Status Factors (H7~H9)

Hypothesis 7 : If a children is not stunted, the probability of having diarrhea of children would be lowered compared to the children who is stunted

Hypothesis 8 : If a children is not underweight, the probability of having diarrhea of children would be lowered compared to the children who is underweight

Hypothesis 9 : If a children is not wasted, the probability of having diarrhea of children would be lowered compared to the children who is wasted

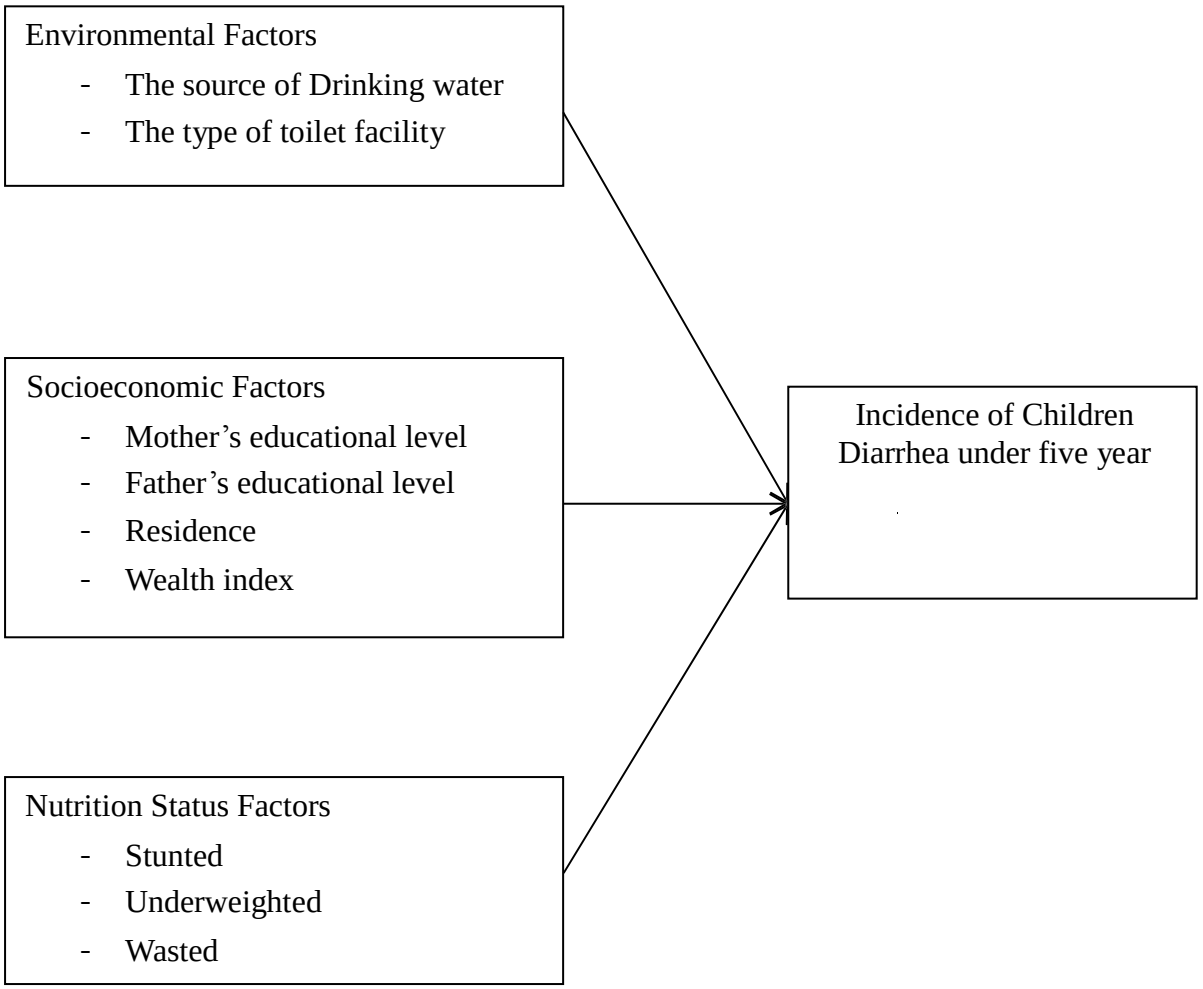
[3] Classification of improved toilet facility and unimproved toilet facility is according to the WHO/UNICEF.

After testing hypothesis 1 to 9, we are going to measure all the variables altogether to see which factor has strong power to make children have a diarrhea with using multivariate logistic regression.

1.5 Conceptual Framework

Incidence of children diarrhea under five years group given period of time reflects the impact of environmental factors, socioeconomic factors, nutrition status factors. Environmental factors can be categorized with two indicators into the source of drinking water and the type of toilet facility. Socioeconomic factors are chosen by four variables with mother's educational level, father's educational level, residence that is either rural area or urban area, wealth index. Nutrition status factors can influence the incidence of children diarrhea among under five years group. The indicators of whether a child is stunted or not, whether a child is underweighted or not and whether a child is wasted or not can measure the nutrition status.

