

ADDIS ABABA UNIVERSITY



FACULTY OF MEDICINE
SCHOOL OF PUBLIC HEALTH

DOES THE EFFECT OF WATER AND SANITATION VARY BY
MATERNAL EDUCATION ON CHILDHOOD DIARRHEA AMONG
UNDER FIVE CHILDREN IN MECHA DISTRICT, WEST GOJJAM,
ETHIOPIA?

By

Muluken Dessalegn

A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY FACULTY OF MEDICINE
SCHOOL OF PUBLIC HEALTH FOR THE PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTERS OF PUBLIC HEALTH

June 2009

ADDIS ABABA, ETHIOPIA

ADDIS ABABA UNIVERSITY
FACULTY OF MEDICINE
SCHOOL OF PUBLIC HEALTH

Does the effect of water and sanitation vary by maternal education on childhood diarrhea among under five children in Mecha district, West Gojjam, Ethiopia?

By:

By:

Muluken Dessalegn (BSC)

Advisors

Advisors:

Abera kumie (MD, MSc,PHD)

Worku Tefera (BSC, MPH)

A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY FACULTY OF MEDICINE
SCHOOL OF PUBLIC HEALTH FOR THE PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTERS OF PUBLIC HEALTH

ACKNOWLEDGMENT

First and foremost, I would like to express my deepest gratitude to my advisors Dr Abera Kumie and Ato Worku Tefera for their unreserved supports and guidance during the whole process to this thesis.

I am very grateful to Dr. Hailu Kassa for his constructive comments and invaluable suggestions.

I would like to thank the School of Public Health Faculty of Medicine, Addis Ababa University for financial support to conduct this study.

I am also very glad to forward my special thanks for unlimited assistance of Mecha Woreda Rural development, education and health Bureau. My appreciation goes to Ato Getnet Alemu for coordinating necessary facility in the data collection. The data collectors and supervisors of this study also deserve special thanks. The hospitality and cooperation of the population of the study site in general, and the study subjects in particular are highly appreciated. My heartfelt thanks also go to Ato Belayneh Genetu for his unreserved assistance in the process of data collection and serving transportation service in rural area.

The librarians of School of public health, Computer lab assistants, as well as Ministry of Health deserve special thanks for providing me relevant literatures.

Finally, I would like to acknowledge to all my friends who generously lend their hands for this study not only in providing comments but also in the data entry.

TABLE OF CONTENT

<u>CONTENT</u>	<u>PAGE</u>
ACKNOWLEDGMENT	I
TABLE OF CONTENT	II
LIST OF TABLES	III
LIST OF FIGURES	IV
ACRONYMS	V
ABSTRACT	VI
INTRODUCTION	1
LITERATURE REVIEW	3
Magnitude of diarrheal	3
Determinants of diarrheal	4
Water, sanitation and diarrhea	7
Water and childhood diarrhea	8
Sanitation and childhood diarrhea	9
Maternal education and diarrhea	10
Conceptual framework	11
OBJECTIVE	14
METHODS AND MATERIALS	15
Study design	15
Study area and period	15
Source population	15
Study population	15
Sample size determination	15
Sampling procedure	16
Study variables	17
Data collection	18
Data management and analyses	18
Data quality	19
Ethical consideration	19
Dissemination of the study	20
Operational definition	20
RESULT	22
DISCUSSION	38
STRENGTH AND LIMITATIONS	44
CONCLUSION	45
RECOMMENDATION	46
REFERENCE	47

<u>LIST OF TABLES</u>	<u>PAGE</u>
Table 1. Socioeconomic characteristics of the study households of Mecha Woreda West Gojjam Ethiopia Feb. 2009	23
Table 2. Environmental characteristics of the study households of Mecha Woreda, West Gojjam Ethiopia Feb. 2009	25
Table 3. Maternal childcare and health practices Mecha Woreda Feb. 2009	27
Tables 4. Demographic and health characteristics of the index children Mecha Woreda West Gojjam Ethiopia Feb. 2009	28
Table 5: Socio-economic Determinants in relation to childhood diarrhea among under five children in Mecha District, West Gojjam Ethiopia Feb. 2009	30
Table 6. Environmental determinants in relation to childhood diarrhea among under five children in Mecha District, West Gojjam Ethiopia Feb. 2009	31
Table 7. Behavioural and child care practice determinants in relation to childhood diarrhea among under five children in Mecha District, West Gojjam Ethiopia Feb. 2009	33
Table 8. Summary of the hierarchical logistic regression analysis of the relative effect of Socioeconomic, environmental and behavioural factors on the prevalence of Childhood diarrhoea Mecha Woreda, West Gojjam Ethiopia Feb. 2009	35
Table 9: Stratified analysis of latrine facility by maternal education on the effects of childhood diarrhea in Mecha Woreda, West Gojjam Ethiopia Feb. 2009	37
Table 10: Summary of Childhood Diarrhea Stratified by maternal Education in Mecha woreda, West Gojjam Ethiopia Feb. 2009	37

<u>LIST OF FIGURES</u>	<u>PAGE</u>
Figure 1. Conceptual framework of potential determinants of childhood Diarrhoeal morbidity.	13
Figure 2: Distribution of childhood diarrhea morbidity by age group, Mecha Woreda, Feb. 2009	32

<u>LIST OF ANNEX</u>	<u>PAGE</u>
Annex 1. Map of Mecha Woreda indicating the study sites.	51
Annex 2. Schematic representation of the sampling procedure.	52
Annex 3. The English version of the consent form.	53
Annex 4. The English version of the questionnaire	53
Annex 5. The Amharic version of consent form	63
Annex 6. The Amharic version of the questionnaire	64

IV

ACRONYMS

CDD	Control of Diarrheal Disease
CI	Confidence Interval
DHS	Demographic and Health Survey
EDHS	Ethiopian Demographic and Health Survey
EPIINFO	Epidemiological Information
FMOH	Federal Ministry of Health
JMP	Joint Monitoring Program
MDG	Millennium Development Goal
MMT	Morbidity-Mortality-and Treatment
NSSE	National Sanitation Strategy for Ethiopia
OR	Odds Ratio
ORT	Oral Rehydration Therapy
SPSS	Statistical Package for Social Sciences
TV	Television
UNICEF	United Nation children's Emergency Fund
VIP	Ventilated Improved Pit
WHO	World Health Organization

ABSTRACT

BACKGROUND: Diarrhoeal disease is widely recognized as a major cause of child morbidity and mortality in many developing countries, particularly in sub-Saharan Africa including Ethiopia. While a good living environment, comprising safe water and latrine facilities, is essential in reducing the risk, it is unclear if the disadvantage associated with untreated water and lack of latrine facilities are the same for all children. Since diarrhea is transmitted through a variety of agents, we argue that other parentally provided inputs combined with water and latrine facilities in determining a child's vulnerability.

OBJECTIVES: The study assesses the effects of drinking water and latrine facilities on the risk of childhood diarrhoea among under five children and as well whether they vary by maternal education.

METHODS: a community based cross-sectional study was carried out on February, 2009 with a total sample size of 768 households that had at least one under-five child, which was randomly selected from the ten rural kebeles and one urban kebele that was found in Mecha Woreda, West Gojjam, Ethiopia. Information on the households' socio-economic, environmental and behavioural characteristics was collected using structured, pre-tested questionnaire by trained data collectors. Diarrhoeal morbidity occurrence among under-five children during the two weeks preceding the time of the interview was registered to determine prevalence. Logistic regression model was employed to examine the significance of environmental factors and level of mother's education in preventing childhood diarrhoea.

RESULT: The findings of this study showed that the overall prevalence of diarrhoea in under-fives was 18.0%. Multivariate logistic regression analysis showed that children of less educated mothers had more than fivefold higher odds of having diarrhoea than their higher educated counterparts. In the analysis maternal education, mother's history of recent diarrhea, availability of latrine facility, duration of breast feeding and age of the child had a significant association after adjusting other variables. The highest risk was found in households without improved water source and latrines facilities. When these variables stratified by maternal education, however, it became evident that children whose mothers were less educated were the most vulnerable in the absence of water and latrine facilities.

CONCLUSION AND RECOMMENDATION: Highly educated mothers protect their children against diarrhea much better under poor environmental condition than their less educated counterparts. There were interaction effects of water with maternal education and sanitation with

maternal education on childhood diarrhea. Thus effective educational programs that emphasize on hygiene and good home management practices and encouraging female school enrolment should be strengthened to reduce childhood diarrhoea morbidity.

VI

INTRODUCTION

Diarrhoeal diseases kill an estimated 1.8 million people each year [1-3]. Among children under five years in developing countries, diarrhoea accounts for 21% of all deaths [4]. In addition, diarrhoea is also responsible for 25 to 75% of all childhood diseases and account for about 14% of outpatient visits, and 16% of hospital admissions[5, 6]. Of the estimated total 10.6 million deaths among children younger than five years of age worldwide, 42 percent occur in African region[7].

In Ethiopia, morbidity reports and community-based studies have shown that diarrhoeal disease is a major public health problem that causes excess morbidity and mortality in children [6, 8-10]. Based on 2005 data of Demographic and Health Survey (DHS) and Federal Ministry of Health (FMOH) data, diarrhea accounts 20 % of under five mortality rate in the country. Morbidity-Mortality-and Treatment (MMT) surveys conducted among under five children in Ethiopia at different times revealed five diarrhoeal episodes occur per child per year. The diarrhoea attributed mortality rate is about 10 per 1000 under-five population[6, 10]. Studies conducted in central rural Ethiopia revealed that diarrhoea is one of the common causes of under-five mortality, accounting about 8.4 to 27% of all deaths [11, 12].

Researchers on child health agree that the cause of infant morbidity and mortality in developing countries is multi-factorial. The child's morbidity depends on the interaction of socio-economic, biological, behavioural and environmental factors [13-15]. Hence to understand children morbidity one has to examine the relation and interactions among the aforementioned webs.

Although treated water and adequate sanitary facilities are essential in reducing the risk of diarrhea, a significant number of people in sub-Saharan Africa lack access to such facilities [16]. While the long-term solution might involve the provision of such facilities, there is the need to understand how existing household facilities could be best optimized to reduce the risk in the short run[17]. Previous research in Ethiopia, for instance, has inadequate or little evidence [18] if the disadvantages associated with unimproved water source and lack of latrine facilities are the same for all children. If there is evidence that some children are less vulnerable in the absence of treated water and sanitary facilities, specific intervention programs could then be made.

In this paper, we assess whether latrine and drinking water facilities provide different protection to children of literate mothers compared with those of illiterate mothers. The major research questions to be addressed are: first, are children in households without piped water and latrine facilities more vulnerable to diarrheal morbidity? Second, do the disadvantages associated with such facilities vary by maternal education?

LITERATURE REVIEW

MAGNITUDE OF DIARRHEA

Diarrhea is a major cause of morbidity and mortality among children in the developing world[3]. Kosek et al. [3], estimate that diarrhea accounted for 21 percent of all deaths of children under five years of age and causes 2.5 million deaths per year. Study of Bern et al [2]., in the global burden of disease also documented diarrhea morbidity of 2.6 episodes per child per year. According to Kirkwood [19], diarrhea accounted for 35 days of illness per year in children under five years in Sub-Saharan Africa.

A comprehensive analysis of 73 studies from 23 Sub-Saharan African countries showed that children under five years of age experience about five episodes of diarrhea each year. The analysis also showed that prevalence of childhood diarrhoea ranged from 10.5 to 19 percent[5]. In their study on the determinants of childhood diarrhoea in The Republic of Congo, Mock et al. [8], found a two-week period prevalence of 18.6 percent in children

under-three years of age. In rural Zaire, a longitudinal study done on children aged 3-35 months showed annual incidence of 6.3 episodes per child [20].

In Ethiopia, like other developing countries, diarrhoeal diseases are important child health problem. A special survey by the Control of Diarrheal Disease (CDD) programme in Ethiopia [21] , from May 1984 to February 1985 in different urban and rural areas using a two week recall period revealed that a diarrhea prevalence ranging from 10.5% to 18.4% , with a median rate of 16.5% . Kesela, T. [6] In 1991, showed that the country had diarrhoeal episode of five per child per year, and a two-week period incidence of 16 percent. The age and cause-specific mortality rate was found to be 9.7 per thousand under-five population attributed to diarrhea. The 2004 National Child Conference, reported that a two-week period prevalence of diarrhoea in under-five children was 24 percent [22]. The 2000 and 2005 Ethiopian Demographic and Health Survey (EDHS) showed the prevalence of under five childhood diarrhea in the two weeks period was an overall, 24 and 18 percent respectively [9, 23].

According to a follow-up study in Butajira in 1994, the incidence of diarrhoea was about two-episodes/person-year [12, 13]. A community-based cross-sectional study done to determine the Oral Rehydration Therapy (ORT) use rate showed a two-week prevalence of 22.7 percent in under-five children in Adami Tulu Woreda, Central Ethiopia in 1996 [24]. Another cross sectional study from Jimma town, Southwest Ethiopia in 1997 , showed a prevalence of 36.5 percent [25].

Kaba and Ayele [26] in 2000, in their Ethnographic study of diarrhoeal disease among under-five children found a two-week prevalence of 33.7 percent. A community based study conducted in Keffa-Sheka Zone, Southern Ethiopia in 2000, found a two-week childhood diarrhoea prevalence of 15 percent [27]. A study to determine household illness prevalence in Gondar in 2001 showed that diarrhoea was one of the three most frequently occurring symptoms, accounting for 11.4% of the overall illness prevalence [28].

A comparative cross sectional study in 2003, conducted in Butajira rural health project on determinants of diarrheal morbidity showed that at the time of survey the two week prevalence of diarrhea was 38.5 % i.e. (urban 22.5% , whereas in rural lowland 46.2% and rural of highland was 46.7%)[18].

This discrepancy on the prevalence of childhood diarrhea might be due to a variation in environmental condition, behavioural and socio-demographic factors in the study area in addition to the effect of methodological and sample size difference.

DETERMINANTS OF DIARRHEA

The etiological factors associated with diarrheal diseases in children include microbial agents which are usually transmitted through food and water contaminated with human faeces [29]. Studies indicate that factors such as age of the child, quality and quantity of water, availability of latrine facilities, housing conditions, level of maternal education, household economic status, place of residence, feeding practices, and the general level of hygiene in the home affects the exposure to diarrheal pathogens [30-33]. Diarrhea diseases are prevalent among poor households living under conditions of poor personal and domestic hygiene[33]. Some studies indicate lower diarrhea morbidity and mortality among children from wealthy homes in the developing world[32].

Even though each of these potential risk factors is associated with diarrhoea, the mechanisms through which they affect a child's risk of diarrhoea are quite different. For example, educational level and water quality are both associated with diarrhoeal disease. However, water quality has a direct effect on the child's exposure to pathogens, while education level has an indirect effect through its influence on the mother's childcare practices [13, 32, 34]. Many aspects of environmental sanitation and infant feeding are also influenced by the same set of underlying socio-economic factors. For example, a study revealed that household

income was inversely related to the duration of breastfeeding, and directly related to having in-house water connection or a private excreta disposal facility [12].

The role of hygiene behaviours in improving health outcomes related to water and sanitation is returning to the forefront of discussions. Three studies reviewed [17, 34, 35] showed that hand washing education and soap availability resulted in reductions of 30-48% in disease prevalence [36]. Huttly et al [37] reviewed the impact of hygiene on diarrhoeal prevalence, and calculated that a 35 % reduction in diarrhoeal prevalence was possible. Another review by Curtis [38] reported morbidity reductions between 27 and 89% as a result of hand washing. Studies on risk factors for diarrhoeal disease have described the relationship between parental behaviour and the occurrence of childhood diarrhoea. Studies suggested that maternal practices related to hygiene, breastfeeding, food preparation, appropriate weaning practices, and health care are important determinants of diarrhoeal disease incidence [36]. The introduction of supplementation with other liquids or foods marks the beginning of a child's exposure to possibly contaminated foods and liquids [35, 39]. It has been reported that partially breastfed or non-breastfed infants have about two to five times higher episodes of diarrhoea experienced by exclusively breastfed infants [39].

