A hierarchical modelling approach to identify factors associated with the uptake of HIV counselling and testing, maternal health services, and prevention of mother to child HIV transmission programme services among post-partum women in Ethiopia

By

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Abstract

The HIV/AIDS epidemic remains an unbeaten challenge that affects all parts of the global population. Since the identification of the epidemic in the early 1980s, nearly 58 million people have become infected with the virus and 25 million people have died of HIV-related complications.

This study aimed to elucidate individual and community level factors associated with the uptake of antenatal care (ANC), health facility delivery, HIV Counselling and Testing (HCT), and Prevention of Mother-to-Child Transmission of HIV (PMTCT) services by implementing a hierarchical (multilevel) methodological approach.

This study used a cross-sectional, multistage sampling design in which health facilities were first selected (stage 1), followed by recruitment of post-partum women who came for child immunization from each health facility (stage 2), in Tigray region. Structured interview guides were developed for interviews.

Four-fifths (80.0%) of mothers used antenatal services at least once during their most recent pregnancy and of these 74.6% of women accessed HCT. Sixty nine percent of women had delivered at a health facility, 79% of mothers and 55.7% of their children had received PMTCT services.

Place of residence was significantly associated with ANC attendance and place of delivery, with women living in urban areas almost 2 times (OR=1.75, 95% CI 1.06, 2.92) more likely to deliver at a health facility. With the addition of one health facility per 25000 people, the likelihood of delivering at a health facility increased by 2.45 fold (OR=2.45, 95% CI 1.04, 5.78). Attending ANC (OR=4.54; 95%CI 2.82,7.33) and getting support from husband (OR=1.97; 95%CI 1.25,3.10) were significantly associated with HCT, at the individual level. At the community-level, for the addition

of one health facility and HCT site for every 25000 people increase the likelihood of HCT utilization by 2.1 and 2.4 fold respectively. Mothers who delivered at a health facility were 18 times (OR=18.21; 95%CI 4.37,75.91) and children born at a health facility were 5 times (OR=4.77; 95%CI 1.21,18.83) more likely to receive PMTCT services, compared to mothers delivering at home. With the addition of one nurse per 1500 people, the likelihood of getting PMTCT services for a mother increases by 7.22 fold (OR=7.22; 95% CI 1.02,51.26).

Community-level random-effects were also significant and there was confirmation of nesting at the community-level even after controlling for individual and community-level variables. Findings also showed that HCT utilization was nested according to district of residence, contributing 11.3% of the variance. In addition, the variation of mothers getting PMTCT services between districts was only 0.6%, but was 27.2% for children.

Conclusion: Factors influencing utilization of maternal health services work at different levels, individual and community. Hierarchical models reveal these differences in ways that single-level (individual or community) models do not. Interventions are needed to increase spouse involvement in ANC utilization, and explore effective ways of increasing health facility delivery among poor women with little formal education in rural areas and increasing the number of health facility per people are important. The government should focus on increasing ANC access, educating couples on the importance of health services utilization, increasing the number of health facilities and HCT sites per population to improve HCT utilization. In addition to these, programmes should focus on increasing health facility delivery, training traditional birth attendants to understand the need for PMTCT and increasing

HCT coverage to advance getting PMTCT services for mothers at the individual level and for children at both individual and community level.

Permission to conduct the study was granted from the Ethics Committee of the University of the Western Cape and from Tigray Region Health Bureau. Verbal informed consent was obtained from each participant in the health facility based interview

Dedication

This thesis is dedicated to my lovely late father Terefe Lerebo Bonje.

Acronyms

AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal Care
ART	Antiretroviral Treatment
ARV	Antiretroviral
CD_4	Cluster of differentiation 4
CI	Confidence Interval
CSA	Central Statistical Authority
DHS	Demographic and Health Survey
EDHS	Ethiopian Demographic and Health Survey
FHAPCO	Federal HIV/AIDS Prevention and Control Office
HCT	HIV Counselling and Testing
HIV	Human Immunodeficiency Virus
HH	Household
MCH	Maternal and Child Health
MDGs	Millennium Development Goals
MOH	Ministry of Health
MTCT	Mother-to-child HIV Transmission
NVP	Nevirapine
OR	Odd Ratio
PMTCT	Prevention of mother-to-child HIV transmission
PNC	Postnatal Care
sdNVP	single dose Nevirapine
SE	Standard Error
SES	Socio-economic status
SSA	Sub-Saharan Africa
TBA	Traditional Birth Attendant
UNICEF	United Nations Children's Fund
VPC	Variation Partition Coefficient
WHO	World Health Organization
ZDV	Zidovudine

Keywords

Antenatal care, health facility delivery, home delivery, HIV counselling and testing, Prevention of mother-to-child HIV transmission, mother, child, multilevel modelling, Tigray, Ethiopia

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I am grateful to my parents and my siblings for their prayer and unreserved support when I needed it most. My mother Tiruwork Butuse, father in law Tamirat Arficho, mother in law Tirunesh Abose, Sisters Bogalech, Genet, Betelihem, Sintayehu, Rediet, Emnet, Mahilet brothers Alemayehu, Lulu, Tesfalem, Ephrem, Biruk, Lobe, Getasew and my lovely nephews Kirubel and Surafel deserve special mention for their enormous contribution to my success. My gratitude goes to my special friends; Dr Benyam Mezmur, Woldekidan Amade, and Mulatu Menebo who made this PhD journey exciting and enjoyable.