Figure 2. Conceptual Framework



Source: Based on Mosley and Chen (1984) theoretical frame work.

1.6 Summary of Data

Using Nigeria Demographic and Health Survey 2008, this paper explores to find out the key risk factors of having diarrhea incidence among children under 5 year age group. Female aged from 15 to 49 (33385) were asked information about Household environment variables such that source of drink water, toilet facilities, main flooring material and etc, Demographic factors; Socioeconomic factors; such as mothers education level, fathers education level, father's occupation, region, residence and etc.

Questionnaires were prepared by the Nigerian government and were conducted from 2003 to 2008.

1.7 Structure of this study

The structure of this study is organized in five chapters. The first chapter is the introduction that clearly states that what the purpose of this study and explains the problem and importance of this study. This is followed by brief introduction of hypothesis and methodology, conceptual framework, summary of data and structure of study. Chapter two encompasses the literature review on risk factors on incidence of children diarrhea and also reviews on child health status in Nigeria. We then analyze data with logistic regression and conclude together with a policy implication for Nigerian government.

II. Literature review

In this part, the theoretical background of the risk factors on children diarrhea will be explained. Afterwards, previous studies of relevant factors and children health outcome will be introduced. Then, literature review on child health status and some studies will be discussed under the context of Nigerian country.

2.1 Literature review on risk factors for children diarrhea

The health determinants signify various factors that have an effect on human's health outcome.

Child health is affected by many factors and the research on the topic has been done. Researchers used various different conceptual frameworks to analyze the impact of different factors on child health. However, most common framework is from Mosley and Chen (1984) that studied the determinants of infant and child mortality as exogenous factors such as cultural, socioeconomic, community and regional determinants and endogenous factors such as maternal, environmental, nutrition, injuries and personal illness.

Literatures on risk factors associated with the incidence of child diarrhea disease are somewhat different in globally. Although the findings are different across the countries and country-specific analysis is needed to achieve better health outcome, environmental, socioeconomic, demographic and behavioral factors are associated with the occurrence of diarrhea among children.

In the republic of Congo, Mock et al.,(1993) demonstrated that type of weaning food fed to the child, maternal age, sex of child, maternal sickness and method of refuse disposal, maternal age, sex of child are statistically significant variables among under 3 years of aged children having diarrhea by using logistic regression with survey data undertaken in

the Republic of Congo in 1993. It pointed out interestingly that the breastfeeding status is not associated with children diarrheal disease.

In Eritrea, Gebremariam (1995) found that age of child, number of children living in house, toilet facility, floor material, maternal education, wealth, residence are associated with the prevalence of diarrhea among under 5 years group by using the 1995 Eritrea Demographic and Health Survey (EDHS) with logistic regression. However, he reported that toilet and education become insignificant when other factors constant.

In western India, Acachat et al., (2011) claimed that low socioeconomic class, bad sanitary practices, poor nutritional status and weaning practices have significant impact on children diarrhea occurrence by using six randomly selected data in western India in 2011 with chi-square test.

In Ghana, Stephen (2003) measured the odds ratios of childhood diarrhea using the 1998 Ghana Demographic and Health Survey with water, toilet, parents education, residence, maternal age at birth, age of child, marital union, ethnicity factors. He found that mother's education is most important factors among other variables. According to his study, Children who have mothers are less educated are the most vulnerable group in the absence of water and toilet facilities.

There has also been increasing specific interest in recent years on the importance of environmental health factors on child health especially in developing countries where have lack of clean drinking water and basic sanitation facility. Several studies have proved the significant positive effect of water and sanitation on reducing child diarrhea (Esrey et al., 1991; Fewtrell et al.,2005; and Waddington et al., 2009).

Isabel and Gunther (2010) show the association between access to water and sanitation technologies and both child morbidity and child mortality by using data set from 173 Demographic and Health Survey conducted in 71 low- and middle-income countries between 1986 and 2007. They pointed that improved sanitation facilities are associated with lower child mortality and lower risk of child diarrhea morbidity while improved water facilities have an impact on lower risk of child diarrhea morbidity and a lower risk of children nutritional status and doesn't have an impact on child mortality.

Given the fact that each country has different situation among environmental, socioeconomic, demographic and behavioral factors even in each one of Sub-Saharan African countries, this doesn't give us right direction to decide whether water and sanitation has great effect on childhood diarrhea or not.

2.2 Literature review on child health in Nigeria

Nigeria is located in western part of Sub-Saharan Africa. Nigeria has total population of 154,729,000 which is the largest country in sub-Saharan Africa and the tenth most populated country in the world. 63.7 percent of the population lives in the rural areas.

In spite of abundant natural resource like oil, Nigeria is ranked among the 13 poorest countries worldwide that population below the poverty line such as living with less than 1 dollar per day is 71% in 2003. Nigeria has the second largest child mortality rate as 191 per 1000 live births in 2006. The life expectancy is 48 years old in 2006.