A study from Kinshasa demonstrated that the use of improper means of faecal and solid waste disposal and maternal ignorance of proper hygiene practice were significantly associated with diarrhoeal disease [5]. The findings of a case-control study on hygiene behaviour and severe childhood diarrhoea suggested that unhygienic practices were important risk factors for severe diarrhoea in under-five children [5]. The study also indicated an increasing excess risk of diarrhoea with declining standards of maternal hygiene practice and kitchen hygiene. A review of different studies on improving hygiene practices showed a

positive impact on diarrhoea morbidity in young children, with a median reduction of 33 percent[5].

Kosek et al.[3], indicated that Children living in rural areas experienced less frequent diarrhoeal diseases than those living in semi urban areas. The authors noted that this might be explained by the relatively increased use of open pit latrines in semi-urban areas from which the flies transmit enteric pathogens [3]. Further, studies[35] elsewhere have found that children in rural areas are more vulnerable to diarrhea than their urban counterparts. In Eritrea, for example, the risk is about 38 percent higher in rural children compared with their urban counterparts[35]. The general assumption is that rural or urban residence clearly distinguishes between poor and good conditions of health and sanitation. On the other side, the 2005 EDHS showed that diarrhea was more common among rural children 20 % than urban children 12 % [40]. According to the National Sanitation Strategy for Ethiopia (2005) and the Health and Health Related Indicators (2003/04), more than 250,000 children die every year from sanitation and hygiene related diseases. Sixty percent of the overall disease burden is related to poor sanitation and hygiene[41].

The demographic factors include the age and parity of the child, and maternal age at birth. Very young children are less vulnerable to diarrhea because of the protective effects of breastfeeding and the less exposure to contaminated agents, but the risk increases for those aged six months up to 24 months and decreases thereafter[35, 39]. Maternal age at birth also has an association with diarrhea[40]. Although there is no consistency in the literature on its effects, since very young mothers do not have much parental experience on issues relating to infant feeding and child care, their children could be expected to be more vulnerable to diarrhea. Conversely, while old mothers may have much parental experience, they are likely to hold more firmly to certain traditional childcare and feeding practices that could

potentially increase the risk of diarrhea among their children. The effect of maternal age is therefore open to empirical assessment.

The birth order of the child is also expected to associate with the risk of diarrhea[18, 40]. Children of higher birth orders could be expected to be more vulnerable mainly because the quality of care and attention reduces as the number of children a woman has increases. These children may receive poorer quality care hence they are more likely to come into contact with diarrheal pathogens. Higher order births may also signal a higher number of children in the household which increases the risk of contamination of the diarrhea pathogen.

Water, Sanitation and Diarrhea

Annually, there are around 2.4 million deaths related to water and sanitation mainly resulting from diarrhoeal diseases and occurring mostly among children under five [16, 38]. Improving the quantity and the quality of water available, providing adequate sanitation facilities and adopting better hygienic practices interrupt the transmission of most faeco-oral disease. It is anticipated that an improvement in the quality of water and its accessibility, along with sanitary excreta disposal within poor communities in developing countries will have a substantial and immediate impact on diarrheal morbidity and mortality rates[17].

It is well documented that poor environmental condition is a major risk factor for diarrheal disease, as young children are mostly played on the ground, hence they exposed to the dirt, and the contaminated environment. In Timaes and Lush[32] who conducted a comparative study on differentials of child health in urban areas of Brazil, Egypt, Ghana and Thailand, found that environmental factors are strongly related to childhood diarrhoea prevalence.

A study that assessed environmental determinants of childhood diarrhoea, and another study from the Republic of Congo revealed that children coming from households that obtain water

from improved sources were less likely to have diarrhoea as compared to those who get their water supply from unimproved source[24, 36]. A study from Zimbabwe indicated that children living in households that used river water as a source for drinking had 33% more episodes of diarrhea than children living in households using well water[36]. A study that was done to determine the prevalence of childhood diarrhoea in North Gondar Zone, Northwest Ethiopia, indicated that use of unimproved water sources was significantly associated with diarrhoeal morbidity [24]. The results of a study from Southwest Ethiopia showed that the mean per-capita water consumption was lower in households where child had diarrhoea [24]. Data obtained in controlled field study over 5 year in seven developing countries showed that the provision of sanitary facilities for human excreta disposal can reduce the incidence of cholera by as much as 68%, while the provision of safe water supply can decrease it by 73%. Where both latrine and safe water are provided, the incidence can be reduced by as much as 76% [6]. Other studies [35, 36, 39, 42, 43], have shown that properly planned and implemented water supply and sanitation projects can improve population's health status and eliminate or control water related disease.

Water and childhood diarrhea

The provision of safe drinking water has a beneficial effect on the health of the community. This effect can, in part, be monitored by changes in the incidence or prevalence of acute childhood diarrhea [17, 44]. Kosek [45], reviews showed a 16% to 25% decrease in diarrheal morbidity resulting from improved water supply. The reviews also showed reductions in total mortality by 20% and in diarrhoeal disease mortality by 40% for some age groups when water is piped either into or near the household.

Ten of 16 studies looking at the effects of only improved water quality reported positive effects, with a median reduction in morbidity of 17% [45]. Of studies assessing the impact of

water quantity, 14 of 15 studies showed positive impacts of improvements, with a median reduction of 27% in disease prevalence.

Studies in China revealed a decrease in the incidence of diarrheal disease by 38.6 % among deep well tap water users compared to a population using surface water (river, ditches)[46].

Morbidity Reductions Achievable Through Water and Sanitation Improvements [47]

Improvement	Reduction
Quality of water	16%
Quantity of water	25%
Quantity and quality of water	37%
Excreta disposal	22%

Sanitation and childhood diarrhea

Kosek [3], reviews also examined the evidence of the impact of sanitation on health outcomes. Of 30 reviewed studies that looked at sanitation, 21 documented some reduction in diarrhoeal disease, with a median reduction of 22% [3, 17, 45]. The type of improved excreta disposal method was important, with the greatest reductions reported for flush latrines, although pit latrines were also associated with morbidity reductions. Additional studies, such as one in Lesotho, document similar reduction levels [31]. A study of cross-sectional DHS data from eight countries, looking at the effect of improved infrastructure on diarrhoea rate reduction found that improving sanitation but not water resulted in a 34.5 % reduction in diarrhoea rates. The study also found that improving water but not sanitation resulted in a 20.8 % reduction, and improving both resulted in a 37.5 % reduction[47]. In Ghana, the risk of having diarrhea was found to be significantly associated with latrine facility, where children living in houses with latrine facilities are about 50% less likely to contract diarrhea than children living in houses with no such facilities [39].

Maternal education and childhood diarrhea

Several studies[17, 31, 46] on determinants of infant and child survival underscored that child survival in the less developed countries is highly and positively associated with maternal education, more than with any other socio-economic variables. Data from Latin America [21, 31, 38, 46] all show a positive and significant relationship between the extent of maternal education and the chances of child survival, although the magnitude and nature of its effect varies in different settings. The study in Ghana, indicated that the prevalence of diarrhea varies according to education of mother being significantly lower among children of more educated mothers (secondary or higher) than among children of mothers with no or primary education. This is probably because more education provides the knowledge of the rules of hygiene, feeding and weaning practices, the interpretation of symptoms and enhances timely action to childhood illness[19, 31] . A study done in an urban area of southwest Ethiopia also revealed that family income was significantly associated with childhood diarrhoeal morbidity[25]. Research findings on the significance of socioeconomic determinants (parental education and income/wealth) on childhood diarrhoeal morbidity were not consistent. There were studies that did not show significant association between education and income/wealth and diarrhoeal morbidity [19, 36, 46]. Well-educated mothers may be unable to reduce risk of exposure due to factors beyond their control, such as a contaminated community environment, or lack of water. However, their knowledge and wealth may allow them to use healthcare services more effectively than uneducated women [36].

The findings confirm earlier studies which found lower incidence of childhood diarrhea among children of educated mothers than among children of mothers with no formal education[39].

Educated mothers practice good hygiene and better child feeding, all of which increase a child's resistance against infectious diseases. Education enables caregivers to avoid health threats and deal with illness more easily[36]. Experience in Sri Lanka and India, has led to the suggestion that for every year of schooling for girls, a 10 percent reduction in infant mortality be reasonably expected[48]. Education enhances the opportunities for wage employment and income and increases access to household amenities and facilities including those related to better hygiene and environmental health[49-51].

CONCEPTUAL FRAMEWORK

The factors that are related to childhood diarrhea are multi-dimensional in their nature (social, economic, demographic, biomedical and environmental [45]). It also requires a multi-disciplinary approach in its research strategy (socio-economic, demographic and epidemiological research). This is why several analytical/conceptual frameworks have been developed by researchers of all kind concerned to this particular problems. Most of these frameworks give due emphasis to what they refer to variables that are more proximate to the event of diarrhea. Since our prime water, sanitation and maternal education among the factor from the list of childhood diarrheal morbidity determinants, we have adapted and modified a conceptual hypothesis which is expected to show how water, sanitation and maternal education affect childhood diarrhea morbidity (figure-1). Since diarrhea is transmitted through a variety of agents [13, 19, 38, 47], we argue that parentally provided inputs combine with household facilities in determining a child's vulnerability. Good home management practices such as boiling and filtering of untreated water could potentially reduce the risk of childhood diarrhea even in households with poorer sanitary facilities. A priori, we expect the variation in household facilities on the risk of childhood diarrhea to be less pronounced and quantitatively negligible among children of educated mothers than their counterparts with less educated mothers. Thus, while children in household without access to improved facilities may expose to higher risk of diarrhea; those whose mothers are highly educated are expected to be less vulnerable.

According to the Joint Monitoring Program (JMP) for water supply and sanitation by the [World Health Organization](#) and [UNICEF](#) the following are considered as "improved" water sources; household connections , public [standpipes](#), protected [dug wells](#) ,protected [springs](#), [rainwater collection](#)[52].

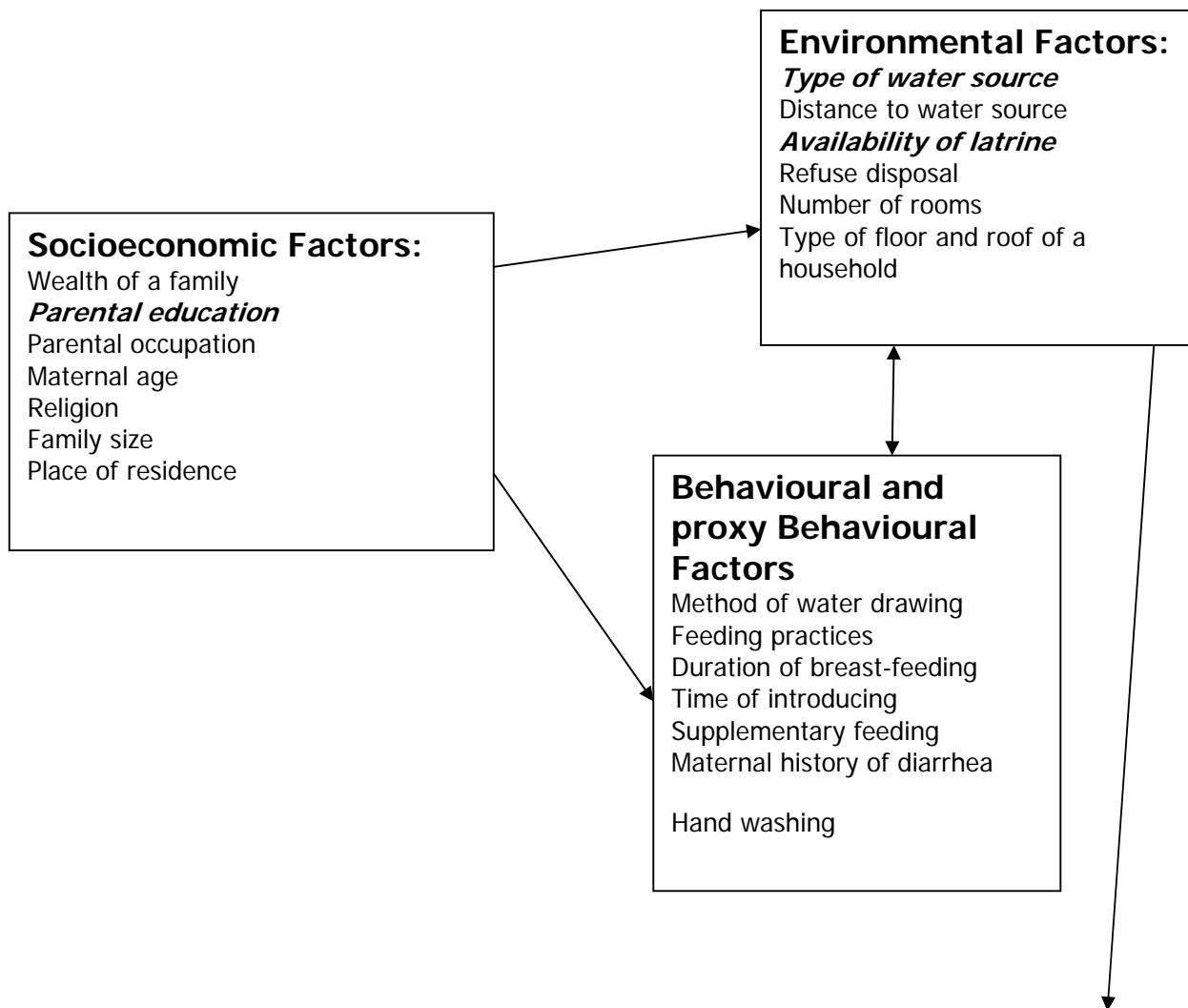
Water sources that are considered as "not improved" are: unprotected [dug wells](#), unprotected [springs](#), river, ponds, dams.

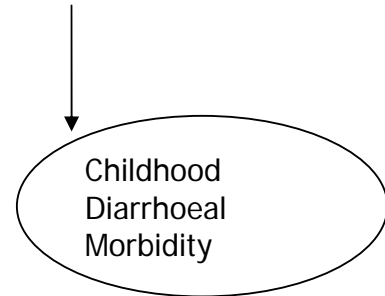
The main independent variables are the household's latrine and drinking water facilities with maternal education as a stratifying variable. The latrine facilities are categorized as no facility and latrine facility while drinking water is classified improved and unimproved water. Given the association between household facilities and child health in general and diarrheal morbidity in particular [21, 35, 39, 46, 53], we expect the risk of childhood diarrhea to be lowest in households with improved water and sanitation. However, on account of the health, nutrition and hygiene related knowledge among highly educated mothers and the fact that such mothers are likely to engage in good home management practices, their children are expected to be less vulnerable to diarrhea than those of uneducated mothers in the absence of water and latrine facilities.

Maternal education was categorized into high and low. Low education is used to refer to mothers with less than secondary education while high education refers to those with at least secondary education. This distinction derives from previous research that suggests a minimum threshold of secondary education as necessary to realize the reproductive related benefits of maternal education[40, 45].

Studies [35, 36, 54, 55] considered ownership of durable goods, such as radio, television, bicycle, or telephone as proxy measure for household economic status. Others also considered parental education and occupation as proxy measure for household income [56]. Therefore, a family who had no any of these as low wealth, those who had at least one of those goods as medium and those who had three of these grouped as high wealth.

Figure 1. Conceptual framework of potential determinants of childhood Diarrhoeal morbidity.





- *The study mainly gives emphasis to the variables drinking water source, latrine facility and maternal education effects on childhood diarrhea.*

OBJECTIVE

GENERAL OBJECTIVE

To investigate the effects of drinking water and latrine facilities on the risk of childhood diarrhea among under-five children and assess whether they vary by maternal education in Mecha woreda.