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Lastly but not least, special thanks go to my son, Johanan (Billiy) your laugh always brings a moment of joy to me each hour of the day. I can now have more time for you! My wife, Dr. Kidist (GGiyee) you are truly my soul mate, thank you for your perseverance and sacrifice, for being a pillar of support and a wonderful calming influence. I am more than grateful. I am also grateful to my Ethiopian friends in Cape Town and Ghent and other parts of South Africa and Belgium, respectively for their encouragement and assistance during my study.

Praise God.

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Declaration

I, the undersigned, hereby declare that the work contained in this dissertation is my own work, except where due acknowledgement is made with full references in the text and it has not previously been submitted to any university or institution of higher learning for any qualification or certificate.

CHAPTER ONE

INTRODUCTION

1.1Background

The human immunodeficiency virus (HIV) epidemic has been an unbeaten challenge for three decades. Since the identification of the epidemic in the early 1980s, 25 million people have died of HIV-related complications and nearly 58 million people have become infected with the virus. According to the United Nations Programme on HIV/AIDS (UNAIDS) 2012 estimates, about 34 million people were living with HIV by the end of the year 2011, and in the same year 2.5 million individuals were newly infected and 1.7 million died of AIDS-related illness. Developing countries, especially sub-Saharan Africa, continue to bear the devastating impact of HIV infections. The region encompasses 69% of HIV infections worldwide, and 71% of new HIV infections among adults (UNAIDS, 2012). Concerning mother-to-child HIV transmission (MTCT), UNAIDS (2012) estimated that almost 330,000 children are infected, and 230,000 children died under fourteen years of age in the year 2011. Around 90 percent of child infections occur in sub-Saharan Africa (UNAIDS, 2012), and Ethiopia is not an exception.

Increasing access to HIV counselling and testing (HCT) is the main precondition for accelerating access to other HIV-related interventions (Towards Universal Access, 2008; CDC, 2003). HIV counselling and testing is a key component for the prevention of HIV transmission, as well as ensuring entry into HIV care programs (CDC, 2003; WHO, 2003; Marks, Crepaz, Senterfitt, Janssen, 2005; Matovu, Gray, Makumbi, Wawer, Serwadda, Kigozi, et al., 2005; Glick, 2005). In the USA almost 20% of people living with HIV who do not know their status are responsible for 54-70% of new infections (CDC, 2005).

In Ethiopia the predominant mode of transmission of HIV is heterosexual sex. This is followed by MTCT. Over 90% of the infections in children occur through MTCT,

which can take place in pregnancy, during childbirth or through breastfeeding. Ethiopia is one of six countries that account for 50% of under-5 child deaths worldwide, with approximately 350,000 Ethiopian children estimated to die each year (EDHS, 2005). Of these, 11% of child deaths result from HIV/AIDS (Save the Children Sweden, 2004). To avert this, detection of maternal infection early in pregnancy through HCT, and access to antiretroviral prophylaxis is crucial. Generally the uptake of these interventions remains low, primarily due to low ANC uptake, low health facility delivery and poor antenatal HIV testing rates. This limits access to effective interventions, which could help to reduce MTCT from 20% - 45% to less than 1% - 2% (Cooper, Charurat, Mofenson, Hanson, Pitt, Diaz, et al., 2002). Interventions to reduce MTCT include a cascade of PMTCT services which start with attendance at ANC, receipt of HCT, and effective antiretroviral therapy during pregnancy, childbirth and postpartum. All of these services are provided in the context of comprehensive maternity care (Stringer, Chi, Chintu, Creek, Ekouevi, Coetzee, et al., 2008).

In Ethiopia, a total of 1,023 health facilities were providing PMTCT services at the end of 2009 (FHAPCO, 2010). More than 616,763 pregnant women made at least one ANC visits in 2009, and 417,841 underwent HCT, of whom 10,267 (2.4%) tested positive. Of total pregnant women diagnosed with HIV, only 6,466(63%) received antiretroviral prophylaxis (ARV or sdNVP) and only 5,025 infants received PMTCT prophylaxis in the same year. Of the estimated 84,189 HIV-positive pregnant women in 2009 only 8% received ARV or sdNVP during childbirth (FHAPCO, 2010).