The Nigerian children morality rate tends to decline slowly since 1990 but still higher than sub Saharan regional average. Based on DHS and WHO health profile, the causes of under- five mortality were categorized as follow. : Malaria (30%), Diarrhea (19%), Acute Respiratory Infections (16%), Vaccine Protected Disease (22%) and the cause of

morbidity under five aged group as follow: Malaria (41%), Diarrhea (24%), Acute Respiratory Infections (15%), and Vaccine Protected Disease (15%). There is the need for articulated policies, projects, and programs to ensure development and improvement of Nigerian children along with the quality of life.

Under this context, Nigeria first signed 1989 UN convention on the Rights of the child and established the Declaration and Plan of Action for Children arising from the World Summit for Children in 1990. In 1992, a National Program of Action for the Survival, Protection, and Development of Children was adopted. This program was evaluated by an End of Decade Review (EDR) and suggestions are as follows. The unstable political situation hindered the smooth implementation relating to women and children. It stated that it is required to organize the sectoral cooperation focused on child health and decentralized management.

The studies for health status of Nigerian children are very limited. Even though diarrhea disease is the second cause of child mortality, there are few studies on Nigerian children health outcome to see which kinds of factors could bring significant impact on the child mortality and morbidity compared to other important factors.

Jinadu (1991) studied the determinants of children diarrheal diseases in a rural area of Nigeria with survey data collected from 856 households. The quality of drinking water storage, children feeding bottles and utensils, inadequate disposal of feces and household refuse significantly affect the high incidence of the disease. In terms of demographic factors, children 0-11 months are shown to have the highest rate of diarrheal disease.

Kandalaetal (2008) used Bayesian geo-additive model to find out the cause of childhood morbidity as diarrhea, cough and fever among young children in Nigeria by using two

Nigerian Demographic and Health survey in 1999 and 2003. were each significantly associated with the childhood morbidity investigated. It found out that parental education, marital status of mother, household economic status, place of residence, type of feeding are each associated with the childhood morbidity.

We attempt to examine the key determinants of diarrhea prevalence in Nigerian by using the Nigerian Demographic and Health survey in 2008. This study aims to find out the considerable measure to have an impact on children diarrhea.

III. Research Methodology and Data

The purpose of this study is to analyze significant association of risk factors with children diarrhea incidence in previous 2 weeks using the Nigeria Demographic and Health Survey (NDHS) in 2008. In this chapter, the introduction of data, data limitations, empirical model to investigate independent variables and dependent variable will be explained.

3.1 Data

The 2008 Nigeria Demographic and Health Survey (NDHS) were implemented by the National Population Commission (NPC) funded by United States Agency for International Development (USAID) and the President's Emergency Fund for AIDS Relief (PEPFAR). Funding for the household listing and additional fieldwork support was provided by the United National Population Fund (UNFPA). ICF Macro, an ICF International company, provided technical assistance through every phase of the survey through the worldwide MEASURE DHS program.

The data set consists of a national representative sample of household level data. The sample size is 34070 including female aged from 15 to 49 (33385) and male group aged from 15 to 49 (15486). Fieldwork was conducted from June-October 2008 and data processing: July 2008-February 2009. We drop some missing data and finally we sort out 24830 respondents that have enough sample size to conduct empirical studies.

The respondents are women groups and aged 25 to 28 female groups are 28.4 % among total 28647 respondents.

The data has several advantages that describe the real life of endogenous poor life in Nigeria.

Using NDHS, we could measure disaggregated characteristics of Nigerian household.

The objectives of collecting this DHS data are to analyze and monitor the population and health situation in Nigeria and the Nigerian DHS contains information on fertility, mortality, health issues, socioeconomic and environmental situations.

We have access information about Household environment variables such that source of drink water, toilet facilities, main flooring material and etc., Demographic factors; Socioeconomic factors; such as mothers education level, fathers education level, father's occupation, region, residence and etc. In this study, the outcome variable that we are interested is childhood diarrhea. Mothers were also asked if their children experienced diarrhea in the last two weeks preceding the survey; either loose stool or blood in the stool.

3.2 Data limitation

This data set has only respondents aged from 15 to 49 years of mothers so that it excludes the group of aged under 15 years. In Nigeria, there is a chance of give birth to a baby before 15 years. The groups of under 15 years old mother were not included in this study. Furthermore, this survey is based on the mother's recalling response that is difficult to measure whether it is true or false on the responses such as the questionnaire are "Have your children had diarrhea in last two weeks?" "Have your children had cough or fever in last two weeks?" There are chance of mother cannot remember the specific symptom or duration of disease. We generally assume that mothers respond true facts of household situations such as children birth, diseases and deaths.

3.3 Methodology

In order to examine the risk factors of children diarrhea, we are going to use logistic regression. The logistic regression is similar to the ordinary least square regression; however, it violates the assumption of explanatory variables such that heteroskedasticity, linearity and normality assumption of ordinary least square regression.

The dependent variable is coded 0 or 1 (Diarrhea incidence or not) binary so we cannot use generalized least square model. Dichotomous outcome should be analyzed with logistic regression model. This model let us predict the probabilistic estimation of child diarrhea incidence predicted by the coefficients or odd ratio. If the odds ratio is 1 means there is no effect of change in the dependent variance, less than 1 means that decreasing risk effect of dependent variance and more than 1 means that increasing risks effect of dependent variance.