SPECIFIC OBJECTIVES

1. To assess the prevalence of diarrhoea among under 5 children in Mecha Woreda
2. To identify determinant demographic, socio-economic, environmental, and behavioural factors contributing to diarrhea among children under-five years of age.
3. To assess whether or not childhood diarrhea associated with water and sanitation and vary by maternal education

METHOD AND MATERIALS

Study Design

This was a community based cross-sectional study in the areas of Mecha District and was conducted from mid of February first to February 28, 2009.

Study Area

The study was conducted in Mecha District in West Gojjam Zone, Region 3, Ethiopia (annex-1). The zone comprises 11 woredas, of which Mecha Woreda is one of them. Merawi is town of the woreda. The Woreda consists of 3 urban kebeles (Merawi town) and 39 rural kebeles. Merawi is located at about 515 Km North West of Addis Ababa and 35Km from Bahir Dar. The total population of the Mecha District reached to 292,250 of these 106,967 males and 107,883 females. The rural part of the District has a population of 195,685 and the urban population is 96,565.[57]

The major ethnic group of the Woreda is Amahra. The population is predominantly Orthodox-Christian by religion. Agriculture is the main livelihood of the population. Teff, maize, millet, barley and legumes are the main crops cultivated in the Woreda.

Source Population

The source population for the study was all under five children of Mecha District.

Study population: The study population of this study was all children in randomly selected households in the selected Kebeles.

Study units: the study units were under five children from randomly selected 768 households which are index child and the data was collected.

Sample Size Determination

There was no any previous study that indicates prevalence of diarrhoea for Mecha Woreda.

The sample size was calculated using EPI-INFO version having the assumption for a cross-sectional survey. The required sample size was determined using the formula of estimating a single population proportion for a cross-sectional survey[58]. That is

$$n = \frac{Z_{\alpha/2}^2 p(1-p)}{d^2} * D$$

Where: n = the required minimum sample size

Z = a standard score corresponding to 95% certainty, and is thus equal to 1.96

d = is the margin of error, taken to be 5% (0.05).

D = design effect, taken as 2.0 (a measure of the variance inflation of an estimate caused by urban to rural, under five households index child).

P = is the proportion of diarrhoeal taken as 50 % (0.5)

Urban /rural= 1:2(to have a better proportion, since the rural population is higher as compared to the urban)

The calculated total sample size for this study was 768 households that had at least one under five children. Accordingly, the sample size for urban was 256, and that of rural 512 households with at least one under-five child (annex-2).

Sampling Procedure

Mecha District purposively selected for this study. The Woreda was initially divided into urban and rural to avoid over representing of a specific characteristics (annex-2). Then, one urban and 10 rural kebeles from the three urban Kebeles and the 39(which represents more than 25% of total) rural kebeles was a randomly selected, respectively in the area.

The total sample size (512) for the rural areas was distributed to the 10 rural kebeles proportionally to their under five households' size and was selected using simple random (lottery) system. The 256 sample was collected from one urban kebele that was selected randomly. The households that had under-five children were selected randomly using a sampling frame from the census.

Inclusion criteria:

1. Households having child/children under 5 years, only the index child was taken.

If there was more than one child in the household, the youngest child was selected to collect information on the child's demographic and health characteristics. Since the youngest group are more vulnerable to main explanatory variables[2, 7, 17].

2. Index child who were not chronically ill and without persistently diarrhea.
3. Families who had permanent residence in the area (for at least 6 months)

Exclusion:

1. Chronically ill children

2. Children with persistent diarrhea for greater than two weeks.
3. Children of homeless family, because those children may not have clear information on some explanatory variables.

STUDY VARIABLES

Outcome (dependent) variable

- ❖ Childhood diarrhea

Explanatory (independent) variable

Main independent variable

- Access to drinking water
- Types of water source
- Availability of latrine
- Maternal education

Other explanatory variables

- Environmental factors :Waste disposal, type of roof and floor of a household
- Socio- economic and demographic characteristics: includes wealth of a family, maternal age, age of child, order of a child, religion, family size, place of residence, paternal education.
 - Behavioural factors: includes method of hand washing (at critical times), water drawing and storage, water treating, breast feeding status, duration of breast-feeding, time of introducing supplementary feeding maternal history of diarrhoea etc.

Data Collection

A pretested structured questionnaire was developed after reviewing literatures, adapted as well modified from WHO core question[59] to collect information on the households' socioeconomic, environmental conditions and behavioural aspects. The respondent for the question was mothers/caretakers in the household that had under-five child/children. If the mother/caretaker was not available at the time of survey, the enumerators were made another

visit to that household the next day. Twelve data collectors who completed grade 12(10 +2) high school education and residents of the area was recruited and trained on the techniques of interviews and data collection. Four Health Extension Workers (HEW) was involved as supervisors in the survey. The supervisors were trained together with the data collectors for two days. The supervisors were responsible for supervising the data collectors; checking for the completed questionnaire; and correcting any mistake or problem encountered. Five percent (38) of the households were reinterviewed by the supervisors and the principal investigator to check for the consistency of data collection.

The principal investigator gave the training. Training manual was prepared to aid the training process. The training mainly focused on interviewing techniques, and emphasis was also given for questions that need careful attention and observation. Classroom lecture and field practice were included in the training. Random crosschecking some questionnaires was also made by principal investigator. The overall data collection process was coordinated by the principal investigator.

Data Management and Analyses

The data entry and cleaning was performed using EPI INFO window-version statistical package. Frequencies, cross tabulations and sort were used to check for missed values and variables. Missed data was corrected after revising the original questionnaire and was analyzed using computer programme (EPI INFO & SPSS-15) and presented with appropriate diagrams, tables and figures. The sequence of analysis was as follows:

1. Descriptive analysis was done using percentages (%), mean/median, and standard deviation
2. Bivariate analysis for determinant variables

3. The outcome measure, diarrheal morbidity, was based on mothers' response (yes or no) to a question on whether a particular child had experienced diarrhea during the last two weeks before the survey. Given the binary nature of the dependent variable, a binary logistic regression was used.

4. Stratification

Data Quality

The questionnaire was developed by the principal investigators after reviewing literatures, and WHO core questions on water and sanitation[59]. To keep its consistency, questionnaires first prepared in English was translated to Amharic and then back to English. Pre-test was made one kebele in urban and two rural kebeles of the Woreda (which was not included in the actual data collection) two weeks ahead of the actual data collection time (February first, 2009) and something which was confusing or inconsistent was corrected. Intensive training and orientation about the objective and process of data collection was provided for data collectors and supervisors for two days. Closer supervision was undertaken during data collection and completed questionnaires were checked daily for consistency and completeness by the supervisors and the principal investigator. The collected information was rechecked for its completeness and consistency before entering the data into a computer. The data entry was made by principal investigator and 10% of the data validation was made by another person.

Ethical consideration

Permission was obtained from the Institutional Review Board (IRB) of Addis Ababa University, Medical Faculty. Informed verbal consent was sought from the mothers/caretakers of the children. Confidentiality was maintained during interview. The data

used only for the study purpose and was not passed to a third party. Children who were found to be sick during the visits were supplied ORS (aided by the Woreda Health Bureau) and advised to consult the nearby health institution for better management.

Dissemination of the study

In terms of the dissemination of the information contained in this thesis, several strategies will be used. For example, the executive summary will be circulated among the government agencies, national and local NGOs, and the private companies who entirely participated in implementation of water and sanitation programmes so that the recommended solutions will be put in to action in a desired and designed manner.

Efforts will be made to present the findings of the study in appropriate seminars, workshops, and conferences. Eventually, an effort will be made to publicize the paper in national and international journals.

Operational definition

Diarrhoea- is defined as having three or more loose or watery stools in a twenty-four hours period, as reported by the mother/caretaker of the child.

Water supply: the supply of water for drinking purpose.

Sanitation: excreta disposal (latrine), excluding other environmental health interventions such as solid waste management and waste water drainage.

Hygiene: is washing hands with soap/ash before eating/food preparation, after eating, visiting latrines and cleansing child's bottom and before feeding a child.

Prevalence rate: the total number of diarrhoea cases at the time of the interview divided by the total number under five children in the study area.

Index child: refers to a child that was included in the study from a household, a child with diarrhea, if no child with diarrhea, the youngest child was selected in case more than one child in the house to collect information on the child's demographic and health characteristics.

Improved water sources: includes household connections , public [standpipes](#), protected [dug wells](#) ,protected [springs](#) [52] .Water sources that are considered as "unimproved" are: unprotected [dug wells](#) , unprotected [springs](#) [52]. “Improved” source is one that is likely to provide "safe" water.

Proper disposal is a way of disposal refuses which includes burning, buried in pit or store in a container and disposed in designed site, whereas disposing in open field considered as unimproper disposal.

Room –is a partion in the house that does not share air (ventilation) from other part of house/partion.

Low education –are those mothers with less than secondary education

High education- is those mothers with at least secondary education and above

Low wealth- a family who had no any of radio, television, bicycle, or telephone.

Medium- a family who had at least one of those goods (of radio, television, bicycle, or telephone)

High wealth- those families who had three of these (of radio, television, bicycle, or telephone)

Per capita water consumption- is calculated by considering frequency of water collection in a day, capacity of container and family size. i.e.

$$\text{Per capita water Consumption} = \frac{\text{Freq. of collection} \times \text{Capacity of container}}{\text{Family size}}$$

Design effect- is a measure of the variance inflation of an estimator caused by utilizing a cluster design instead of a simple random sampling scheme.

RESULT

Households' Socio-economic, Environmental and Behavioural Descriptions

1. Socio-economic Characteristic

A total of 768 households were included in this study and response rate was 100 percent. Out of these households, 256 (33.3%) were from urban area, i.e. Merawi town, while 512(66.7%) from ten rural kebeles (annex-1).

Mean age of mothers was 28.48 (± 6.5) years, while their mean age at the birth of the index child was 25.8(± 5.9) and the mean age of the fathers was 35.6(± 8.3). More than 75% of the mothers were below the age of 32 years (Table 1). The majority of mothers were married 726(94.1%), and illiterate 573 (74.6%), Orthodox by religion 743 (96.8%) and almost all Amahra (99.6%) by ethnicity. Four hundred eighty four (63.0%) mothers occupation were farmers most of these were lived in rural, and 172(22.4%) were house wife that mostly lived in urban.

The mean household family size of the study population was 5.1(± 1.8) persons. About 479(62.2%) households had a family size of less than or equal to four persons and the rest of the households had 5 or more persons in their families (Table 1). Three hundred and ninety one (50.1%) of the study family had no functional radio and the main source of income was agriculture 532(69.3%). About half of the study population, grouped as low wealth group 381(49.6%) and only 10.7% of the families had a higher wealth.

Table 1: Socioeconomic and demographic characteristics of the study households of Mecha Woreda, West Gojjam Ethiopia Feb. 2009.

Characteristics	Frequency	Percent
Maternal education		
Illiterate	573	74.6
read & write	61	7.9
1-4	18	2.3
5-8	34	4.4
9-12	59	7.7
12+	23	3.0
Marital status of the mother/caretaker		
Married	726	94.5
Divorced	31	4.0
Widowed	11	1.3
Occupation (mother/care taker)		
Government	38	4.9
Housewife	172	22.4
Merchant	44	5.7
Farmer	484	63.0
Selling local drinks	17	2.2
daily labour	13	1.7
Residence of the family		
Urban	256	33.3
Rural	512	66.7
Family have a functional radio		
Yes	377	49.1
No	391	50.9
Religion of the family		
Orthodox	744	96.8
Muslim	24	3.1
Main source of income		
Agriculture	532	69.3
Trade	102	13.3
Craft	14	1.8
Salary	87	11.3
daily labour	33	4.3
Wealth of the family		
Low	381	49.6
Medium	305	39.7
High	82	10.7
Family size of the household		

≤4	479	62.4
≥5	289	37.6
Mothers age at birth		
15 – 24	348	45.3
25 – 34	358	46.6
>34	62	8.1

2. Environmental Characteristics

From the total of 768 households, 575 (74.9%) had corrugated roof, of this 248(96.7%) of urban and 327(63.9) of rural had corrugated roof. Two hundred twenty four (29.2%) households had one room, and 286(37.2%) had two rooms. In two hundred eighty six (37.2%) households animals lived within the same house. The distribution of these in place of residence 17(6.6%) of urban households and 269(52.5%) of urban households animals live in the same house with persons.

About four hundred forty three (57.7%) of the households in study population had no any latrine facility and of those who had no access the majority of these were less educated mothers (64.1%), whereas 96.3% of higher educated mothers had latrine facility. Of the total households which posses latrine facility, 285(87.7%) had traditional pit latrine and the rest 40(12.3%) had Ventilated Improved Pit (VIP). The distribution of type of latrine facility by maternal education, 222(90.2%) of less educated mothers and 63(79.7%) of higher educated had traditional pit latrine. More than half 433(56.4%) of the households disposed their refuse improperly (in the open field) (table 2).

Five hundred and thirty one (69.1%) households used unimproved water as the main source of water for drinking. Regardless of the type of water source, 520 (67.7%) households got water in a 30 minutes walking distance from their home. Only 32.3% of the households spent more than 30 minutes to fetch water.

The mean per capita per day water consumption in study area was 7.7 (± 4.4) litres.

Table 2. Environmental conditions of the study households of Mecha Woreda, West Gojjam, Ethiopia Feb. 2009.

Characteristics	Frequency	percent
Drinking Water source		
Improved	237	30.9
Unimproved	531	69.1
Distance of water source(round)		
≤ 30 minutes	520	67.7
> 30 minutes	248	32.3
Animals live with humans		
Yes	286	37.2
No	482	62.8
Latrine facility		
Available	325	42.3
Not available	443	57.7
Type of latrine facility		
Traditional pit	285	87.7
VIP	40	12.3
Ownership of latrine		
Private	277	85.2
Shared	48	14.8

Refuse disposal		
Proper disposal	335	43.6
Improper disposal	433	56.4
Number of rooms		
1	224	29.2
2	286	37.2
≥ 3	258	33.2
Mean water consumption (Litres/person/day)	7.7(±4.4)	

3. Behavioral and Child Demographic and Health Characteristic

Of the total 768 mothers/caretakers, 107(13.9%) mothers breastfed their children exclusively. Two hundred forty two (31.9%) mothers stopped to breastfed their child before the age of one year. Three hundred eighty six (50.3%) stopped to breastfed their child between the age of one and two year. From those mothers who start additional food for their children, Four hundred forty four (60.2%) mothers started supplementary feeding for their children after the child reached 6 months and above.

Out of the total 768 mothers/care takers, 63(8.2%) had diarrhoea in the past two weeks of a survey. The prevalence of diarrhoea was 59(8.6%) among low educated mothers and 4(4.9%) among high educated mothers.

Method of drawing water from storage was dipping 681 (88.7%) which was a common practice in the study area. Seven hundred and sixty eight mothers (94.9%) claimed to wash their hands usually in a day at least before the preparation of a food and before they eat. Treating water was not common in the study area, that was 683(88.9%) was not treating water.

Of those mothers who were asked does a fly can transmit diseases? About half of them 392(51.0%) replied “No” and this response was common in low educated mothers (55.8%) as compared to counterpart (11.0%).

Table 3. Maternal childcare and health practices Mecha Woreda, West Gojjam, Ethiopia Feb. 2009

Characteristics	Frequency	Percent
Current BF status		
Exclusive	107	13.9
Partial	417	54.3
No BF	244	31.8
Duration of BF		
<1year	242	31.5
1-2	386	50.3
≥ 2	140	18.2
Initiation of supplementary feeding		
< 6month	294	39.8
≥ 6month	444	60.2
Maternal diarrhoeal morbidity(two week)		
Yes	63	8.2
No	705	91.8
Water drawing		
Dipping	681	88.7
Pouring	87	11.3
Wash hand		
Yes	729	94.9
No	39	5.1
Treating water		
Yes	85	11.1
No	683	88.9
Knowledge of flies can transmit disease		
Yes	376	49.0
No	392	51.0

In 768 study households there was a total of 940 under five children, of these 151(16.1%) had a history of diarrhea in the preceding two weeks. Whereas the overall prevalence rate of diarrhea among under five index children (768) in Mecha District was 138(18.0%), i.e. 32(12.5%) in urban and 106 (20.6%) in rural of the study area.