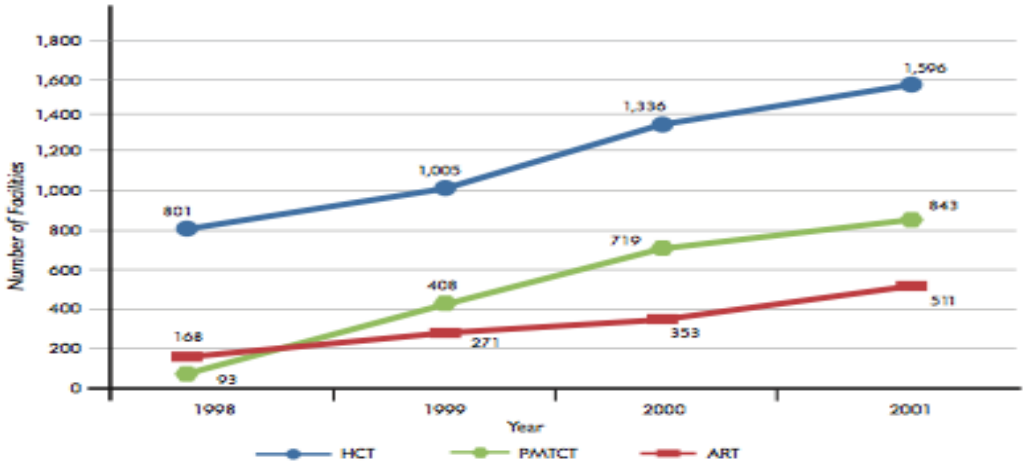

Fig 1. Trend in the number of facilities providing HCT, PMTCT, and ART (EFY 1998-2001) (Source FHAPCO, 2010)

1.2 Introduction to study problem

Several papers have studied the demographic and socioeconomic determinants of uptake of ANC, health facility delivery, HCT and PMTCT mostly at the individual level. Examples of barriers to access to these health services have been identified:

a) demographic factors such as age, education level, place of residence, ethnicity, marital status and religion (Shisana, Rehle, Simbayi, Parker, Zuma, Bhana, et al. 2005; Hutchinson, Mahlalela, 2006; Ma, Detels, Feng, Wu, Shen, Li, et al., 2007; Wringe, Isingo, Urassa, Maiseli, Manyalla, Changalucha, et al., 2008; Bwambale, Ssali, Byaruhanga, Kalyango, Karamagi, 2008; Gage, Ali, 2005; Haile, Chamber, Garrison, 2007),

b) socio-economic factors such as employment status (Ma et al., 2007), household income (Gage, Ali, 2005),

c) social factors such as gender based violence, fear of stigma, discrimination (Morin, Khumalo-Sakutukwa, Charlebois, Routh, Fritz, Lane, et al., 2006; Obermeyer, Osborn, 2007) and lack of confidentiality (Radebe, 2006; Varga, Brookes, 2008),

d) long waiting times, and transport to reach facilities (Bwambale et al., 2008),

e) health systems factors such as stock outs of HIV test kits / ART (Morin et al., 2006; Ma et al., 2007),

f) health status (Ma et al., 2007; Wringe et al., 2008); and

g) HIV knowledge such as prior knowledge of HCT/PMTCT sites and HIV risk perception and risk behaviour (Ma et al., 2007; Wringe et al., 2008; Boulle, Hilderbrand, Menten, Coetzee, Ford, Matthys, et al., 2008).

A limitation of existing research in this field has been the use of single level analytical techniques that ignore clustering and the multilevel or hierarchical structure of data on individuals living in different households, neighbourhoods, cities, and provinces.

Multilevel modelling that can simultaneously account for factors at individual and neighbourhood levels is likely to provide a more robust and sophisticated understanding of ANC, health facility delivery, HCT and PMTCT and the factors associated with uptake.

Most health services (ANC, health facility delivery, HCT, PMTCT) are delivered within an organizational system, such as a health system, which provides ready access to intact groups of subjects. With pregnant women nested within health facility and district health office, the data are inherently clustered. Correlated groups within data often arise as a result of nesting, in which data are structured (or nested) within a grouping variable (Atkins, 2005). For example, individuals are nested within a couple; family members are nested within a family; students are nested within classrooms; patients are nested within hospitals; workers are nested within work group or companies; and repeated measures are nested within an individual. Multilevel modelling effectively describes change across one or more levels of grouping. The main reason to apply this modelling is that many kinds of data, including observational data collected in the human and biological sciences have a hierarchical or clustered structure (Goldstein, 1999).

It is likely that the pregnant women who attend a particular health facility or the individuals who reside within a particular geographic area are more similar to each other than a randomly selected group of pregnant women or individuals would be. Such similarity may be due to shared group experiences, reciprocal influence resulting from group interaction, or non-randomly distributed background variables. The general concept is that individuals interact with the social contexts to which they belong, meaning that their social groups or contexts influence individuals, and that the individuals who make up that group in turn influence the properties of those groups. Generally, the individuals and the social groups are conceptualized as a hierarchical system of individuals and groups, with individuals and groups defined at separate levels of this hierarchical system. Naturally, such systems can be observed at different hierarchical levels, and variables may be defined at each level (Hox, 2002). When modelling data gathered from these clustered individuals, the within-group homogeneity (indexed by the intraclass correlation or ICC) results in positively correlated error terms among the individuals within a particular group. In such a situation (i.e., with positive ICC), the above mentioned health outcome analysis

suffers from the same difficulty as other traditional analytic techniques, namely the unit of analysis problem (Palmer, Graham, White, Hansen, 1998).