We have responses of the case where the response yi is binary, assuming only two values that for convenience we code as one or zero. For example, we could define

yi = pi = 1 if the i-th a child had a diarrhea in the last 2 weeks.

yi = pi = 0 if the i-th a child didn't have a diarrhea in the last 2 weeks.

Our dependent variable yi = pi = pr (y=1) is the probability of having a diarrhea become our dependent variable. .

From this, we could make logistic regression model. We can compute Pi as an equivalent formula uses the inverse of the logit function, which is the logistic function, i.e.:

Empirical Model

The logistic regression model is based on the logistic function is given as $(z) = \frac{1}{1+e^{-(x)}}$ where

x varies from -∞ to +∞. The range of (z) is between 0 and 1, regardless of the value of x.

Therefore, this characteristic is suited for our study as our dependent variable is coded 0 or 1. The logistic regression model could be developed from the logistic function by representing z as a linear square model, i.e. z= $a + \beta 0 + \beta_1 x_1, i + ,,, + \beta_{k-1} x_{k-1}, i$ where a and β_i are constants representing unknown parameter.

Given that our dependent variable is dichotomous, the probability of having diarrhea (Y) is as follows.

Pr (Y=1 l Xi - Xn) = F ($\beta 0 + \beta_1 x_1, i + ,,, + \beta_{k-1} x_{k-1}, i$) $= \frac{1}{1+e-(\beta 0 + \beta\ x\ 1 i + ,,, + \beta\ k-1 x_{k-1}, i)}$----

----------(1.1)

Where,

β1... βi: - is coefficient for ith independent variable x,

X1...Xi: - denote the environmental, socioeconomic, and nutrition status variables that might have an association with child diarrhea.

This model can be written as :pi/1-pi = $\beta 0 + \beta 1 x 1, i + ,,, + \beta k-1 x k-1$ given as $\text{In}(\frac{(Y=1 \text{ l } Xi - Xn)}{1-(Y=1 \text{ l } Xi - Xn)})$

$= \beta 0 + \beta_1 x_1, i + ,,, + \beta_{k-1} x_{k-1}, i$

$\beta 0 + \beta_1 x_1, i + ,,, + \beta_{k-1} x_{k-1}, i$ represents odds ratio in logistic regression----------(1.2)

For the next step, we calculated the Marginal Effect from the equation of (1.1) to measure expected change in probability with respect to a unit change in an independent variable form the means

Marginal Effect for X_k = P (Y=1 l X) * P (Y=0 l X) * b_k----------(1.3)

Where b_k is the coefficient of i_k independent variable from logistic regression.

3.4 Measurement of variables

All of Dependent variables and independent variables are from the questions of demographic and health survey 2008.

3.4.1 Dependent Variables

Childhood diarrhea (Yes, No) - Responses to question: Had diarrhea in the last 2 weeks are the Independent Variables.

3.4.2 Independent Variables

1. Household Environment Variables

1) Source of drinking water

At household level, the types of drinking water were measured with 13 variables from the original data. World Health Organization jointly with UNICEF classified the water indicators into 3 classification; Piped on premise, improved water and unimproved water. Therefore, water variables were recoded into three codes in order to examine the effect of better technology of source of drinking water on diarrheal disease in this study.

Table 2. The Classification of source of drinking water

Original data code	Source of drinking water	Classification according to the WHO/UNICEF	Classification according to the United Nations
11	Piped to dwelling	Piped on premises	Improved water
12	Piped to yard/tap	Piped on premises	Improved water
13	Public tap/standpipe	Other improved water	Improved water
21	Tube well or borehole	Other improved water	Improved water
31	Protected well	Other improved water	Improved water
32	Unprotected well	Unimproved water	Unimproved water
41	Protected spring	Other improved water	Improved water
42	Unprotected spring	Unimproved water	Unimproved water
43	River/dam/lake/ponds/stream/canal/irrigation channel	Surface water	Unimproved water
51	Rainwater	Other improved water	Improved water
61	Tanker truck	Unimproved water	Unimproved water
62	Cart with small tank	Unimproved water	Unimproved water
71	Bottled water	Other improved water*	Unimproved water

2) The type of Toilet facility:

At household level, the types of toilet facility were measured with 15 variables from the original data. World Health Organization jointly with UNICEF classified the sanitation indicators into 3 classification; open defecation, unimproved sanitation and improved sanitation. Therefore, sanitation variables were recoded into three codes in order to examine the effect of better technology of type of toilet facility on diarrheal disease in this study.