Of the total 768 index children, about 445(57.9%) were below the age of 24 months. The mean age of the index children included in this study was 2.047(\pm 1.36) years. Of the total 636 children whose age was 9 months and above at the time of the survey, 604(95%) children were claimed to get immunized for measles by their mothers 205(33.9%) and after checking their cards 399(66.1%).

Of the total index children 437(56.9%) were male by sex and in terms of their birth order 240(31.3%) children had an order of four and above four (see table 4).

Tables 4. Demographic and health characteristics of the index children Mecha Woreda, West Gojjam, Ethiopia Feb. 2009.

Characteristics	Frequency	percent
Age of the index child		
0-5 month	56	7.3%
6-11 month	76	9.9%
12-24 month	313	40.8%
24month & above	323	42.1%
Sex		
Male	437	56.9
Female	331	43.1
Birth order		
First	159	20.7
Second	190	24.7
Third	179	23.3

Fourth & above	240	31.3
Measles vaccination		
Yes	604	95.0
No	32	5.0
Diarrhea in the past two weeks		
Present	138	18.0
Absent	630	82.0

Socio-economic, Environmental and Behavioural Determinants in relation to child diarrhea among under five children

Socio-economic Determinants on childhood diarrhoea

Table 5 presents the households' selected socio-economic and demographic variables and their relation to childhood diarrhea. As shown in the table, in the crude analysis, **all** variables showed significant association with diarrheal morbidity except maternal age and family size.

In Table 5 maternal educations' showed a strong association with diarrhea. Diarrhoeal morbidity was significantly associated with both fathers' and mothers' education. Children who were born to low educated mothers were about six times more likely to have diarrhoea than children of mothers who were high educated [OR: 6.45, 95% CI: (2.01, 20.75)].

Similarly father's education has a significant association with childhood diarrhea.

The finding on place of residence suggested that children in rural areas had a significantly higher risk than their urban counterparts. The likelihood of developing diarrhea for Children who lived in rural area have 1.83 times higher risk than urban children [(OR: 1.83, 95%CI :(1.17, 2.87)]. Maternal wealth had also a significant association with childhood diarrhea. Children whose family were low wealth [(OR: 3.44, 95%CI :(1.30, 8.57)] and those whose families were medium wealth [(OR: 4.17, 95%CI :(1.62, 10.73)] at the time of the survey were more likely to have diarrhoea than children whose families were high wealth.

Maternal age at birth also showed a risk of diarrhea, children of both very young (19.3%) and old (21.0%) mothers were most vulnerable; but the effects were not significant.

Table 5. Socio-economic Determinants in relation to child diarrhea among under five children in Mecha District, West Gojjam, Ethiopia Feb. 2009

Characteristic	Diarrhoea		Crude OR (95% CI)
	Yes	No	
Residence			
Rural	106(20.6)	406(79.5)	1.83(1.17, 2.87)*
Urban	32(12.5)	224(87.5)	1.00
Mothers age at birth			
15 – 24	67(19.3)	281(80.7)	1.00
25 – 34	58(16.2)	300(83.8)	0.81(0.54,1.22)
>34	13(21.0)	49(79.0)	1.11(0.54, 2.26)
Wealth of family			
Low	68(17.8)	313(82.2)	3.44(1.30, 8.57)*
Medium	65(21.3)	240(78.2)	4.17(1.62, 10.73)*

High	5(6.1)	77(93.9)	1.00
Mothers education			
Low education	135(19.7)	551(80.5)	6.45(2.01, 20.75)*
High education	3(3.7)	79(96.3)	1.00
Father education			
Low	645(97.9)	14(2.1)	76.4(39.6,147.3)*
High	41(37.6)	68(62.4)	1.00
Family size of household			
<=4	55(16.4)	280(83.6)	1.00
>=5	83(19.2)	350(80.8)	1.21(0.82, 1.79)

*Statistical significance: $p < 0.05$

Environmental Determinants on childhood diarrhoea

Table 6 presents the households' selected environmental variables and their relation to childhood diarrhea. As shown in the table below, in the crude analysis, **all** variables showed significant association with diarrheal morbidity except the number of rooms and type of latrine facility.

Table 6: Environmental Determinants in relation to child diarrhea among under five children in Mecha District, West Gojjam, Ethiopia Feb. 2009

Characteristic	Diarrhoea		Crude OR (95% CI)
	Yes	No	
Drinking water source			
Unimproved	110(20.7)	421(79.3)	1.95(1.22, 3.13)*
Improved	28(11.8)	209(88.2)	1.00
Latrine facility			
No Latrine	99(22.3)	344(77.7)	2.11(1.39, 3.22)*
Have Latrine	39(12.0)	286(88.0)	1.00
Type of latrine			

Traditional pit	37(13.0)	248(87.0)	2.83(0.65,12.24)
VIP	2(5.0)	38(95.0)	1.00
Waste disposal			
Improper disposal	96(22.2)	337(77.8)	1.99(1.32, 3.01)*
proper disposal	42(12.5)	293(87.5)	1.00
Number of rooms			
1	40(17.9)	184(82.1)	1.12(0.68,1.85)
2	56(19.6)	230(80.4)	1.25(0.76,1.96)
≥ 3	42(16.3)	216(83.7)	1.00

**Statistical significance: $p < 0.05$*

Let start with drinking water, there were a significant differences on the basis of water source [OR: 1.95, 95% CI :(1.22, 3.13)]. Children in households with improved water source were the least vulnerable to diarrhea compared with those with drinking water from unimproved sources.

There was a difference in the likelihood of diarrhea by the availability of latrine facility. The gross effect suggests that, the absence of a latrine facility were significantly associated and increases the risk of childhood diarrhea twice [OR: 2.11 (1.39, 3.22)]. Childhood diarrhoeal morbidity was significantly associated with waste disposal. Those families who dispose waste improperly had odds of having diarrhea [OR: 1.99, 95% CI: (1.32, 3.01)] twice more than those who dispose properly.

Behavioral and Child Demographic and Health Characteristic on childhood diarrhea

In tables 7 depicted below maternal child care and behavioural practices, and the demographic and health characteristics of index children in relation to diarrhoeal morbidity is shown. Children who were partially on breast milk [OR: 2.43, 95% CI: (1.24, 4.88)] were more likely to have diarrhoea than children who were exclusively on breast milk. Partially feeding showed a significant association. Duration of breastfeeding was also significantly

associated with childhood diarrhoeal morbidity. As shown in table 7 the odds of diarrhea was significantly high for those children who had <1year duration of breast feeding [OR: 3.1, 95% CI: (1.78, 5.43)] and for those who were between one and two years [(OR: 3.85, 95% CI :(2.24, 6.65)].

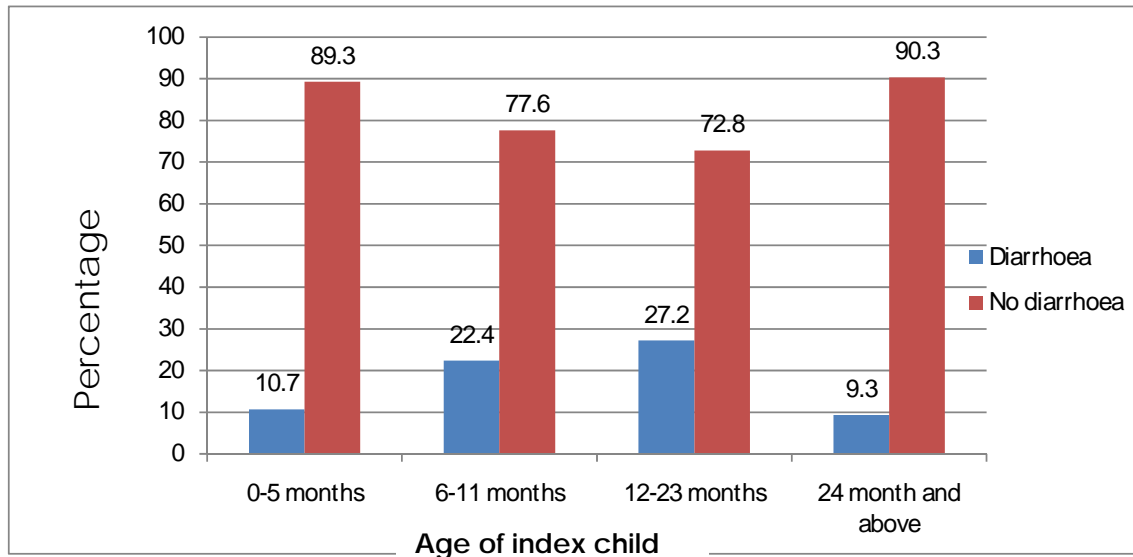


Figure- 2 the distribution of childhood diarrhoea by age in a sample of Mecha woreda, West Gojjam 2009.

The age of the child showed (figure-2) an effect on the risk of diarrhea, the risk being highest at age segments 6-11 months [OR: 2.4, 95% CI (0.81, 7.43)] and 12-24 months [OR: 3.11, 95% CI (1.22, 8.37)] and least at 0-5 months and 24 and above months (OR: 0.85, 95% CI (0.32, 2.41)).

Maternal history of diarrhea had a significant risk on their children’s diarrhoea status. The likelihood of developing diarrhea among children was five times higher for those children whose mothers had a history of diarrhoea as compared to those whose mothers did not have diarrhoea[OR: 5.03, 95% CI: (2.85, 8.87)] .

Table 7. Behavioural and child care practice determinants in relation to child diarrhea among under five children in Mecha District, West Gojjam, Feb. 2009.

Characteristic	Diarrhoea	Crude OR (95% CI)
----------------	-----------	--------------------

	Yes	No	
Water drawing			
Dipping	127(18.6)	554(81.4)	1.584(0.82, 3.07)
Pouring	11(12.6)	176(87.4)	1.00
Mothers/care takers know flies can transmit disease			
No	91(23.2)	301(76.8)	2.12(1.42, 3.17)*
Yes	47(12.5)	329(87.5)	1.00
Current Breast feeding status			
Exclusive	12(11.2)	95(88.8)	1.00
Partial	98(23.5)	319(76.5)	2.43(1.24, 4.88)*
No breast feeding	28(11.5)	216(88.5)	1.03(0.48, 2.24)
Duration of BF			
<1year	49(22.2)	171(77.7)	3.1(1.78,5.43)*
1-2	59(26.2)	166(73.8)	3.85(2.24,6.65)*
≥ 2	24(8.5)	260(91.5)	1.00
Maternal diarrhea			
Yes	30(47.6)	33(52.4)	5.03(2.85, 8.87)*
No	108(15.3)	597(84.7)	1.00
Child characteristics			
Age of the index child			
0-5 month	6(10.7)	50(89.3)	1.00
6-11 month	17(22.4)	59(77.6)	2.40(0.81, 7.43)
12-23 month	85(27.2)	228(72.8)	3.11(1.22, 8.37)*
24month & above	30(9.3)	293(90.7)	0.85(0.32, 2.41)
Sex			
Male	87(19.9)	350(80.1)	1.36(0.94,1.99)
Female	51(15.4)	280(84.6)	1.00
Birth order			
First	28(17.6)	131(82.4)	1.00
Second	28(14.7)	162(85.3)	0.81(0.44,1.49)
Third	32(17.9)	147(82.1)	1.02(0.56,1.85)
Fourth +	50(20.8)	190(79.2)	1.23(0.72,2.13)
Measles vaccination©			
No	7(21.8)	25(79.2)	1.53(0.59,3.83)
Yes	109(18.0)	495(82.0)	1.00

*Statistical significance: $p < 0.05$

© $n=636$

5. MULTIVARIATE ANALYSIS

The unadjusted OR results revealed significant differences in the effects of household facilities as well as varying degrees of the control variables on the risk of childhood diarrhea. However, because no controls are introduced at this level, we were unable to assess the independent effects of the covariates. Against this background, the multivariate results presented in Table 8 explore if the benefits of treated water and latrine facilities persist after controlling for other factors. The multivariate analysis is performed taking the conceptual framework (Figure-1) into consideration.

Hierarchical logistic regression technique was used to assess the relative effect of the explanatory factors on the outcome factor. To avoid an excessive number of variables and unstable estimates in the subsequent model, only variables reached a p-value less than 0.3 were kept in the subsequent analyses [60].

Three nested logistic models are estimated: Model 1: examines the joint effects of behavioural characteristics. Model 2: behavioural factors that had a p-value < 0.3 and the environmental factors; Model 3: builds on variables with p-value < 0.3 in Model 2 and including the socio-demographic factors.

As shown in Table 8, from the behavioural and proxy behavioural variables entered in the first step of the analysis, recent history of maternal diarrhoea, duration of breast feeding and age of the index child remained significant in this step (model 1) and kept to second model. In model 2 those covariates with $p < 0.3$ in the behavioural and environmental factors entered and assessed their effects. In this model, maternal recent history of diarrhoea, duration of breast feeding and age of the index child remained as significant risk on developing childhood diarrhea, on the other hand, latrine facility and drinking water source had no significant association after controlling the effects of the above mentioned covariates. Therefore, those significant variables and drinking water source and latrine facility ($p < 0.3$)

kept in subsequent model. In the final model (model 3), the joint effects of behavioural, environmental and socio-demographic covariates assessed (see table 8).

Table 8. Summary of the hierarchical logistic regression analysis of the relative effect of Socioeconomic, environmental and behavioural factors on the prevalence of Childhood diarrhoea in Mecha Woreda, West Gojjam Ethiopia Feb. 2009.

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI)		
		Model 1	Model 2	Model 3
BEHAVIORAL				
Maternal diarrhea				
Yes /No*	5.03(2.85,8.87)**	5.12(2.87,9.12)**	5.02(2.81,8.97)**	5.38(2.96, 9.76)**
Water drawing dipping /pouring*	1.584(0.82,3.07)	1.98(0.669, 1.34)	0.96(0.462,2.01)	-
Breast feeding status				
Partial/ Exclusive*	2.43(1.24,4.88)**	2.01(0.726,5.57)	1.97(0.713,5.45)	1.823(0.65, 5.11)
No breast feeding/Exclusive*	1.03(0.48, 2.24)	0.89(0.458,1.73)	0.89(0.46,1.74)	0.846(0.42,1.68)
Duration of breast feeding				
<1/>=2*	4.38(2.01, 9.87)**	2.85(1.10,7.46)**	2.83(1.13,7.40)**	2.71(1.02,7.25)**
1-2/>=2*	3.39(1.59, 7.50)**	2.27(0.97, 5.37)	2.39(1.01,5.55)	2.31(0.96, 5.55)
Age of the index child				
0-5 month	1.00	0.635(0.169,2.38)	0.65(0.174,2.42)	0.636(0.27, 2.38)
6-11 month	2.40(0.81, 7.43)	2.16(0.78,5.98)	2.12(0.76, 5.88)	2.36(0.82, 6.75)
12-23 month	3.11(1.22, 8.37)**	2.56(1.23, 5.99)**	2.43(1.18,5.26)**	2.76(1.28,5.95)**
24month & above	0.85(0.32, 2.41)			
ENVIRONMENTAL				
Drinking water source use				
Unimproved/ Improved*	1.95(1.22,3.13)**		1.377(0.76, 2.28)	1.72(0.85,3.48)
Latrine facility				
No Latrine /Have Latrine*	2.11(1.39, 3.22)**		1.43(0.8, 2.56)	1.92(1.03,3.38)**
Waste disposal				
Improper/ proper*	1.99(1.32, 3.01)**		1.17(0.65, 2.08)	-
Socio-DEMOGRAPHIC				
Mothers education				
Low/High*	6.45(2.01,20.75)**			5.55(1.52, 19.4)**
Residence				
Rural/urban*	1.83(1.17, 2.87)**			2.14(0.93, 4.76)
Mothers age at birth				
15 – 24	1.00			0.171(0.013, 2.19)
25 – 34	0.81(0.54,1.22)			1.42(0.66, 3.05)
>34	1.11(0.54, 2.26)			
Wealth of family				
Low/ High*	3.44(1.30, 8.57)**			1.02(0.35, 3.53)
Medium/ High*	4.17(1.62,10.73)**			1.6(0.53, 5.00)

- *Only variables reached p-value less than 0.3 were kept in the subsequent analyses, and displayed in the table.* Reference group ** Significant at $p < 0.05$.*

Finally in the condensed model (model-3), maternal education, latrine facility, history of mothers' diarrhea, duration of breast feeding and the age of the index child had a significant association. According to multivariate analysis in table 8, less educated mothers children had more than five times higher odds of having diarrhoea than those children having higher educated mothers [OR: 5.55, 95% CI:(1.52, 19.4)]. The odds of having diarrhoea in children who lived in households which had no latrine facility were about two times higher than the odds in children who lived in households which had latrine facility [OR: 1.92, 95% CI:(1.03,3.38)].