Because traditional analyses or single level analysis are not designed to accommodate clustered data, their application requires the researcher to make a decision about whether the analysis should be based on individual level responses, ignoring the clustering, or on aggregate measures for each group, eliminating the individual scores. If the individual was chosen as the unit of analysis, the analysis would proceed as if the data were unclustered and any group level variables were, in fact, individual level variables. If the inference is drawn at the group level based on individual level data the atomistic fallacy results, and ignoring relevant group level variables and only focusing on individual level may lead to the psychologistic fallacy (i.e. assuming that individual level outcomes can be explained exclusively in terms of individual level characteristics (Riley, 1963). However, with positive ICC frequently found in clustered data, the correlated errors among the individuals within a group violate the independent observations assumption of ordinary least squares (OLS) estimation, resulting in downwardly biased standard error estimates, overly large test statistics, and inflated Type I error rates (Barcikowski, 1981; Moulton, 1986; Scariano, Davenport, 1987; Scott, Holt, 1982; Walsh, 1947). If the analysis were to proceed at the group level, all individual level data would be aggregated into group means, and groups, not individuals, would be treated as the observations in the analysis (MacKinnon, Johnson, Pentz, Dwyer, Hansen, Flay, et al., 1991).

If the inference is drawn at the individual level based on group level data the ecological fallacy results, ignoring the role of individual level factors in a study of groups may lead to the sociologistic fallacy (Riley, 1963). Though this eliminates the correlation among individual error terms, this approach is not ideal for a number of reasons. First, the power of statistical tests is reduced because the number of observations is limited to the number of groups, rather than the number of individuals, and the degrees of freedom for the analysis are correspondingly decreased. Second, this procedure discards the individual variability in scores, which may comprise the majority of the variability present in the data (de Leeuw, 1992). In addition, primary interest in these type of health outcome studies typically centres on the individual, but the group level relationships explored by an aggregate analysis do not necessarily parallel individual level effects, making inferences about individual behaviour

potentially misleading (Robinson, 1950; Pedhazur, 1982). Thus conducting an analysis of clustered data by aggregating all individual level information to the group level is often not an optimal solution to the correlated error problem.

Multilevel modelling was developed in response to the challenge of appropriately analysing clustered data. This technique preserves the original data structure (i.e., individual level variables need not be aggregated to group means) while explicitly modelling the within-group homogeneity of errors by allowing the estimation of error terms for both the individual and the group. Because of the complex structure of the model and the nature of the error terms, multilevel models are estimated using iterative Empirical Bayes/ Maximum Likelihood (EB/ML) techniques, rather than the OLS methods typically employed to estimate the parameters of single-level models. The standard error estimates for a multilevel model are more accurate than those for a single-level individual-as-unit-of-analysis model. In addition to the correction of standard error estimates and the more appropriate significance tests that result, multilevel models also provide other advantages over traditional analytic techniques. Prominent among these is the ability to simultaneously examine the effects of variables at both individual and group levels, as well as possible cross-level interaction effects (Bryk, Raudenbush, 1992).

Hierarchical modelling is mostly used in the fields of education, demography and social sciences to describe an analytical approach that allows the simultaneous examination of the effects of group level and individual level variables on individual level outcomes (Diez-Roux, 2000). It has a variety of names for similar statistical analyses, including hierarchical linear models (Raudenbush, Bryk, 2002), mixed-effects models (Laird, Ware, 1982; Pinheiro, Bates, 2000), random regression models (Gibbons, Hedeker, Elkin, Waternaux, Kramer, Greenhouse, et al., 1993), and multilevel models (Snijders, Bosker, 1999). Because of growing statistical technology and increasing interest in societal influences on individual health status, group level and individual level factors in regression models have prompted interest in contextual research in epidemiology (Atkins, 2005; Diez-Roux, 1998). According to Pickett and Pearl (2001) “the statistical issues involved in multilevel studies have been well described, and hierarchical regression analysis is becoming widely accepted as the appropriate tool for examining group level effects on individual health”. However, as

far as this researcher can assert, this variation in health has received less attention in public health until recently and almost none in African studies and HCT/PMTCT.

By explicitly acknowledging the existence of groups, modelling group-to-group variation simultaneously with individual-to-individual variation, and including group-level properties with individual-level variables in the analyses, multilevel models allow for the importance of both groups and individuals in understanding health outcomes. It provides one way to link the traditionally distinct ecological- and individual-level studies and to overcome the limitations inherent in focusing only at one level. Like other statistical methods, multilevel analysis will help describe, summarize, and quantify patterns present in the data (Diez-Roux, 2000).

1.3 Problem statement

Assuming a close relationship between ANC, HCT and PMTCT two glaring dilemmas exist when provinces and districts are compared in Ethiopia. ANC and HCT coverage are considerably better in some provinces and districts but PMTCT uptake is lower. This dilemma goes beyond. There are districts and provinces that have better coverage of ANC, HCT and PMTCT but with high rates of child HIV infectivity and vice-versa. In addition, there are provinces (Table 1 and Fig 2) and districts (see Annex 1) in Ethiopia with relatively better health work force ratio and better primary health expenditure but relatively low coverage of ANC, health facility delivery, HCT and PMTCT (MoH, 2009; FHAPCO, 2010; EDHS, 2011).