Table 3. The Classification of type of Toilet facility

original data	Type of toilet facility	Classification according to the WHO/UNICEF	Classification according to the United Nations
11	Flush to piped sewer system	Improved sanitation	Improved sanitation
12	flush to septic tank	Improved sanitation	Improved sanitation
13	flush to pit latrine	Improved sanitation	Improved sanitation
14	flush to somewhere else	Unimproved sanitation	Improved sanitation
15	flush to don't know where	Unimproved sanitation	Improved sanitation
21	Pit latrine Ventilated improved pit	Improved sanitation	Improved sanitation
22	Pit latrine with slab	Improved sanitation	Improved sanitation
23	Pit latrine without slab /Open pit	Unimproved sanitation	Unimproved sanitation
31	No facility	Open defecation	Unimproved sanitation
41	Composting toilet	Improved sanitation	Unimproved sanitation
42	Bucket toilet	Unimproved sanitation	Unimproved sanitation
43	Hanging toilet / latrine	Unimproved sanitation	Unimproved sanitation
96	Other	Missing	Missing
97	Not dejure resident	Missing	Missing
98	Missing total	Missing	Missing

2. Socioeconomic Variables

1) Mother’s highest educational level (None=0, Primary=1, Secondary=2, higher=3)

2) Father’s highest educational level (None=0, Primary=1, Secondary=2, higher=3)

3) Residence (Rural=1, Urban=2)

4) Wealth index (1st quintile=1, 2nd quintile=2, 3rd quintile=3, 4th quintile=4, 5th quintile=5)

3. Nutrition status

1) Height /Age Standard deviations: if the number is under -2SD, it is stunted. Z scores are calculated by standardizing a child's height given age and sex against an international standard of well-nourished children. In this calculation, children with z scores below -2SD are classified as stunted and over -02 are defined as not stunted (WHO, 2003).

(Stunted=0, not stunted=1)

2) Weight /Age Standard deviations: if the number is under -2SD, it is underweighted. In this calculation, children with z scores below -2SD are classified as underweighted and over -02 are defined as not underweighted (WHO, 2003).

(Underweighted=0, not Underweighted =1)

3) Weight/ Height Standard deviations: if the number is under -2SD, it is wasted. Z score are calculated by standardizing a child's weight given height and sex against an international standard of well-nourished children. In this calculation, children with z scores below -2SD are classified as wasted and over -02 are defined as not wasted (WHO, 2003).

(Wasted=0, not Wasted =1)

IV. Analysis and Findings

4.1 Descriptive analysis

Here is the absolute and percent distribution of explanatory variables for the 2008 Demographic and Health Survey.

Table 4. Descriptive Result

No.	Variable		frequency	percentage	cumulative
1	water	unimproved source of drinking water	14,702	52.24	52.24
		improved source of drinking water	12,546	44.58	96.82
		Piped on premises	895	3.18	100
2	toilet	Open defecation	9,519	33.89	33.89
		unimproved sanitation facility	5,125	18.24	52.13
		improved sanitation facility	13,447	47.87	100
3	mother education level	None	14418	50.33	50.33
		Primary	6552	22.87	73.2
		Secondary	6338	22.12	95.33
		Higher	1339	4.67	100
4	Father	None	11477	40.78	40.78

	education	Primary	5,934	21.09	61.87
		Secondary	7,305	25.96	87.83
		Higher	2,986	10.61	98.44
5	Residence	urban	7,613	26.58	26.58
		rural	21,034	73.42	100
6	wealth index	Lowest	7,604	26.54	26.54
		Lower	6,871	23.99	50.53
		Middle	5,609	19.58	70.11
		Higher	4,755	16.6	86.71
		highest	3,808	13.29	100
7	Nutrition status	Stunted	14818	51.73	51.73
		Not stunted	13829	48.27	100
		underweight	15068	52.6	52.6
		Not underweight	13579	47.6	100
		Wasted	11264	39.32	39.32
		Not wasted	17383	60.68	100

The above Table 4. shows that 52.23% of households do not access to the improved water and 52.13% of children do not access to the improved sanitation facility. Furthermore, around 50% of mothers are uneducated and 40.78% of fathers are not educated. 73.42% of people are living in the rural area and 26.54% of people are in the lowest of wealth index. About 39.32 percent of the children under five years of age were wasted (thin for their height). The level of stunting, underweight, and wasting are also higher for rural children than urban children. This shows that Nigeria has a very high prevalence of stunting, underweight and wasting according to the classification established by the World Health Organization to indicate level of child malnutrition.

Overall, 11.48 % of Nigerian children had a diarrhea in last 2 weeks among 25,273 children. As it is stressed it earlier in this study, it is quite high rate of occurrence of disease. Table 5 allows us to analyze which variables are more associated with diarrheal incidence.

As the water variables from unimproved water to piped on premise, the incidence of diarrhea are declined.

In terms of sanitation facility, it revealed interesting fact that there is still high prevalence of diarrheal disease among the category of improved sanitation facility. It is even more than the number of non-diarrheal cases.

As mother's education level is increased, the number of diarrhea cases is dropped dramatically compared to the description result of father's education level.

In case of residence of urban, highest wealth index, not stunted children, not underweighted children and not wasted children have lower rate of diarrhea incidence compared to rural, lowest wealth index, stunted children, underweighted children and stunted children.