History of diarrhoea in mothers were also significantly associated with childhood diarrhoeal morbidity [OR: 5.38, 95% CI :(2.96, 9.76)]. The probabilities of children developing diarrhea from mothers who were having diarrhea were fivefold more than children of mothers who had not diarrhea in the past two weeks. Age of index child (12-23 months) and duration of breast feeding (< 1 yr) showed significant association with diarrhoea morbidity (see table 8).

The central question in this paper, however, was whether the effects of drinking water source and latrine facilities vary by maternal education. But, drinking water source has no significance in the condensed model there is no to go further and. Table 9, indicates latrine facility stratified by maternal education to see their effects on childhood diarrhea.

Table 9: Stratified analysis of latrine facility by maternal education on the effects of childhood diarrhea in Mecha Woreda, West Gojjam, Ethiopia Feb. 2009

Latrine facility stratified by maternal education	Diarrhoea		
	<u>Yes</u>	<u>No</u>	
No latrine	99	344	Crude OR=2.11(1.39,3.22)*
Latrine	39	286	
Low education			
No latrine	98	341	1.68(1.09,2.62)*
Latrine	36	211	
High education			
No latrine	1	3	OR=8.3(0.00,165.9)
Latrine	3	75	

* Statistically Significant at $p < 0.05$.

Table 10: Summary of the risk of Childhood Diarrhea in environmental setting Stratified by maternal Education in Mecha Woreda, West Gojjam, Ethiopia Feb. 2009.

Latrine facility	Maternal education	
	Low	High
Have no latrine	1.68*	8.30
Have latrine	1.00	1.00

* Statistical Significant at $p < 0.05$.

As depicted in the table 10, the risk of diarrhea was only statically significant in those mothers who were less educated in spite of the presence of latrine.

DISCUSSION

The overall prevalence rate of diarrhea 18.0 percent is consistent with recent World Bank estimates and with the findings in Keffa-Sheka Zone (15%), in Adami-Tulu Woreda (22.7%), North Gondar Zone (17.9%) and the 2005 EDHS report (18%)[23, 24, 61, 62] and in Ghana[63] but varies remarkably across groups.

Overall, the directions of the unadjusted effects are congruent with theoretical expectations. Starting with drinking water; not surprisingly, children in households with improved water source are the least vulnerable to diarrhea compared with those with drinking water from unimproved sources in the bivariate analysis. This is an expected finding because improved water source tends to be less contaminated than other sources and substantiates several recent findings in sub-Saharan Africa notably, Ethiopia [18, 21] Congo [36, 42], Eritrea [35], Nigeria [42], and Zimbabwe [46]. There were significant differences on the basis of drinking water source in the bivariate analysis yet the significance disappeared in the multivariate analysis. The absence of association between type of water source with diarrhoeal morbidity after controlling environmental, socio-demographic, and behavioural factors may be explained by the differences that might not exist in the sample households with respect to the use of improved water source. In addition to this, type of water source provides little information about water quality and/or protection against diarrhoeal infection. For instance, as depicted in table 3 the majority (88.7%) of the households' practice of water drawing was dipping, hygienic practice of the family also matters and this might be the possible contamination, despite the type of water source. Even though the source is protected, water may be contaminated at or following collection, i.e. during transport

and/or storage. In addition to these, as shown in the table 2 the quantity of water per capita consumption low and this affects the health of the childhood.

There was a remarkable difference in the likelihood of diarrhea by the presence of a latrine facility. The crude OR effect suggests that, the absence of a latrine facility increases the risk of childhood diarrhea by 39% and statistically significant at $p < 0.05$ which is consistent with a study in Ghana. A latrine facility provides some notion of a household's sanitary conditions and as such an indication of the possibility of transmission of the diarrheal pathogens through faecal contamination[47]. Childhood diarrhoeal morbidity was significantly associated with waste disposal in the bivariate analysis. Those families who dispose household refuse improperly had odds of nearly twice likelihood [OR: 1.99, 95% CI: (1.32, 3.01)] of developing childhood diarrhea than those who dispose properly. This high risk could perhaps be due to contamination caused by open field defecation as well as the use of chamber-pots as latrine bowls by children in such households which are not often properly disposed of.

From all the environmental variables considered in this study, only availability of latrine facility remained significant after controlling for socioeconomic, behavioural and other environmental variables. In this study, the risk of having diarrhea was found to be significantly associated with latrine facility, where children living in houses without latrine facilities were about 92% more likely to contract diarrhea than children living in households with such facilities, which is consistent with the study in Ghana on maternal education and child morbidity[39].

In this study, the findings on place of residence suggested that children living in rural areas had a significantly higher risk than their urban counterparts in the bivariate analysis, which is consistent with findings in Eritrea[35]. Timaeus and Lush [32] found a strong association

between the socio-economic status of the household and the incidence of childhood diarrhea in urban areas of Ghana. In Eritria, another study[35] also demonstrated a significant variation in diarrhoea prevalence between urban and rural children. Place of residence, urban-rural, in general affects mothers' exposure to education and the extent to which proper sanitation, clean water and health care facilities are available[35, 36]. However, this variation in prevalence between urban and rural did not persist after adjusting for environmental, behavioural and other socioeconomic variables. This might be attributed to the difference between urban and rural areas in literacy status, type of water source and latrine availability.

From all socioeconomic variables tested in, maternal education remained significant both in bivariate and after controlling behavioural, environmental and other socio-demographic factors. The findings on maternal education suggested that mothers with higher education experienced better chance of a child being free of diarrhea, which is consistent with a cross-sectional study in Ethiopia[18, 21] and Ghana[63] and a cohort study in Zaire[20], in that maternal education was significantly associated with diarrhoeal incidence morbidity in children. The study in Ghana[63] indicated that the prevalence of diarrhea varies according to education of mother being significantly lower among children of more educated mothers (secondary or higher) than among children of mothers with no or primary education. Lower levels of maternal education are associated with high morbidity of diarrhea. The morbidity of diarrhea reduces with secondary or higher levels of maternal education. Our findings concurred with that of earlier studies which found lower incidence of childhood diarrhea among children of educated mothers than children of mothers with no formal education [39]. Educated mothers practice good hygiene, better child feeding and weaning practices, and the interpretation of symptoms and enhance timely action to childhood illness, all of which increase a child's resistance against infectious diseases[19]. Education enables caregivers to avoid health threats

and deal with illness more easily[64]. Experience in Sri Lanka and India[48], has led to the suggestion that for every year of schooling for girls, a 10 percent reduction in infant mortality be reasonably expected. Children do not become sick because their mothers are less educated but mainly because such mothers rarely practice better hygiene and nutrition. Throughout the years in school, however, educated women are regularly exposed to the importance of hygiene and nutrition. As a result, they are more aware of disease causation and therefore indulge in good sanitary practices and other preventive measures to reduce the risk among their children.

The ownership of consumer durables is a better indicator of wealth than the inaccurate estimates of income and expenditure which often underestimate the true cost of living[2]. Studies [35, 36, 54, 55] considered ownership of durable goods, such as radio, television, bicycle, or telephone as proxy measure for household economic status [56]. We considered, in this study, ownership of radio, TV, bicycle, and/or telephone as proxy measures for households' wealth status. Family wealth had a significant association with childhood diarrhea. Children whose family were in low wealth category and those whose families were in medium wealth category at the time of the survey were more likely to have diarrhoea than children whose families were high wealth category in the bivariate analysis. Children in low wealth households have higher rates of diarrhea than their wealthy counterparts; this might be due to inadequate access to environmental facilities, unsanitary environments in the home and poor child hygiene. The relationship between the household socio-economic characteristics and childhood diarrhea has been amply demonstrated in the literature[32, 35, 65] [66]. Although family wealth showed an association with the occurrence of childhood diarrhoea in the bivariate analysis, after controlling behavioural, socio-demographic and environmental factors it exhibited no significant association with diarrhoea morbidity. This might be, being

a wealthy family does not really indicate good child care practice, the behavioural situation of the family , in addition to this the wealthy family may related with an increased need of children

It is well documented that maternal child care and hygiene practices have important impacts on the occurrence of diarrhoea in children[35, 55]. In this study, maternal history of diarrhoeal morbidity was found to be significant predictors of diarrhoeal morbidity in children. The five-fold increase in the odds of getting diarrhoea in children whose mothers had diarrhoea may be explained by the fact that maternal morbidity may be considered as a sign of disease exposure in a family. This is so because mothers are food handlers of the family, and also they are usual childcare providers[35, 36]. Moreover, the care of the child may be compromised if the mother herself is sick. Similar finding was observed in Congo[36] where maternal diarrhoeal morbidity was associated with a two-fold increase in the odds for diarrhoeal disease in children. Mother's exposure to diarrhoea may also indicate poor hygienic practice in the household ends up in disease incidence for the child/children.

Duration of breast feeding was found to be significant predictors of diarrhoeal morbidity in children. The odds of developing childhood diarrhea was 2.71 times in children who breast less than one year as compared to children who breast feed two years or more. This is because breastfeeding is an effective means of protecting children from diarrhoeal disease.

As mentioned above breast feeding protects children from diarrheal. This protection is greatest in the first three months of life, and falls thereafter[25, 36]. The finding of this study showed that children who were exclusive breastfed at the time of the survey were less likely to have diarrhoea compared to partial and not breastfed children. This significant association is exhibited in the bivariate analysis of partially breast fed children (table 8) unlike not breast fed child. This finding may have resulted from the confounding effect of age. In this study,

the majority of children who were not breastfed at the time of the survey were above two years of age. In older children, repeated infections from enteric pathogens stimulate immunity, which helps declining of diarrhoeal disease in children older than two years. Accordingly, the statistical significance of current breastfeeding status disappeared, in model 1, 2 and the final multivariate model while the direction of association remained the same as shown in the bivariate analysis.

In general, results showed that the risk of having diarrhea in the two-week reference period reached its peak at 6-11 months and 12-23 months and then begin to fall with increasing age of child. This pattern resembles to those found in many studies of sub-Saharan Africa[40]. In Ethiopia, for instance, the peak occurs among infants 6-11 months of age and those between 12 and 23 months [67], with 24 to 59 months old at lowest risk. In Nigeria, the prevalence of diarrhea was found to be highest among children 6- 11 months of age, the period when most children are weaned [51]. The low risk of diarrhea during the age 0-5 months observed in this study clearly indicates the protective effect of exclusive breast feeding in the first six months of life. In addition to breast milk, inborn immunity and less exposure to contaminated agents during the early period contributes to the lower prevalence of diarrhea. On the other hand, the prevalence peaks when the child has lost inborn immunity and when it is exposed to different types of infections from eating unhygienically prepared food and from unclean water and unhealthy environment. In this finding the age of the child also showed a statistically significant effect on the risk of diarrhea which is consistent as a study conducted in Ghana[35, 63], the risk being highest at age segments of 6-11 months and 12-23 months and least at 0-5 months and 24 months and above. The higher risk at these age segments could be attributed to weaning practices during which infant food can easily become contaminated. At these ages also, infants are either crawling or walking and, as such, can easily pick dirt or other contaminated objects if considerable care and attention are not given.

It is clear from Table 10 that the children of less educated mother were the most prone to diarrhea in the absence of latrine facilities which is consistent with a study in Ghana[37, 40] . However, the effect was no indication in improved water source, this probably in addition to, as we mentioned before the effect of drinking disappear in the condensed model the sample size (768) might not sufficient to indicate the interaction effects.

There is thus evidence that although children in households without latrines are exogenously exposed to a higher risk of diarrhea, educated mothers in such households take action in ways to reduce the risk among their children. Thus, while children in households without latrines are the most vulnerable, the risk is considerably higher for those whose mothers are less educated, perhaps reflecting differences in parentally provided inputs, particularly on hygiene and nutrition. The results, shown in Table 10, revealed substantially lower risks among children of the highly educated for similar household facilities.

Therefore, maternal education bears a significant impact on diarrhea morbidity. Given this, educated mothers without adequate facilities expected to take steps to ensure a healthy environment. This could, for instance, be done by decontaminating untreated water and disposing of faeces in a sanitary manner than their less educated counterparts and by so doing, reduce the vulnerability of their children. While it is true maternal education is a proxy for household resources as Ware (1984)[68] has pointed out, these results suggest it goes beyond that.

Strengths and Limitations of the Study

Strength

The data is community based rather than records reviewing which is common in under reporting in our situation. The study assessed the households' socioeconomic, environmental and behavioural characteristics that are considered to have effects on child health, in general, and childhood diarrhoea morbidity, in particular. Considering multiple contributing factors that affect child health may help use the limited resources more effectively, by identifying the

most important risk factors. The multiple factors considered in this study were analyzed using a hierarchical logistic regression technique. This technique helps control for mediating and confounding factors, and also to identify the most important risk factors for proper intervention. Census was made to have list of under five children and randomization was made.

Limitation

The outcome measure, diarrheal morbidity, was based on mothers' response (yes or no) to a question on whether a particular child had experienced diarrhea during the two weeks before the survey. There might be different perception on their child health as well the definition of diarrheal, but it was tried to give the definition of diarrhoea to the mother. The probability of recall and selection bias and as being cross-sectional in the design, this study shares the drawbacks of similar cross sectional studies.

The study was conducted in dry season (February) and probably might lower its prevalence as compared to early rainy season, and due to this the generalizability is limited to dry season.

CONCLUSION

From this study we can conclude the following points:

- The prevalence of under-five childhood diarrhoea was 18 percent.

- The strong explanatory covariates for variation in the level of diarrhoeal morbidity are the maternal education, latrine facility, maternal history of diarrhea, duration of breast feeding and age of the child.
- The highest risk of childhood diarrhoea was found in households without latrines facilities. When the analysis was stratified by maternal education, however, it became evident that children whose mothers were less educated were the most vulnerable in the absence of latrine facilities.
 - Highly educated mothers protect their children against diarrhea much better under poor environmental setting than their less educated counterparts. Given this, educated mothers without adequate facilities expected to take steps to ensure a healthy environment.
- There were no interaction effects of improved water source with maternal education, but there were interaction effects sanitation with maternal education on childhood diarrhea.

RECOMMENDATION

Overall, the findings have important policy implications for health intervention and support the view that investing in girls' education may have substantial benefits on child health and survival in our country. While the long term solution to reducing diarrhea might involve the provision of a better sanitation to the entire population, we have found that education provides a solution. Specifically, secondary or above level of education for girls must be achieved in order to improve childhood diarrhoea morbidity.

These problems may be alleviated in the long run, by integrated efforts of different sectors.

However, there are activities that can be performed before long-term solutions are obtained.

Taking this into consideration, the following recommendations are forwarded based on the findings of the study.