Table 1. Distribution of doctor, nurse/mid wife, per capita health expenditure in ETB and women age 15-49 who had a live birth in the five years preceding the survey by HIV counselling and testing (HCT), antenatal care (ANC) and Health facility delivery during pregnancy for the most recent birth, according to region, Ethiopia (source by modifying EDHS, 2011; FHAPCO, 2010; and MoH, 2009)

Region	Doctor/ 100,000 people	Nurse/mid wife/10,000 people	Per capita health expenditure in ETB	Ever tested for HIV (in %)	ANC uptake (in %)	Health facility delivery (in %)
Tigray	2.23	5.14	42	60.4	65.0	11.6
Affar	1.02	1.26	21	30.1	35.3	6.8
Amhara	1.71	2.13	37	37.1	40.9	10.2
Oromiya	1.31	1.75	16	35.4	39.5	8.0
Somali	1.52	0.67	14	11.4	25.3	7.6
Benishangul-Gumuz	1.69	6.35	17	38.9	41.0	9.1
SNNP	1.52	2.50	35	34.5	40.8	6.2
Gambela	3.91	2.74	21	49.7	57.7	27.5
Harari	15.03	14.31	81	58.1	59.5	32.4
Addis Ababa	32.72	11.83	30	66.4	94.6	82.3
Dire Dawa	14.71	7.55	50	67.3	61.3	39.7

Explaining these different relationships of ANC, health facility delivery, HCT and PMTCT within a province and also between provinces and districts has important policy implications because it allows a much more detailed assessment of needed policy interventions and a better targeting to fight HIV/AIDS and MTCT and to meet

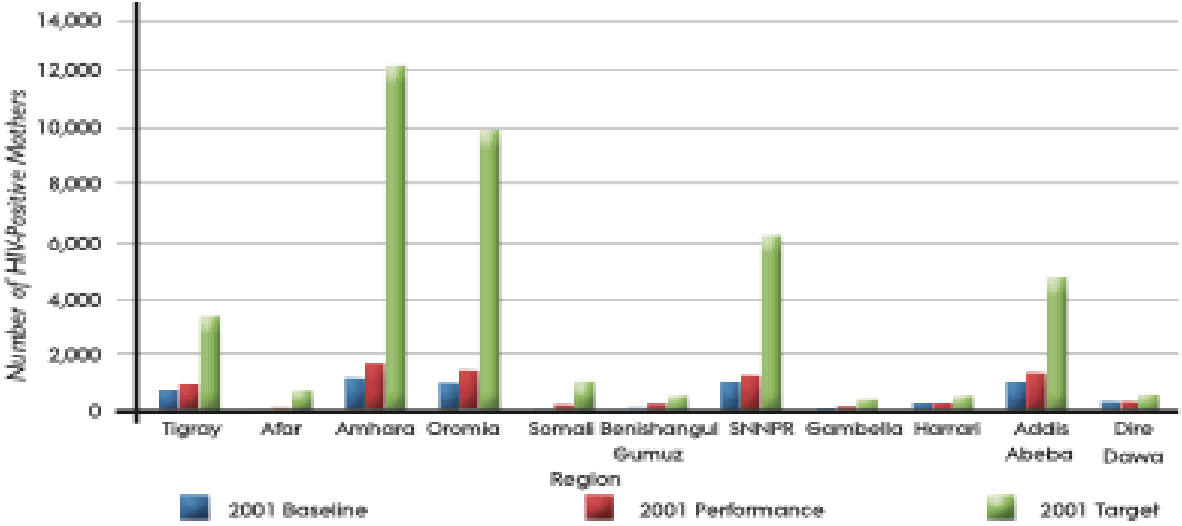

Figure 2: Comparison of baseline, performance and target of the number of HIV-positive mothers provided with PMTCT prophylaxis by region (EFY 2001) (Source MoH 2009)

the Millennium Development Goals (MDGs) (UN, 2010). But approaches using aggregated macro data have not been able to explain it appropriately. There are no attempts to explain this dilemma from an individual level perspective that have also analyzed the group level determinants simultaneously for ANC, health facility delivery, HCT and PMTCT with the focus on their differences and similarities using micro data.

This study will analyze service user experiences with maternal health services, and health provider conditions and efforts in providing the services. Assessing service user experience will help understand the constraints of mothers, families and communities face in accessing maternal health services. Studying the health provider conditions will allow critical insight into key factors that hinder more efficient and equitable delivery of services. The study focuses on four essential maternal health services: use of antenatal care services, safe delivery assisted by a trained professional, utilization of HCT, and receiving PMTCT services.

1.4 Rationale for the study

Ethiopia has been implementing a national PMTCT programme since 2001 with HCT started earlier than this. ANC, health facility delivery, HCT and PMTCT are unevenly distributed throughout the provinces and districts. For instance, performances of ANC coverage show wide variations across regions ranging from 25.3% in Afar Region and 31.3% in Gambella Region to 100% in Addis Ababa (MoH, 2010). The trend is similar for HCT and PMTCT. There are some districts with relatively high Primary

Health Care per capita expenditure and better nurse workloads but that have lower HCT and PMTCT uptake (FHAPCO, 2010).

Although several individual level characteristics have been associated with accessing HCT and PMTCT (e.g., age, education), associations with contextual level characteristics, such as nurse load, PHC per population, have largely been understudied. Several theoretical frameworks (Belsky, 1984; Bronfenbrenner, 1986) have, however, stressed that the immediate environment (e.g., home or community context) may influence individuals' health behaviour. Nevertheless, most studies on ANC, health facility delivery, HCT and PMTCT have applied traditional single-level analytic techniques, ignoring the social context within which individuals live (Crick, Grotpeter, 1995; Prinstein, Boergers, Vernberg, 2001; Tomada, Schneider, 1997). This study will explicitly examine individual, contextual level correlates of HCT and PMTCT by implementing a multilevel methodological approach.