Table 5. . Descriptive result on children diarrhea incidence

No.	Variable		A child had a diarrhea in the last 2 weeks. (dr=1)	a child didn't have a diarrhea in the last 2 weeks. (dr=0)	total
1	water	unimproved source of drinking water	11,130	1,650	12,780
		improved source of drinking water	10,113	1,120	11,233
		Piped on premises	715	102	817
2	toilet	Open defecation	7,557	894	8,451

		unimproved sanitation facility	3,811	633	4,444
		improved sanitation facility	10,549	1,343	11,892
3	mother education level	None	10,640	1,792	12,432
		Primary	5,204	601	5,805
		Secondary	5,325	438	5,763
		Higher	1,203	70	1,273
4	Father education	None	8,443	1,439	9,882
		Primary	4,691	551	5,242
		Secondary	5,985	579	6,564
		Higher	2,536	209	2,745
5	Residence	urban	6,244	687	6,931
		rural	16,128	2,214	18,342
6	wealth index	Lowest	5,599	958	6,557
		Lower	5,127	820	5,947
		Middle	4,407	526	4,933
		Higher	3,891	402	4,293
		highest	3,348	195	3,543
7	Nutrition status	Stunted	13,039	1,738	14,777
		Not stunted	7,539	775	8,314
		underweight	13,228	1,797	15,025
		Not underweight	7,350	716	8,066
		Wasted	9,849	1,411	11,260
		Not wasted	10,731	1,102	11,833

4.2 Logistic regression analysis

we exploit logistic regression with using equation such as the odds ratio of the independent variables, coefficient of the independent variables and marginal effect of the independent variables to find out (i) how the independent variables are associated with child diarrheal disease will be studied and then (ii) how much the independent variables can decrease or increase in the incidence of child diarrheal disease by a change in the independent level.

Equation (1.1): The probability of child diarrhea morbidity =Coefficient from the logistic regression (Drink water, toilet facility, Mother's education level, Father's education level, residence, wealth index Nutrition status factors)

Equation (1.2): The probability of child diarrhea morbidity = Odds ratio from the logistic regression (Drink water, toilet facility, Mother's education level, Father's education level, residence, wealth index Nutrition status factors)

Equation (1.3): The probability of child diarrhea morbidity =Marginal effect from the logistic regression (Drink water, toilet facility, Mother's education level, Father's education level, residence, wealth index Nutrition status factors)

Table 6. Equation (1.1): The probability of child diarrhea morbidity =Coefficient from the logistic regression (Drink water, toilet facility, Mother's education level, Father's education level, residence, wealth index Nutrition status factors)

dr	Coefficient	Std. Err.	P>z	95% Conf. Interval	
unimproved source of drinking water	(Reference)				
improved source of drinking water	-0.0974858	0.0492546	**	-0.19402	-0.00095
Piped on premises	0.4163668	0.1287772	***	0.163968	0.668766
Open defecation	(Reference)				
unimproved sanitation facility	0.396422	0.062488	***	0.273947	0.518897
improved sanitation facility	0.3794854	0.055839	***	0.270043	0.488927
Mother's education None	(Reference)				
Primary	-0.1865502	0.06456	***	-0.31309	-0.06001
Secondary	-0.3481097	0.082942	***	-0.51067	-0.18555
Higher	-0.478327	0.169443	***	-0.81043	-0.14623
Father's education None	(Reference)				
Primary	-0.1196044	0.064304		-0.24564	0.006429
Secondary	-0.0917463	0.071429		-0.23174	0.048252
Higher	-0.061028	0.102555		-0.26203	0.139977
rural	(Reference)				
urban	0.218521	0.063151	***	0.0947479	0.3422948
Wealth 1st quintile	(Reference)				
2nd quintile	-0.1186716	0.058693	**	-0.23371	-0.00364
3rd quintile	-0.4040555	0.072019	***	-0.54521	-0.2629
4th quintile	-0.6275242	0.093288	***	-0.81037	-0.44468
5th quintile	-1.145618	0.130614	***	-1.40162	-0.88962
Nutrition Status Stunted	(Reference)				

Not stunted	-0.1736366	0.063968	***	-0.29901	-0.04826
underweight	(Reference)				
Not underweight	-0.0500433	0.076045		-0.19909	0.099002
Wasted	(Reference)				
Not wasted	-0.2537002	0.053827	***	-0.3592	-0.1482
Constant	-1.90996	0.084167		-2.074925	-1.744996
Number of	21783				

Observation	
LR chi2(18)	491.77
Log likelihood	-7285.2439
Pseudo R2	0.0326

(P-value; *<p, 0.01, **<p, 0.05, *<p, 0.1, Blank means insignificant)**

Table 7. Equation (1.2): The probability of child diarrhea morbidity = Odds ratio from the logistic regression (Drink water, toilet facility, Mother's education level, Father's education level, residence, wealth index Nutrition status factors)

dr	Odds Ratio	Std. Err.	P>z	95% Conf. Interval	
unimproved source of drinking water	(Reference)				
improved source of drinking water	0.907115	0.04468		0.823639	0.999052
Piped on premises	1.516442	0.195283	***	1.178177	1.951826
Open defecation	(Reference)				
unimproved sanitation facility	1.486496	0.092889	***	1.315145	1.680173
improved sanitation facility	1.461532	0.08161	***	1.310021	1.630566
Mother's education None	(Reference)				
Primary	0.829817	0.053573	***	0.731187	0.941751
Secondary	0.706022	0.058559	***	0.600091	0.830651
Higher	0.61982	0.105024	***	0.444667	0.863963
Father's education None	(Reference)				
Primary	0.887271	0.057055		0.782206	1.00645
Secondary	0.912337	0.065167		0.793149	1.049435