1. Thus effective educational programs that emphasize on hygiene and good home management practices such as the use of latrine, hygienic behaviour and importance of duration of breast feeding in child care practice should be strengthen to reduce child morbidity on diarrhea
2. Encouraging female school enrolment should be strengthen
3. Simple and "easy to understand" information to mothers/caretakers on how to care for a child especially when they (mothers) get illness should be provided.
4. Improve the environmental condition at the household level by providing continuous information more technical and minimal material support.

REFERENCE

1. WHO, *Network on Household Water Treatment and Safe Storage*. 2005.
2. Bern, C., et al., *The magnitude of the global burden of diarrhoeal disease: a ten-year update*. *Bulletin of WHO*, 1992. **70**: p. 705-14.
3. Kosek, M., C. Bern, and R.L. Guerrant *The magnitude of the global burden of diarrhoeal disease from studies published 1992-2000* *Bulletin of WHO* 2003. **81**: p. 197-204.
4. WHO, *Water, sanitation and hygiene : Public Health and the Environment*. 2007, Geneva: WHO.
5. WHO, *Child Health Research Project. Childhood diarrhoea in Sub-Saharan Africa. Special report*. Apr. 1998. **2**(1).
6. Ketsela, T., *Knowledge, and practice of mothers/caretakers towards diarrhoea and its treatment in rural communities in Ethiopia*. *Eth. Med. J*, 1991. **29**(4).
7. Bryce, J., et al., *The Child Health Epidemiology Reference Group. WHO Estimates of the Causes of Death in Children* *Lancet*, 2005 **365**: p. 1147-52.
8. Larson, P., et al., *Acute childhood diarrhoea. The ecology of health and disease in Ethiopia*. *West view Press Oxford*, 1993: p. 203-210.
9. *Central Statistics Authority & ORC Marco. Ethiopia Demographic and health survey. 2000: Addis Ababa. Ethiopia and Calverton, Maryland, USA*.
10. Mekasha, A., F. Lemma, and T. Shiferaw, *Child health problems in Ethiopia. EPHA Expert Group Report.*, in *Ethiop. J. Health Dev*. 1995. p. 189-192.
11. Shamebo, D., et al., *The Butajira Rural Health Project in Ethiopia: Mortality pattern of the under-fives*. *J.Tropical Pediatrics*, 1991. **37**: p. 254 - 61.
12. Shamebo, D., et al., *The Butajira Rural Health Project in Ethiopia: A nested case-referent (control) study of under-five mortality and its health and behavior determinants*. *Annals of Tropical Pediatrics* 1994. **14**: p. 201-209.
13. Freij , L. and S. Wall, *Exploring child health and its ecology: The Kirkos study in Addis Ababa*. *Acta Paediatrica Scandinavia*, 1977(Suppl. No. 267).
14. Mosley, W. and L. Chen *An analytic framework for the study of child survival in developing countries*. *Population and Development Review*. 1984. **10**: p. 25-48.
15. UNECA, *The impact of maternal and child health and family planning (MCH/FP) programmes on fertility, infant and childhood mortality and maternal health*. 1989: New York: UN
16. WHO/UNICEF., *Global Water Supply and Sanitation Assessment 2000 report*. 2000, Geneva: WHO.
17. Esrey, A., *Water, waste and well-being: A multicountry study*. *American Journal of Epidemiology* 1996. **143**(6): p. 608-623.

18. Mulugeta, T., *socio-economic, environmental, and behavioral factors associated with the occurrence of diarrheal disease among under five children , Meskana Mareko Woreda, souther Ethiopia, in community health. 2003, AAU: Butajira.*
19. Kirkwood, B.R. and *Diarrhoea. In Feachem, R.D, Jamison,D.T (eds): Disease and mortality in Sub-Saharan Africa. New York. Oxford University Press, 1991: p. pp. 134-57.*
20. Manun'ebo , M., *et al., Influence of demographic, socioeconomic, environmental variables on childhood diarrhoea in a rural areas of Zaire J. Trop. Med. Hyg, 1994. 97(1): p. 31-38.*
21. Yohannes, A.G., K. Streatfield , and L. Bost, *Child morbidity patterns in Ethiopia Journal of Biosocial Science, 1992. 24: p. 143-155.*
22. *Child Health in Ethiopia, in Background Document for the National Child Survival Conference. April 22-24, 2004: Addis Ababa, Ethiopia.*
23. *Central Statistics Authority & ORC Marco. Ethiopia Demographic and health survey 2005. 2006: Addis Ababa. Ethiopia and Calverton, Maryland, US.*
24. Tesfaye, F., *et al., ORS usage in acute childhood diarrhoea, Adami-Tulu Woreda. Ethiop. Med. J, 1996. 34(3).*
25. Getaneh, T., *Diarrhoea morbidity in urban area of Southwest Ethiopia East. Afr.Med. J. , 1997. 74(8): p. 491-494.*
26. Kaba, M. and F. Ayele, *Ethnographic study of diarrhoeal disease among under-five children in Mana District, Jimma Zone, Southwest Ethiopia Ethiop. J. Health Dev., 2000. 14(1): p. 77-83.*
27. Teklemariam, S., T. Getaneh, and F. Bekele .*Environmental determinants of diarrhoea morbidity in under-five children. Keffa-Sheka Zone. Southwest Ethiopia. Ethiop. Med. J., 2000. 38(1): p. 27-34.*
28. Ali , M., *et al., A communitybased study of childhood morbidity in Tigray, Northern Ethiopia. Ethiop. J Health Dev, 2001. 15(3): p. 165-172.*
29. Kung'u, W.N., *et al., Diarrhoea prevalence and risk factors in slums J. Nat. Inst. Public Health, 2002. 51: p. 73-76.*
30. Teran, M.M., *Early feeding patterns and children's health in Mexico in DHS World Conference. August 5-7 1991: Washington, D. C. p. pp. 451-74.*
31. Daniels, D.L., S.N. Cousens, and L.N. Makoae, *A case-control study of the impact of improved sanitation on diarrhoea morbidity in Lesotho. Bulletin of WHO, 1990. 68: p. 455-63.*
32. Timaeus, I. and L. Lush, *Intra-urban differentials in child health Health Trans Rev, 1995. 5: p. 163-190.*
33. McGranahan, G., *et al., Environmental change and human health in countries of Africa, the Caribbean and the Pacific. Stockholm:.. Stockholm Environment Institute, 1999.*
34. Feachem, R. and M. Koblinsky *Interventions for the control of diarrhoeal diseases among young children: promotion of breast-feeding Bull World Health Organ, 1984. 62(2): p. 271-29.*

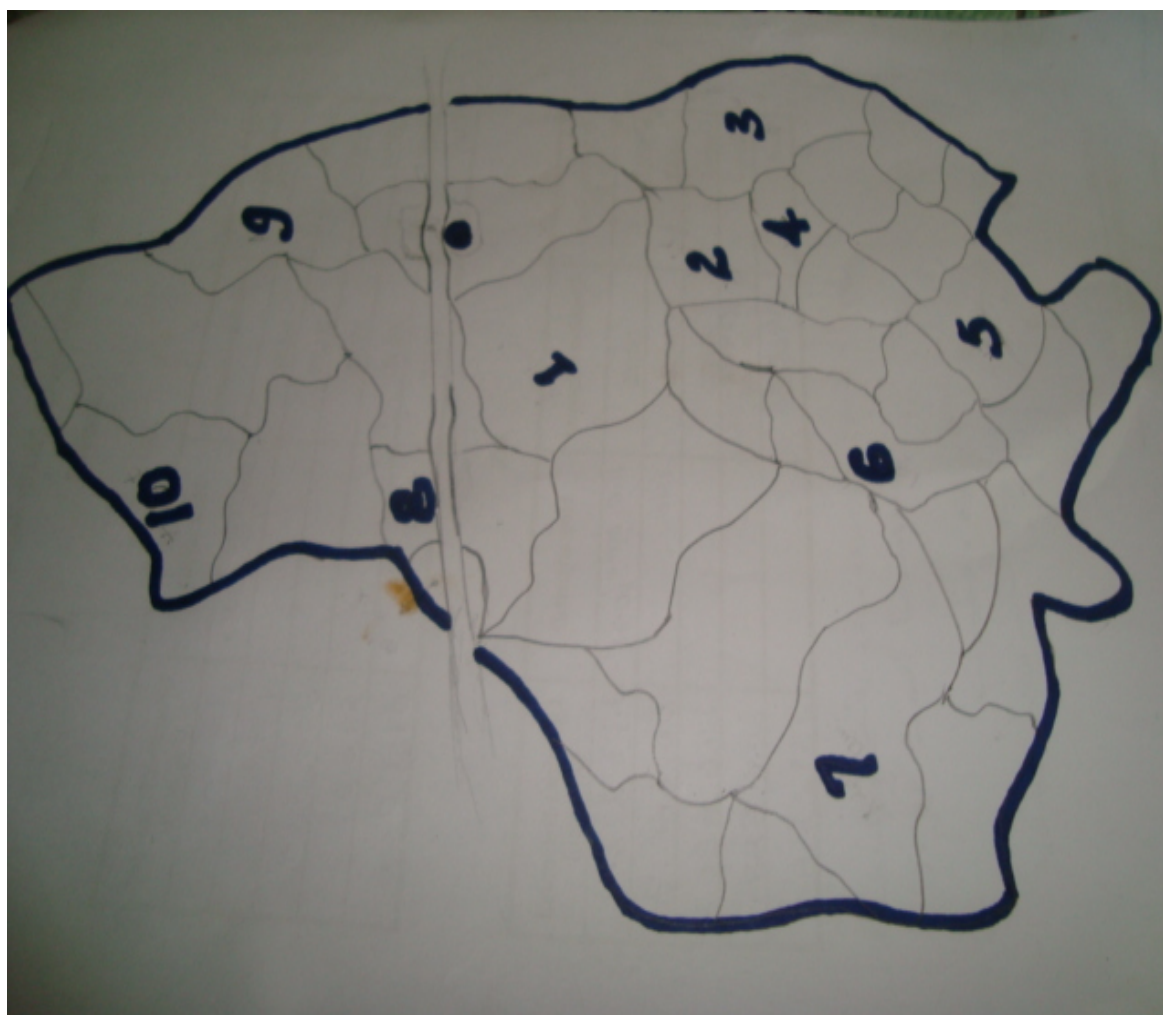
35. Woldemicael, G., *Diarrhoeal morbidity among young children in Eritrea: Environmental and Socio-economic determinants. Journal of Health, Population and Nutrition, 2001. 19(2): p. 83-90.*
36. Mock , N., et al., *Socioeconomic, environmental, demographic and behavioural factors associated with the occurrence of diarrhoea in young children. Soc. Sci. Med, 1993. 36(6): p. 807-816.*
37. Huttly, S.R.A., et al., *The epidemiology of acute diarrhoea in a rural community of Imo State, Nigeria. Trans. R. Soc. . Trop. Med. Hyg., 1987. 81: p. 865-70.*
38. Curtis, V., S. Cairncross, and R. Yonli, *Domestic hygiene and diarrhoea - pinpointing the problem. Trop Med Int Health, 2000. 5(1): p. 22-32.*
39. Tagoe, E., *Maternal education and infant/child morbidity in Ghana: The case of diarrhea: evidence from the Ghana DHS. In Paulina, M. and J. An-Magritt, eds., Women's Position and Demographic Change in sub-Saharan Africa. Liege, 1995. IUSSP.*
40. Mensah, P., *Persistent diarrhea in Ghana. A. 1997, report submitted to the Japan International Development Agency (JICA).*
41. *GOVERNMENT OF ETHIOPIA: Report on Progress in Implementing the World Fit for Children Plan of Action in Ethiopia. June 2007: Addis Ababa.*
42. Ahiadeke, C., *Breastfeeding, diarrhoea and sanitation as components of infant and child health: A study of large scale survey data from Ghana and Nigeria. Journal of Biosocial Science, 2000. 32: p. 47-61*
43. WHO, *Press Release. Opening Today of Bangkok Conference Marks New Initiative to Fight Child Mortality and Morbidity linked to Unhealthy Environments. 2002.*
44. WHO, *Drinking water: A determinant of health, world health forum WHO. 1983: Geneva. p. 172.*
45. Esrey, A., et al., *Health benefits from improvement in water supply and sanitation: Survey and analysis of literature on selected diseases. Bulletin of the WHO, 1991. 69(5): p. 609-621.*
46. Root, G.P.M., *Sanitation, community environments, and childhood diarrhoea in rural Zimbabwe. Journal of Health, Population and Nutrition, 2001. 19 (2): p. 73-82.*
47. Esrey , S., R. Feachem , and J. Hughes, *Interventions for the control of diarrhoeal diseases among young children: improving water supplies and excreta disposal facilities. Bull World Health Organ, 1985. 63(4): p. 757-772.*
48. Amonoo-Lartson R., G.J.E., H.J. Lovel, *District health care: challenges for planning, organisation and evaluation in developing countries. Hong Kong: MacMillan. 1985.*
49. Cerrutti, M., *Intermittent employment among married women: a comparative study of Buenos Aires and Mexico. J. Compar. Fam. Stud, 2000. 31: p. 19-45.*
50. Ehiri, J.E., *Infant and child mortality in Nigeria: the role of socio-economic factors (Dissertation), Swansea: University of Wales. 1993.*

51. *Togunde, O.R., Determinants of women's employment in urban Nigeria: the impact of socio-economic factors. J. Asian Afr. Studies, 1999. 34: p. 279-97.*
52. *WHO/UNICE, Improved water source and sanitation, in Wikipedia free encyclopedia. 2008.*
53. *Mock NB, S.T., Abdoh AA & Franklin RR, Socioeconomic, environmental, demographic and behavioural factors associated with the occurrence of diarrhoea in young children. Soc. Sci. Med, 1993. 36(6): p. 807-816.*
54. *Abaire, B., CRS Experience on Water Supply and Sanitation 2004, Addis Ababa, Ethiopia: Catholic Relief Services Ethiopia Program.*
55. *Ezra M , G.E., Breastfeeding, birth intervals and child survival: analysis of the 1997 community and family survey data in southern Ethiopia. Ethiop. J. Health Dev., 2002. 16(1): p. 41-51.*
56. *Faris kebede , K.M., Hygienic behavior and environmental conditions in Jimma town, Southwest. Ethiopia. Ethiop. J. Health Dev. , 1999. 13 (2): p. 77-86.*
57. *Federal Democratic Republic of Ethiopia Population census commission and housing census Results of Ethiopia .Addis Ababa. Ethiopia 2008.*
58. *Pagano M , G.K., Principles of Biostatics, Second Edition, Pacific Grove, United States of America. 2000.*
59. *WHO/UNICE, Core questions on drinking-water and sanitation for household surveys. 2008: p. 6-19.*
60. *Victoria CG, H.S., Fuchs SC , Olinto MTA., The role of conceptual frameworks in epidemiological analysis: A hierarchical approach. Int. J. Epid, 1997. 26(1): p. 224 -227.*
61. *Teklemariam, S., T. Getaneh, and F. Bekele Environmental determinants of diarrhoea morbidity in under-five children.Keffa-Sheka Zone. Southwest Ethiopia. Ethiop. Med. J., 2000. 38(1): p. 27-34.*
62. *Mitike, G., Prevalence of acute and persistent diarrhoea in North Gondar Zone, Ethiopia. East Afr. Med. J. , Aug. 2001. 78(8): p. 44-48.*
63. *Kwasi Owusu B, M.K., Childhood diarrheal morbidity in the Accra Metropolitan Area, Ghana: socio-economic, environmental and behavioral risk determinants. journal of health and population indeveloping countries, 2003.*
64. *World Resources Institute World Resources 1998-99: A guide to global environment. Environmental change and human health. New York: Oxford University Press. 1998.*
65. *Ketema L, L.S., Persistent diarrhoea: socio-demographic and clinical profile of 264 children seen at a referral hospital in Addis Ababa Ethiopian Med. J. , 1997. 35 p. 161-68.*
66. *Alam, N., Predictors of diarrhoea in young Bangladeshi children. J. Trop. Paediatr. . (1995. 41: p. 7-14.*
67. *Habtemariam, G., Determinants of Child Health and Survival in Central Ethiopia. Thesis., in School of Hygiene and Tropica. 1994 London l Medicine.*

68. Ware, H., *Effects of maternal education, women's roles and child care on child mortality*. Pp 191-214 in Henry Mosley and Lincoln C. Chen (eds.) *Child Survival: Strategies for Research*. The Population Council: New York, 1984.