District/community characteristics are hypothesized to jointly influence individual health care choices. Therefore, two-level random effects generalized linear models are applied. Multilevel analysis allows the dissecting of how maternal health service use differs by communities and health facility areas, and identifies factors related to individuals, and health facilities that explain these differences.

1.5 Research Questions and Hypotheses

This study seeks to answer two research questions as presented below. Each research question is followed by its respective hypotheses.

Research Question 1: How do individual and community level characteristics affect the use of antenatal care services, institutional delivery, utilization of HCT, and receipt of PMTCT services?

Hypothesis for Research Question 1: Individual characteristics found by previous research to be associated with maternal health care use are: education level of the mother; parity; age; and wealth index. These personal and household characteristics of

service users are also expected to be associated with maternal health service use in this study. Both the education level of the mother and wealth index are hypothesized to increase the likelihood of use of maternal health services.

On the other hand, parity and age are expected to be negatively associated with the likelihood of use of maternal services. Characteristics of the district/ or community represent the immediate environment in which the households exist, and are expected to have an effect on a mother's choice to use maternal health services. The community-level factors studied are enabling factors specifically related to access to maternal services inside the districts. It is hypothesized that in any given area, the easier the access the more likely mothers will use maternal health services.

Therefore, having a health professional in the district, and a health facility in the district, are factors that are expected to increase the odds of women using maternal health services. On the other hand, mothers living in a community far away from health facilities, and/or further away from the district health center, are hypothesized to have more difficult access to district resources, information and communication, and social services including health services in the district, thus lowering the odds of maternal health service use. The linearity of the effect of distance to health facilities will be assessed, since a certain threshold in distance may exist that decreases the mother's likelihood of service use.

District characteristics represent the nature of the health services delivered in the area, specifically characterizing the structural and procedural quality of services provided in the health facility area. It is expected that better structural and procedural quality of services provided in the area improve service coverage of maternal health services. Therefore, mothers are more likely to use maternal health services if they live in areas with a better structural facility that has more health staff (represented by the number of health staff at the health facility and higher midwife to population ratio) who are better supervised and provide more outreach services.

Research Question 2: To what extent do the individual level variables and community level variables explain the community-level variations in use of the

antenatal care services, institutional delivery, utilization of HCT, and getting PMTCT services?

Hypothesis to Research Question 2: It is hypothesized that despite the uniformity in the design of the service delivery systems across Tigray region, Ethiopia, the execution of the delivery policy is not standardized across areas, and districts differ from one another in the levels of service utilization, with considerable amount of unobserved "district-effect" represented by random effects in the models. The unobserved district-effect represents factors affecting use of services related to the environment immediately surrounding the mothers, such as cultural beliefs and practices, and general level of awareness about maternal health and health services. The unobserved district-effect represents factors that affect a group of communities within the health facility area such as the reputation of the public health center and the services provided.

Community-level factors characterizing the level of access to maternal services within the district, characterizing the structural and procedural quality of services provided in the area are expected to explain a considerable portion of the community-level variances in all outcomes. However, it is also expected that sizable community-level variance will remain after taking into account individual level variables. The unobserved factors represented by community-level variations are expected to be larger for place of delivery than for ANC services. Home delivery is still widely accepted as a norm in Ethiopia; therefore, factors such as cultural barriers and fear of unexpected costs associated with referrals and institutional deliveries are likely to play a large role in deciding the delivery location.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Every hour, more than 283 people become infected with HIV and more than 237 die, mostly because they have no access to HIV prevention, treatment and care services. Sub Saharan Africa is home to 70% of new infections and 75% of deaths (UNAIDS, 2012). According to Global HIV Prevention Working Group, (2004) it is well recognized that a comprehensive approach of HIV prevention, treatment and care is essential for reducing new infections and AIDS death. In contrast to the progress made in responding to HIV over the past ten years, the HIV pandemic remains the most severe infectious disease that has become a challenge to global public health (UNAIDS/WHO, 2007). This continuing transmission of HIV and its progression to AIDS seriously undermines the achievement of six out of eight of the Millennium Development Goals (WHO, 2005).

Surveys in sub-Saharan Africa have shown that a median of just 12% of men and 10% of women had been tested for HIV and received the results (Towards Universal Access, 2008). Greater knowledge of HIV status is critical to expanding access to HIV treatment, care and support in a timely manner, and offers people living with HIV an opportunity to receive information and tools to prevent HIV transmission to others. Increased access to HIV testing and counselling is essential in working towards universal access to HIV prevention, treatment, care and support as endorsed by the G8 leaders in 2005 and the UN General Assembly in 2006.