Higher	0.940797	0.096484		0.769486	1.150247
rural	(Reference)				
urban	1.244236	0.078575	***	1.099382	1.408175
Wealth 1st quintile	(Reference)				
2nd quintile	0.888099	0.052125	**	0.791593	0.996371
3rd quintile	0.667607	0.04808	***	0.57972	0.768818
4th quintile	0.533912	0.049808	***	0.444695	0.641028
5th quintile	0.318028	0.041539	***	0.246199	0.410812
Nutrition Status Stunted	(Reference)				
Not stunted	0.840602	0.053772	***	0.741551	0.952884
underweight	(Reference)				
Not underweight	0.951188	0.072333		0.819477	1.104069
Wasted	(Reference)				
Not wasted	0.775924	0.041765	***	0.698236	0.862257
Number of Observation	21783				
LR chi2(18)	491.77				
Log likelihood	-7285.2439				
Pseudo R2	0.0326				

(P-value; *<p, 0.01, **<p, 0.05, *<p, 0.1, Blank means insignificant)**

Table 8. Equation (1.3): The probability of child diarrhea morbidity = Marginal effect from the logistic regression (Drink water, toilet facility, Mother's education level, Father's education level, residence, wealth index Nutrition status factors)

dr	dy/dx	Std. Err.	P>z	95% Conf. Interval	
unimproved source of drinking water	(Reference)				
improved source of drinking water	-0.0093	0.004701	**	-0.01852	-8.9E-05
Piped on premises	0.039737	0.012296	***	0.015637	0.063836
Open defecation	(Reference)				

unimproved sanitation facility	0.037833	0.005971	***	0.026131	0.049535
improved sanitation facility	0.036217	0.005337	***	0.025757	0.046676
Mother's education None	(Reference)				
Primary	-0.01815	0.006149	***	-0.0302	-0.0061
Secondary	-0.0319	0.007175	***	-0.04596	-0.01783
Higher	-0.04175	0.012616	***	-0.06648	-0.01703
Father's education None	(Reference)				
Primary	-0.01135	0.006034		-0.02318	0.000479
Secondary	-0.0088	0.006787		-0.0221	0.004506
Higher	-0.00592	0.009808		-0.02514	0.013305
rural	(Reference)				
urban	0.020855	0.00603	***	0.009037	0.032673
Wealth 1st quintile	(Reference)				
2nd quintile	-0.01387	0.006898	**	-0.02739	-0.00035
3rd quintile	-0.04268	0.007679	***	-0.05773	-0.02763
4th quintile	-0.0612	0.008864	***	-0.07857	-0.04383
5th quintile	-0.09295	0.009199	***	-0.11098	-0.07493
Nutrition Status Stunted	(Reference)				
Not stunted	-0.01657	0.006106	***	-0.02854	-0.0046
underweight	(Reference)				
Not underweight	-0.00478	0.007258		-0.019	0.009449
Wasted	(Reference)				
Not wasted	-0.02421	0.00514	***	-0.03429	-0.01414
Number of Observation	21783				

Note: dy/dx for factor levels is the discrete change from the base level.

(P-value; *<p, 0.01, **<p, 0.05, *<p, 0.1, Blank means insignificant)**

Mother's education is revealed to be important in our analysis. The odds ratio of mother's education is 0.825 compared to none mother's education level in Equation (1.2). The coefficients for mother's education level are --0.1865502, -0.3481097, -0.478327 separately in Equation (1.1). Marginal effects of mother's education level measures are -0.0192925, 0.0333802, -0.0433354 in Equation (1.3). It is interpreted that Mother's education level with primary level lowers the probability of getting diarrhea by 1.92% (-0.0192* 100 = -1.92%) compared to those with none educational level. (Odds ratio is less than 1 and means decreasing risk effect). With same interpretation, Secondary mothers education level lowers the probability of getting diarrhea by 3.3% (-0.33 * 100 = -3.3%) and Higher mothers education level lowers it by 4.3% (-0.043 * 100 = -4.3%).

It supports the previous studies that better educated mothers lower the risk of child health as the important agent to prevent and cure disease (Stephen Obeng Gyimah, 2003, Bbaale E,2011).

The odds ratio of piped on premises is 1.516442 in Equation (1.2). Compared to households that use unimproved source of drinking water, sources of drinking water with piped on premises rather increases the probability of getting diarrhea by 3.9 % (0.039 * 100 =3.9%) as odds ratios is more than 1 in Equation (1.3).

The odds ratio of improved toilet facility is 1.461532 in Equation (1.2). Compared to households having open defecation, improved toilet facility rather increases the probability of getting diarrhea by 3.6 % (0.036217*100 = 3.6%) in Equation (1.3).

Results from both water and sanitation analysis imply that even though the household have better condition of water and saniation facility, they still have high incidence of diarrhea morbidity. It suggests that there are underlying situations and problems for maintenance and management issues.

From Equation (1.1) to Equation (1.3), father's educational level is not statistically significant.