ANNEXES

ANNEX 1. MAP OF MECHA WOREDA, INDICATING THE STUDY SITES FEB. 2009.

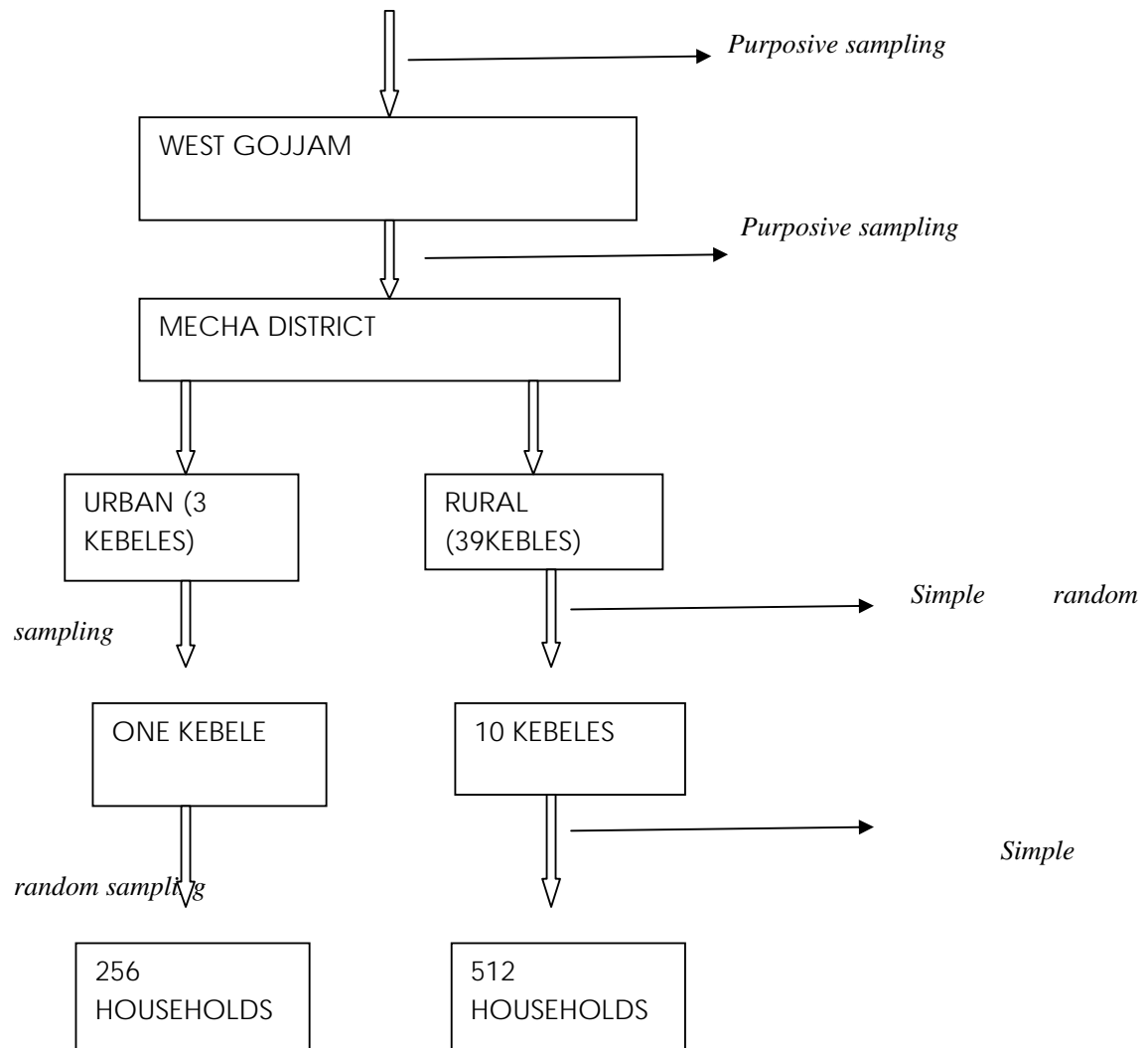


KEYS:

<i>S.NO.</i>	<i>Kebele name of the woreda</i>	<i>Data collector</i>
0	Merawi town	Abebe Worku, Girma Dessalegn, Awulew
1	Kudmie	Tilahun
2	Kurt Bihar	Mengie
3	Tatek	Girma M.
4	Mider Genet	Alehgn
5	Yinesa lemert	Habtamu
6	Selam lehulem	Getaneh
7	Addis Alem	Minuyelet
8	Ambo mesk	Mengaw
9	Andenet	Yibel M
10	Edeget behibiret	Girmaw W

ANNEX2: SCHEMATIC REPRESENTATION OF THE SAMPLING PROCEDURE

AMHARA



ANNEX 3: CONSENT FORM

Hello! My name is I am here on behalf of Muluken Dessalegn student of the School of Public Health, Addis Ababa University. He is conducting a research for the partial fulfilment of second degree on “the interactive effects of drinking water, sanitation facilities and maternal education in childhood diarrhea among children under five in Mecha Woreda. Therefore, I am going to ask you several questions about drinking water and sanitation services and related issues about the research.

I have received permission from the Addis Ababa university medical faculty school of public health, Woreda council office and respective health offices to conduct this study. The interview will just take 20-30 minutes. Your responses will help for both governmental and nongovernmental who works water and sanitation child health program implementers to better understand your needs.

Your household was randomly selected to participate in this study and there are other 768 households that selected randomly in the woreda. The information from this interview will not be used for other purposes by any of the institutions and individuals without your agreement. Additionally, your participation is voluntary and you have the right to not participate fully or partially. Your answers will be completely confidential, and if at any time during the interview you want to stop answering questions, you are free to do so. Would you be willing to participate?

Yes1 No2

Generally, I have been explained about this research study and I have understood the same. And, I hereby agree to participate in this research study and give my voluntary consent.

Respondent

Sign _____

Date _____

Interviewer

Name _____

Signature. _____ Date of interview _____

ANNEX 4: QUESTIONNAIRE

Questionnaire ID----

ADDIS ABABA UNIVERSITY MEDICAL FACULTY SCHOOL OF PUBLIC HEALTH

QUESTIONNAIRE PREPARED TO ASSESS WHETHER THE EFFECTS OF DRINKING WATER AND SANITATION FACILITIES VARY BY MATERNAL EDUCATION ON CHILDHOOD DIARRHOEA MORBIDITY OR NOT AMONG CHILDREN UNDER FIVE IN MECHA WOREDA, WEST GOJJAM, 2008/09.

How to approach and interview households:

- You will be given the name (ID) of the household head and the house number that is going to be interviewed.
- Once you get the household, you should get permission to enter in to the house. Do not rush in to the house without the permission of the household members.
- Introduce yourself by name, and explain the purpose of your visit.
- Tell the household member “*WHY*” and “*HOW*” the household is selected for the study.
- Ask whether the mother/caretaker of the child is present.
- If the mother/caretaker is there, briefly explain the purpose of the study by reading what is written on the questionnaire, and ask for her consent.
- If the mother/caretaker is not around, take an appointment for another visit.
- At the end of the interview, tell the respondent that it is the end of the interview, and thank the individual for giving her/his time.

THANK YOU FOR YOUR COOPERATION

Name of interviewer:

Supervisor.....

Date:

House number or code:

Q001.Residence/ Address

- Rural :
 - Kebele:
 - House No.....
 - Village:.....
- Urban:
 - Kebele:
 - House No.....
 - Village:.....

Time started: Time ended:

PART I. SOCIOECONOMIC CONDITIONS

S. No	Questions	Choice of responses	Skip	Code
002	Relation of the respondent to the child	1.mother 2.caretaker		
003	Age of the respondent (mother/caretaker)			
004	Have you been living 6months continuously in that residence	1. yes 2. no		
005	Family size of the household			
006	What is your highest level of education?	1. Illiterate 2.Read and write 3.1-4 4.5-8 5.9-12 6.12+		
007	What is your occupation (mother/care taker)?	1.government employee 2. Housewife 3. Merchant 4. Farmer 5. prepare alcohol 6. daily labour 7. Others (specify).....		
008	Marital status of the mother/caretaker	1. Married 2. Divorced 3. Single 4. Widowed	Q13	
009	Age of the child's father in Years			
010	Educational level of the father	1. Illiterate 2.Read and write 3.1-4 4.5-8		

		5.9-12 6.12+		
011	What is the occupation of husband	1. Government employee 2. Merchant 3. Farmer 4. No job 5. daily labour 6. craft 7.(specify)...others		
012	What is your religion?	1. Orthodox 2. Muslim 3. Catholic 4. Protestant 5. Others (specify)....		
Q13	The wealth of the family	1. radio 2. TV 3.bicycle 4. Telephone		
014	Main source of income	1. Agriculture 2. Trade 3. Craft 4. Salary 5. Others		
Q15	Does the family have a functional radio?	1.yes 2.no		
016	Does the family have livestock	1.yes 2.no		
017	If yes, for Q16, list number & type of livestock?			

List all under-five children present in the household

S. no	Sex of child	Age of child		Diarrhea in the past two weeks**
		Years	months	

** Mark “√” if the child has diarrhoea, and mark “X” if he hasn’t

PART II. ENVIRONMENTAL HEALTH CONDITIONS

Q200A. Water Supply

S. No	Questions	Choice of responses	Skip	code
201	Type of drinking water sources			
	Spring,	1. Yes 2. No		
	Well	1. Yes 2. No		
	Public stand posts	1. Yes 2. No		
	Yard taps	1. Yes 2. No		
	River /dams	1. Yes 2. No		
202	Distance from the house to the water source (Minutes)			
203	How many times did you collect water for drinking yesterday?			
204	Is the source of water currently working?	1. Yes 2. No		
205	Type of water collection container			
	Jerry can	1. Yes 2. No		
	Pails(bucket)	1. Yes		

		2. No		
	Pots	1. Yes 2. No		
	Others (specify).....			
	Average capacity of container in household(liters)			
206	Method of drawing of water from the storage container			
	1. Dipping	1. Yes 2. No		
	2. Pouring	1. Yes 2. No		
	3. Others (specify).....			
207	Is there a separate can for taking drinking water from the storage container? (ask the mother/care taker to show you)	1. Yes 2. No		
208	Covering material is used during transportation	1. Yes 2. No		
209	Frequency of washing collection containers and others			
210	When is strict care while handling water?			
	1. Fetching	1. Yes 2. No		
	2. Transporting	1. Yes 2. No		
	3. Storing	1. Yes 2. No		
	4. Drinking	1. Yes 2. No		
	5. Others			
211	Do you treat your water in any way to make it safer to drink?	1. yes 2. no		

212	What do you usually do to the water to make it safer to drink?	1. boil 2. Add bleach/chlorine? 3. strain through a cloth 4. Anything else 5. Others (specify)...		
-----	--	---	--	--

Q200B. Sanitation services

S. No	Questions	Choice of responses	Skip	code
216	Do you have latrine facility?	1. Yes 2. No —————→	225	
217	Ownership of the latrine	1. Privately owned 2. Shared with neighbours 3. Others (specify).....		
218	Is faeces seen around the pit-hole (or on the floor)? (OBSERVATION)	1. Yes 2. No		
219	Is faeces seen around the house (or in the compound)? (OBSERVATION)	1. Yes 2. No		
220	Type of latrine facility (observation)	1. Traditional pit latrine 2. VIP latrine 3. Public Latrine 4. Communal latrine 5. Others (specify)....		
221	Does the latrine currently functioning	1. Yes 2. No		
222	How far away is the latrine that your household most frequently uses, one-way walking distance in meters?			
223	Do you share the latrine with your neighbours?	1. Yes 2. No		
224	How many other households use the latrine?			
225	If the family has no latrine, where do you dispose human	1. Open field		

	waste?	2. Other (specify)		
226	How do you dispose refuse?	1. Pit 2. Burning 3. Open field 4. store in Garbage can 5. Other		
227	Type of floor material of the living house (OBSERVATION)	1. Mud 2. Cement 3. Wood 4. Other (specify)		
228	Type of roof material of the living house (OBSERVATION)	1. Thatched 2. Corrugated iron sheet 3. Other (specify)		
229	Animals live in the same house where the members of the family live? (OBSERVATION)	1. Yes 2. No		
230	Number of rooms in the house			

PART III. BEHAVIORAL ASPECTS

S. no	Questions	Choice of responses	Skip	code
301	Did you wash your hands yesterday?	1.yes 2.no	302	
	At what point/time?	1. Before food preparation and eating 2. After eating 3. After visiting latrine 4. After cleaning of child bottom		
	By using what did you wash hands yesterday?	1. Soap & water 2. Ash & water 3. Only water 4. Others (specify).....		
302	How old were you at your index child			

	birthday?			
303	Do you separately prepare food for the child, using a separate material?	1. Yes 2. No		
304	What do you use to feed the child?	1. Hand 2. Cup and spoon 3. Cup 4. Bottle 5. Other		
305	Do you know that flies can transmit diseases?	1. Yes 2. No		
306	If “Yes”, can you tell me the name of the diseases?	1. Diarrhoea 2. Typhoid fever 3. Cholera 4. Trachoma 5. Do not know the names 6. Other (specify)....		
307	Do you know that excreta of children can be a cause of diseases?	1. Yes 2. No		

PART IV. INFORMATION OF THE INDEX CHILD

Index Child: Ask the mother/caretaker about the child with diarrhoea, or if there is no child with diarrhoea, ask about the child who is younger than others.

Diarrhoea- is defined as having three or more loose or watery stools in a twenty-four hours period, as reported by the mother/caretaker of the child

S.no	Questions	Choice of responses	Skip	code
401	Age of the index child (Months)			
402	Sex of the index child	1. Male 2. Female		
403	Birth order of the child	1. First 3. Third 2. Second 4. Fourth & above		
404	Do you (the mother/caretaker) have a history of <i>diarrhoea in the past two weeks</i> ?	1. Yes 2. No		

405	Have you ever breast-fed your child?	1. Yes 2. No		
406	For how long did you breastfed your child?			
407	What is his/her current breastfeeding status?	1. Exclusive breastfeeding 2. Partial breastfeeding 3. Not breastfeeding		
408	At what age the child started supplementary /weaning food?(Months)			
409	Did the child receive measles vaccination? Ask for children of age greater than nine months	1. Yes, (response of the respondent) 2. Yes, (by checking the card) 3. No		
410	Does your child have/had diarrhoea?	1. Yes 2. No	end	
411	For how long the diarrhoea last?	1. Less than 14 days 2. Greater than 14 days		
412	If the child has diarrhea today, how many times a day he/she passes stool?	1. Three times 2. More than three times 3. Don't know		
413	The type of diarrhoea that the child had	1. Watery 2. Blood and mucus 3. Others (specify).....		
414	What actions do you take to treat/stop the diarrhoea?	1. Take him/her to health institution 2. Take him/her to traditional healer 3. Increase feeding 4. Give him/her ORS 5. Give him/her cereal based fluids 6. Stop/decrease feeding 7. Homemade treatment 8. Other (specify).....		

ANNEX-5: _____

/

768

20-30

/

:

?