2.2 HIV counselling and testing (HCT)

2.2.1 History of HIV counselling and testing

The first licensed test for HIV become available in the United States in 1985, the initial public health reason for promoting HIV testing was to protect the blood supply; however, two concerns existed. First, it was believed that members of population groups who were experiencing the initial burden of HIV, such as men who have sex with men (MSM), would turn to blood banks as the only place where they might learn their HIV status. Also, the test could not detect HIV infection during the window period before the body developed HIV antibodies. Thus, infected blood could remain in the blood supply, making it a less than ideal location for testing individuals at risk for infection. Secondly, fear abounded regarding confidentiality. In an environment characterized by stigma, a lack of HIV treatment to suppress the virus, and fear that the health system would disclose an HIV-positive status to insurance companies, government agencies and employers, the debate about how to provide testing was intense. In 1987 the US government supported the development of testing sites separate from blood banks, where individuals could test specifically to learn their HIV status (Denison, Higgins, Sweat, 2009). To facilitate this, initial guidance documents on HIV testing were developed that emphasized HIV prevention counselling, and confidentiality provided by CDC and WHO (CDC, 1986; CDC, 1987; WHO, 1990).

A WHO document defined counselling as an on-going dialogue and relationship between client or patient and counsellor, and helped to solidify the role of counselling by stating that counselling should be “an integral part of all HIV testing” programs (WHO, 1990). After three years a CDC technical update reinforced the concept that counselling associated with HIV testing should be an interactive rather than didactic process (CDC, 1993). The WHO issued a statement on testing and counselling that used the term “voluntary” for the first time in 1993, and emphasized that testing without informed consent is “ineffective and unethical” (WHO, 1993). Shortly thereafter, the CDC published the first standards and guidelines on HIV counselling, testing and referral (CDC, 1994). From these initial guidance documents and experiences emerged a model of testing and counselling termed “voluntary counselling and testing” (VCT), which included pre- and post-test counselling with a

focus on client-centred counselling, and the prevention of HIV transmission (Denison, et al., 2009).

In the mid-1990s this VCT model of HIV testing and counselling was promoted heavily as a prevention tool, both within developed and in developing countries (UNAIDS, 1997, 2000a). In resource constrained settings the provision of VCT became more feasible since 1994, due to new testing technologies, particularly rapid tests. Treatment options for HIV-related diseases were also expanding, and zidovudine (AZT) was found to prevent MTCT of HIV (UN, 2001). In this light, HIV testing slowly evolved from a procedure that primarily alleviated fears of infection, and prevention of further transmission, to a diagnostic gateway to treatment. The UN General Assembly Special Session on HIV/AIDS in 2001, in recognition of the importance of HIV testing and counselling as an entry point for treatment, included in the Declaration of Commitment on HIV/AIDS that all countries by 2005 should have a wide range of prevention activities, including expanded access to voluntary and confidential counselling and testing (UN, 2001).

There is considerable agreement in the population that too few people living with HIV – only an estimated 8–25 percent – know their HIV status (WHO/UNAIDS, 2007; WHO/UNICEF, 2007; WHO/UNAIDS/UNICIF, 2007). There is also an agreement that testing is an important gateway for accessing care and treatment. There has been considerable, often heated, debate on how specifically to provide HIV testing, and what outcomes can be attributed to HIV testing and counselling services. The CDC updated their 1994 standards in 2001 to recognize that providers need flexibility in implementing the guidelines, "given their particular client base, setting HIV prevalence level and available resources" (CDC, 2001). Essentially, this policy change questioned whether the individual-focused VCT model of HIV testing – developed in the West when treatment was not available and stigma ran high – was appropriate in a context more than a decade later in which treatment is accessible and prevalence is much higher. In particular, the debate focused on the role of counselling in HIV testing. Was counselling associated with an HIV test a critical element for behaviour change to occur, or was simply knowing one's status enough?

In 2004, UNAIDS and the WHO issued a policy statement on HIV testing and counselling (HTC) that presented the mechanisms and conditions for what they

termed “provider-initiated routine testing” (UNAIDS/WHO, 2004). In 2006, the CDC recommended routine testing in all medical settings in the US, and in 2007 the WHO released the latest guidance on HIV testing and counselling that focuses on provider-initiated testing and counselling (PITC) (Branson, Handsfield, Lampe, Janssen, Taylor, Lyss et al., 2006; WHO/UNAIDS, 2007). In this approach, testing takes place when people visit health-care facilities (particularly ANC clinics and other reproductive health services) and are tested systematically and routinely unless they decline. This approach has increased uptake of HTC in clinical settings, particularly ANC.

Until recently, HTC has been offered largely in healthcare facilities and stand-alone VCT sites. In light of missed opportunities to diagnose patients presenting to health facilities and other high-priority settings, subsequent WHO HTC efforts have sought to expand facility-based voluntary HTC. Now, new community-based approaches are developing to better serve people who otherwise lack ready access to HTC. In many settings community-based approaches may offer the greatest potential for progress toward universal access to HTC, which, in turn, supports universal access to treatment and prevention. Within these two spheres—facility-based and community-based HTC delivery models—are many variations (WHO, 2012).

This brief chronological overview of HIV testing and counselling illustrates the developing role the HIV test has had as a prevention and care tool. Overall, the reasons for taking a test and for promoting knowledge of one's HIV status are varied, and include gaining knowledge for behaviour change and future decisions (e.g., getting married, having children), testing as a human rights issue, government planning, political mobilization, and access to treatment (Denison et al, 2009).