The odds ratio of urban is 1.24423 in Equation (1.2). Compared to who are living in rural, households in urban would increase the probability of getting diarrhea by 2.2 % (0.02 * 100 =2%) in Equation (1.3).

As wealth index increase from the poorest into richest level, it lowers the probability of getting diarrhea up to 9.4 % (-0.092 * 100 = - 9.2%) in Equation (1.3). It reveals that children in the poorest household are most vulnerable to diarrhea incidence.

The odds ratio of children who are not stunted is 0.84062 in Equation (1.2). Compared to who is stunted, not stunted status could lower the probability of getting diarrhea by 1.6 (-0.016 * 100 = -1.6 %) in Equation (1.3). Based on the same calculation, being wasted status has strong power to explain to risk factor of child diarrhea morbidity as not being wasted could lower the probability of getting diarrhea by 2.4 (-0.024* 100 = -2.4%) in Equation (1.3). It is well known fact that if a child has good nutrition status, the risk of diarrhea incidence may be lowered.

Through Equation (1.1) to Equation (1.3), Mother's education has shown a significant association with children diarrhea compared to other variables.

Surprisingly, from the model 1 to model 3, toilet facility independently doesn't have significant impact on the diarrhea probability. Improved toilet facility still increases the probability of getting diarrhea. It means that there are the factors associated with toilet facility like facility quality and maintenance. Finally we assume that improved toilet facility doesn't have direct impact on the children diarrhea. Rather, mother's education level has shown constantly significant effect on child diarrhea morbidity with odds ratio and marginal

effect. Even though there are some risk factors in household level to affect children health status, educated mothers could be able to have better practice of treating and curing for disease.

VI. Conclusion and Policy Implication

5.1 Conclusion and Policy Implication

We measure empirically the risk factors of children diarrhea morbidity to find out significant and important factors. In our study, mother's education was revealed to be a very significant risk factor with controlling other considerable factors. In household level, mothers play an important role for children and infant health status including children's nutrition status.

Female education is very important factor of reducing the incidence of children diarrhea. Female education and nutrition status is somehow neglected factor and important factor for the improvement for the child health status. Nigerian government should regard to integrate the education and nutrition program when designing and implementing the health project or program. Additionally, the government should consider regional disparities and household wealth condition. The poor households are more likely to have children diarrhea. Nigeria is one of the countries that suffer from high rate of child mortality and diarrhea is the crucial factor for increasing child mortality.

An effective way of reducing children disease is not just about increasing public health expenditure as we discussed so far. Measuring specific context of contributing to risk factors for children health should be implemented and try to find the effective way of improving children health.

In recent years, international community including international NGOs and private sector only focus first public health expenditure and then environmental health factor.

Child health is posed as the future of its countries as it is the future human resource. Higher child mortality represents that a country is in the dangerous situation and could bring counter effect of increasing fertility rate.

In general, ensuring the access to clean water and sanitation is important for children health (Esrey et al., 1991). As we have seen previous studies, the effect of water and sanitation are different in terms of countries, regions and time. Our study also couldn't find the positive impact of water and sanitation on child diarrheal disease. Regarding to increasing population size in Nigeria, it is not realistic to cover all access to clean water and sanitation facility. Reaching the full coverage of water and sanitation to all are required huge amount of budget. We should try to increase the access to water and sanitation facility but at the same time what is the effective way of reducing child mortality and morbidity.

It is time to act and design public health strategies in order to reduce highest child mortality and morbidity rate. The role of mother for the children health is very significant because mother mostly take charge of house core like preparing meals and caring babies and children. Designing and implementing program along with the mother's education could be various.

Community level knowledge sharing and management program allow targeting pregnancy or mothers who have children that could be informed how to prevent diarrhea and cure it including other treatable disease. There is a challenge for increasing mother's education level because we cannot make all the women and young female go into the higher level of school. Policy option we could take is to have the community- level knowledge program. With this program, women actively participate in knowledge sharing program and learn the importance of their role for children health. The

way how to intrigue women to participate the program more is another issue later on.

It is time to scale up and speed up of mother's education program for the children heath and national economic and social development perspective. Designing of targeting poor in the rural area mainstreaming gender issue and empowering women could increase better treatment and prevention of disease and ultimately reduce the high rate of children diarrhea mortality and morbidity.

Especially, Nigerian women's participation in the official job market is higher than other African countries as Nigeria economies have fast growing economic development.

5.2 Further Research

As we review the study from Jinadu (1991) earlier in our study, the quality of drinking water storage, children feeding bottles and utensils, inadequate disposal of feces have significant impact on children diarrheal disease. When he researched that study, he collected data himself under the local Nigerian context. In this study, there is any positive association of water and sanitation on diarrheal disease in Nigeria by using Nigerian Demographic and Health Survey in 2008. If we can collect data ourselves by considering indicators that might represent properly the quality of drinking water and sanitation facility in realistic situation, then we can argue the rationales of water and sanitation project and program and its effectiveness for the next step of research. It is also required to investigate the level of safe use and maintenance of technology not only increasing the provision on basic water and sanitation facility. Furthermore, next development research should move forward to how to increase better sanitation practice of individual that might directly impact on children health status.

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