.....1

.....2

- -----

- -----

ANNEX-6

›Ç=e ›uv ĭ'›y`e+

I;U“ ó”M+ ¾Iw[}cw Ö?“ fUΓ f u?f

¾SÖØ “<H ¾SìCÍ u?f “ ¾ “ „, ¾fUΓ f ÅÍ Ý>Uef -Sf ÉT@ u < vK< Ií“ „, ¾T>Ýc}“<”
¾}pTØ ui LÄ ¾T>•^†“<” >e}“iī KT·p ¾}²ÖË SÖÄp::

nKSÖÄI” ÝSËS`- uðf ¾T>Ý}K<f” ’Øx< >e}“<K<

- KØ“~ ¾}S[Ö“< u?f IØ` nKSÖÄI” ÝSËS`I/i uðf SÁ`T”/i” ›[ÖÓØ/B::
- ¾S[Ö“<” u?f “Ñ-I/i “Å “<eØ KSÓvf SËS]Á ðnÉ TÓ-f ›KwI/i ' ðnÉ d Ñ~ “Å “<eØ SÓvf uðèU ¾}ÝKÝK ”“<::
- nK SÖÄp “Å H@É;uf u?f “<eØ LK c“< ^eI”/i” >e}“p/m ¾S×Iuf”/i” ›LT “ u?~ ”Èf “Å}S[Ö“ KU” “Å}S[Ö >e[Ç::
- ÁÑ-æ“<i”< c“< ¾Ií’< “f/>dÇÑ> “MJ’ ¾Ií’<” “f/>dÇÑ> ”Ç=ÁÑ“<- ÖÄp/m::
- ¾Ií’<” “f/>dÇÑ> ðnÅ— ÝJ’< ¾eUU’f ð`T“<” >eð`U/T>
- nKUMMc<” ”ÁÚ[eI/i }“Ó[I/i ÓKcu<”/u?}cu<” >SeÓ’I/i “Å T>kØK“< u?f H>É/H>Í=::
 - S[Í“<” ¾T>Wucu“< eU _____
 - ¾T>W^“<” ¾T>Ý }K“</c<ø` yÄ²/eU _____

- k” _____
- ¾u?f SKÁ IØ` _____

001: >É^h

ÑÖ`

ÿIT

- kuK? _____ - kuK? _____
- ÑAØ/S”Á`/cð` _____ - S”Á`/cð`/ÑAØ _____
- ¾u?f IØ` _____ - ¾u?f IØ` _____

nKSÖÄI ¾}ËS[uf c` f _____ ¾}Ö`kku f c` f _____

¡öM >”É` TIu^© “>=ç•T>Á© G<’ @ -<

}.1	ØÁo-<	>T^B SMf<	Ã²KM
002	nKSÖÄp ¾}Á[Ñ`< ÝIí`< Ò` ÁK`< Ó`<-<’ f	1. “f 2. >dÇÑ>	
003	¾Ií`< “f/>dÇÑ> ÉT@		
004	KU” ÁIM Ñ>²? ux “< qÃ}ªM		
005	¾u?}cw w³f		
006	¾Ií`< “f/>dÇÑ> ¾fUT f ÁÍ	1. U”U ÁM}T[2. T”uw“ Síö ¾Uf<M 3. /0-4/ 4. 5-8 5. 9-12 6. 12	
007	¾Ií`< “f/>dÇÑ> ¾e^ G<’ @	1. ¾S”Óef c^}— 2. ¾u?f Su?f 3. `ÒÈ 4. Ñu_ 5. K?L /ÃÖke/	
008	¾Ií`< “f/>dÇÑ> ¾Öw%o G<’ @	1. ÁÑv< 2. ¾}ó < 3. ÁLÑv< 4. vLDuVf ¾}KÁf	
009	¾Ií`< >vf ÉT@		
010	¾Ií`< >vf ¾fUT f ÁÍ	1. U”U ÁM}T[2. T”uw“ Síö 3. 0-4 4. 5-8 5. 9-12 6. 12+	
011	¾Ií`< >vf ¾e^ G<’ @	1. ¾S”Óef c^}— 2. `ÒÈ 3. U”U e^ ¾K?K`< 4. Ñu_ 5. K?L /ÃÑKê/	

012	¾If' < "LD</>dÇÑ>-< GÄT•f	1. * „,Ëje 2. SeK=U 3. " „,K=i 4. -a,e "f 5. K?L	
	¾If' < u?}cx< ÄL†"< "w[f G. _Ç=Ä K. +y= N. >MÒ S. eMj W. ¾ÓM S•]Á u?f [. ¾ÿ=^Ä u?f		
014	““ ¾Ñu= U”ß	1. Ów`“ 2. "ÓÉ 3. ¾ ÄØuw c^}— 4. ÄV`}— 5. K?L /ÄÖke/	
015	u?f " <eØ ¾T>W^ ^Ç=Ä >K	1. >^/K 2. ¾KU	
016	u?f " <eØ "ed} uÓ:u_ LU >K	1. >K 2. ¾KU	
017	SMe- >- ÿJ' KØÁo @16 e" f “ U” >Ä' f "edf		

uu?~ " <eØ ÄK< ÿ>Uef>Sf u < Í" f ^ ^

.1	¾If" eU	¾If" ë	ÉT@	* u>G<" Ñ>? If' < }pTØ Äµ M?
1				
2				
3				
4				

* If' < }pTØ Äµ f ÿJ' ÄI" UMif >É`Ó/Ñ> ✓
If' < }pTØ "MÁ²< ÄÓV ÄI" >É`Ó/Ñ> ✗

ïöM G<Kf ¾>"vu= Ö? " G<' @

200G: ¾" <H >p`xf

.1	ØÁo-<	>T^ß SMf<	Ä²KM
201	¾}Öuk" < ¾" <H - Ä' f		
	U"ß	1. >- 2. >ÄÄKU	
	¾Ñ<ÉÖÉ	1. >- 2. >ÄÄKU	

	¾I'w x•	1. >- 2. >ÃÅKU	
	vD''Vd	1. >- 2. >ÃÅKU	
	K?L ÃÖke		
202	uu?~ “ uT>kÆuf “<H S"ŸM ÁK“< Å`f SMe `kf U” ÁIM ”“<?	Ämn	
203	¾T>Ö× “<H uk” e”f Ñ>? f””f kÉ}”M		
204	¾“<H >ÑMÓKAf ¾T>ÖkS<f >G<” Ãc^M	1. >- Ãc^M 2. ¾KU >Ãc^U	
205	uf””f””< °Kf KSÖØ ¾T>J” “<H ”Å u?f kÉ}”< uU” ”“< ¾”WÆf	1. Èj”” 2. vMÇ= 3. ”e^ 4. K?L/ÃÑKê/	
206	¾SÖØ ¾T>J””< “<H ÿTÖ^kT>Á”< ”Èf ”“< ¾T>kÆf	1. uSØKp 2. uT”q`q`	
207	¾SÖØ “<H TÖ^kT>Á w%o ¾T>J” °n >K/ ”Ç=Ád;I/i ÖÃp/m	1. >- 2. ¾KU	
208	“<H kÉ}”< “Å u?f c=ÖÖ²< ;Ç” ÃÖkTK<?	1. >- 2. ¾KU	
209	¾“<H TÖ^kT>Á”< n e”f Ó²? uk” Å ÖvM		
210	K”<H Ø”no ¾T>ÁÅÑ~<f SŠ LÃ ”“<	1. “<H c=kÆ 2. cÁÖÑ~<²< 3. c=ÁÖ^pS< 4. c=ÖÖ< 5. K?L ÃÑKî--	
211	“<H”<” ”èI KTÉ[Ó Á;S< M	1. >- 2. ¾KU	
212	“<H”<” ”èI KTÉ[Ó/KTÿU/ ¾T>ÖkS<uf U”É” ”“<	1. TöLf 2. ¾“<H T×]Á SÉH’>f SÚS` 3. TØKM 4. “<H >Ò` 5. K?L /ÃÑKî/	

200K: SçÇÍ u?f Ò` ¾}ÁÁ² >ÑMÓKAf

.1	ØÁo	>T^B SMf<	Ã²KM
216	u?}cu< SçÇÍ u?f	1. >K”< 2. ¾K”<U/SMe ¾KU ÿJ’ ”Å	2®®
217	¾SiÇÍ u?f ¾vKu?f’f G<’ @	1. ¾ÓM 2. ¾Ò^ ÿÑ<[u?f Ò`	

		3. K?L ÄÖke	
218	¾SiÇÍ u?~ >"vu= ¾c"< - Ä'UE` Ä ÄM?/>"vu="< uSSMÿf ¾T>SKe/	1. >- 2. ¾KU	
219	uS•]Á u?~ >"vu= ¾c"< >Ä'UE` Ä ÄM/>"vu="<" uSn-f ¾T>SKe	1. >- 2. ¾KU	
220	SiÇÍ u?f ÿK?K u?}Wu< ¾f ÄÖkTM	1. uT@Ç 2. K?L/ÄÑKê/	
221	Ä[p qhh" "Èf Äe"ÓÇK<	1. uÑ<ÉÖÉ "eØ 2. vTnÖM 3. u¾T@Ç"< 4. u n >Ö^pV K?L x ÄÄóK< 5. K?L/ÄÑKê/	
222	¾SiÇÍ u?~ >Ä'f /uSSMÿf ¾T>SKe	1. Ñ<ÉÖÉ ;Ç" w%o ÄK"< 2. >¾` TeÑu=Ä ÄK"< Ñ<ÉÖÉ 3. ¾I'w 4. K?L/ÄÑKê/	
223	SçÇÍ u?~ u>G<'< c>f >ÑMÓKf ÄW×M	1. >- 2. ¾KU	
224	SçÇÍ u?~ ÿS•]Á u?~ U" ÄIM Ä`nM/u'UÍ SK"f/		
225	SiÇÍ u?~" ÿK?L ÑA[u?f Ò` uÖ^ ÄÖkTK<	1. >- 2.¾KU	
226	SiÇÍ u?~" ÿe" f ÑA[u?f Ò` "'< uÖ^ ¾T>ÖkS<uf		
227	¾u?~ "KM G<'@ /uT¾f ¾T>SKe/	1. >ð` 2. c=T>" 3. "Úf/x"<L/ 4. K?L ÄÖke	
228	¾S•]Á u?~ ×]Á ¾}W^uf /uT¾f/	1. d` ;Ç" 2. q`qa 3. K?L/ÄÑKê/	
229	"cdf uu?f "<eØ ÿc-< Ò` >w["< Ä•^K</u?~" uT¾f ¾T>SKe/	1. >- 2.¾KU	

230	uu?f¨<eØ ÁK<¾;õKAf w³f		
-----	------------------------	--	--

ïõM 3 ¾MUÉ“ ¨kf Ò ¾}ÁÁ² ØÁo

301	Ï-” f“”f“ Øu¨<’u` ?	1. >- 2. ¾KU →	3@2
	SMc- >- ÝJ’ U” c=ÁÁ`Ñ</c=c\¨¨<¾ Öu<f />T^B >ÃeÖ</	1. UÓw ÝT²ÖËf- uðf 2. UÓw ÝSwLf- uðf 3. Ý}SÑu< u%EL 4. If’<” ÝSSÑw- uðf 5. If’<” ÝìÉ u%EL 6. K?L ÃÑKî	
	uU”¨¨< Ï-” ¾T> Öu<f	1. udS“ 2. >SÉ 3. u¨<H w%o 4. K?L ÃÑKî	
302	KØ“~ ¾}S[Ö¨<” MÏ-” c=¨MÆ ÉT@- e”f’u`?		
303	KIf’< ¾T>J” UÓw T²ÓÍ Kw%o n >K	1. >- 2. ¾KU	
304	If’<” uU”¨¨< ¾T>SÓu<f	1. u Ï 2. T”Ý=Á 3. Ý<vÁ 4. Ö<Û	
305	¨w ui ¨ÁU e}LMð ¨ÁUf<M Á¨<nK<	1. >- 2. ¾KU →	307
306	SMc-/305/ >- ÝJ’ U” >Á’f M e}LMð f<LK<	1. fpTØ 2. ÃöÃÉ 3. >}f/çK?^/ 4. f^çT/¾>Ã” ui / 5. >L¨<pU 6. K?L	
307	¾If” >Á’UE` ¾ui S¨e>? K=J” ¨ÁT><M Á¨<nK<::	1. >- 2. ¾KU	

308	U” ui ÅØkc<		
-----	-------------	--	--

jõM 4 eK Ií’< >ÖnLÄ S[Í

.1	ØÁo-<	>T^B SMf<	Ä²KM
401	¾Ií’< ÉT@	“	
402	¾Ií’< ë	1. “É 2. c?f	
403	Ií’< K “f¾ª e”}— MĪ”’<	1. >”Ä— 2. G<K}— 3. fe}— 4. >^}— “ÿ²Á uLÄ	
404	“f¾ª/dçÑ> vKð”< G<Kf dU”f Ñ>²? ”<eØ }pTØ Ä³D†”< ’u’?	1. >- 2. >MÁ²U	
405	Ií’< Ÿ}”KÄ EÜa Ö<f Öw,, Á”<nM	1. >- 2. >Á”<pU	
406	Ií’< Ke”f Ñ²? ÁIM Ö<f Öv	“	
407	u³” Ñ>²? ÁK”< ¾Ö<f >SÒÑw G<’ @	1. ¾ “f Ö<f ”}f w%o ”’< ¾T>SÑu”< 2. uÿðM ¾Ö<f ”}f ÄSÑvM 3. ¾ “f Ö<f >ÄSÑwU	
408	Ií’< ÉT@”< e”f ” c=J” ”’< }ÚT] UÓw ¾ÄS[”<?	“	
409	Ií’< ¾Ÿ<ð~ SŸLYÁ jfvf }ŸfxªM?/Ÿ²Ö~ ” uLÄ LK Ií’“f w%o ¾T>Ö¾p/ ¾jfvf ”É ”K Ÿ”Æ Ò` ÁSd;	1. >ªŸSLg< ¾}Ñ- 2. >ª”Æ ¾}Ñ- 3. >M}Ÿ}uU	
410	Ií’< }pTØ 14 k” ”Ç=I Äµf Á”<nM	1. >- 2. >MÁ²”</SMc< >MÁ²”<U KJ’ ¾k}f” ØÁo-< Kó†”</	ØÁoI’ Ú’e
411	}pTØ Ke”f Ñ>²? q¾uf	1. Ÿ14 k” u < 2. Ÿ14 k” uLÄ	
412	uk” ”<eØ e”f Ñ>²? ÁekUÖªM	1. fef Ñ>²? 2. Ÿfef Ñ>²? uLÄ 3. >L”<k”<U	
413	U” >Ä’f }pTØ ”’<?	1. ”Ä ”<H ¾kÖ’ 2. ÄU” SÓM ¾}kLkKuf 3. K?L/ÄÑKê/	
414	}pTÖ<” KTqU KIí’< U” >É`Ñ”<K M?/T^à< > ”wwL†”< Ÿ>”É uLÄ SMe K=• ÄLM/	1. ”Ä Ö?” ÉĪf ”cĪªKG< 2. ”Ä vIM I;U” ”eĪªKG< 3. ”fa” ŸT>uL”< UÓw }ÚT] eÖªKG< 4. *.>.>?e eÖªKG< 5. Ÿ}ðÚ Ø^Ø_ ¾}²ÖË ðdi eÖªKG< 6. Ÿ”fa”< ŸUcÖ”< UÓw Á’c	

		eÖ°KG< 7. uÓM SÉH'>f Ñ'Š cØŠ°KG< 8. K?L /ĂÑKê/	
--	--	--	--

ANNEX 7: DECLARATION

I, the under signed, declared that this is my original work, has not been presented for a degree in this or any other university, and that all the sources of material used for this thesis has been fully acknowledged.

Name Muluken Dessalegn

Signature_____

Place Addis Ababa, Ethiopia

This thesis has been submitted for examination with my approval as University advisor.

Name Abera Kumie (MD, MSc, PHD)

Signature_____

Name Worku Tefera (BSc, MPH)

Signature_____