2.2.2 HCT and sexual risk behaviours

Since the 2001 UNGASS commitment to expand access to VCT (UN, 2001), the estimated number of people using HIV testing and counselling services in more than 70 surveyed countries increased from 4 million persons in 2001 to 16.5 million in 2005 (UNAIDS, 2006), and more than 95 million HIV tests were performed in 2010 (WHO/UNAIDS/UNICEF, 2011). This increase reflects a commitment taken at the

international, national, community and individual levels. By combining personalized counselling with knowledge of one's HIV status, HIV testing and counselling is believed to motivate people to change their sexual behaviours to prevent the transmission of the virus.

According to Higgins, Galavotti, O'Reilly, Schnell, Moore, Rugg, et al. (1991), HIV counselling and testing had no impact on pregnancy decisions among infected women, including pregnancy rates and termination. However, discordant couples increased condom use and safe sexual practices. The first meta-analysis of VCT efficacy data published in 1999 by Weinhardt, Carey, Johnson, Bickham, supported the provision of HIV counselling and testing intervention as an effective secondary behaviour-change strategy, but only among those infected with HIV.

A more recent community-based trial conducted in Uganda found no difference between participants who learned their HIV test result and those who did not in terms of sexual risk behaviours or HIV incidence (Matovu *et al*., 2005).

Another a randomized controlled trial that examined the efficacy of VCT in three developing countries (Kenya, Tanzania, and Trinidad), found that participants randomly assigned to the VCT arm had a greater proportional reduction in unprotected sex with non-primary partners than participants assigned to a health information arm (men, 35 percent vs 13 percent; women, 39 percent vs 17 percent; VCT vs health information) (VCT Efficacy Study Group, 2000). In addition to this, Denison *et al*., (2009) found that VCT recipients were significantly less likely to engage in unprotected sex when compared to behaviours before receiving VCT, or as compared to participants who had not received VCT (OR 1.69; 95%CI 1.25–2.31). Overall, these studies showed mainly the greatest risk reduction appears to occur among people infected with HIV, either individuals or discordant couples.

2.2.3 HCT as entry point to prevention, care and treatment

There have been calls to incorporate HIV testing and counselling into health services such as prenatal care, care for TB patients, care for sexually transmitted infections (STIs), hospitalization and even general primary care (Obermeyer, Bott, Carrieri, Parsons, Pulerwitz, Rutenberg, et al., 2009). A study conducted by De Cock, Affolter, Farver, Van Brantegem, Scheuch, Ferraro (2006) showed that increasing HIV testing

is a way to normalize and destigmatize HIV. Another study conducted by Bozzette (2005) reveals that screening for HIV is cost effective. The prevalence of unprotected anal or vaginal intercourse with uninfected partners was on an average 68% lower in HIV positive individuals aware of their status compared to individuals unaware of their status (CDC, 2006).

When a person is infected with HIV, the virus slowly weakens the ability to fight illness, and it over time develops into AIDS. But if the infected person is identified earlier, effective prevention and treatment can be initiated. For instance, cotrimoxazole preventive treatment increases the survival of HIV positive TB patients by approximately 60% (Badri, Ehrlich, Wood, Maartens, 2001). Cotrimoxazole preventive treatment is highly effective, if it is started for people living with HIV/AIDS whose CD4 cell count is >500/mm3 (Harries, Zachariah, Jahn, Schouten, Kamoto, 2009). According to Golub, Saraceni, Cavalcante, Pacheco, Moulton, King, et al. (2007) antiretroviral treatment and isoniazid preventive treatment together decrease the risk of active TB by 76%. Only 16% of TB patients knew their HIV status in 2007, and because of this, people living with HIV and TB had low access to cotrimoxazole preventive treatment and antiretroviral treatment.

If there is no effective prevention, there will be growing HIV infections that will require treatment. Of the interventions, HIV testing and counselling plays a pivotal role both in treatment and prevention (WHO, 2004). Untreated sexually transmitted infections increase the risk more than six times of passing on or acquiring HIV during sexual intercourse; and particularly for those with inducing ulcers or discharge the risk of becoming infected with HIV from a single exposure increases by 10 to 300 times (UNAIDS, 2004; FHI, 2001).

A study conducted in the North Carolina, United States, showed that more than two thirds of the acute HIV infection cases were detected among the one third of the study participants who attended the sexually transmitted disease clinics (Pilcher, Fiscus, Nguyen, Foust, Wolf, Williams, et al., 2005). A study conducted in Malawi found that the prevalence of acute HIV infection was 4.9% in STI clinic (Pilcher, Price, Hoffman, Galvin, Martinson, Kazembe, et al., 2004), with almost the same result (median=4.7% HIV sero-prevalence) found from a study conducted in 28 USA STI clinics (Weinstock, Dale, Linley, Gwinn, 2002). There is also evidence showing the

effectiveness of HIV testing and counselling in STI clinics; such as a study conducted in a Miami STI clinic which revealed a decline in STI infection rates following HIV testing and counselling for those who tested HIV positive (UNAIDS, 2001). A small descriptive study conducted in Nigeria also confirmed that young people showed sexual behaviour change by increased uptake of condom usage and decreased STI incidence, after HIV testing and counselling (Boswell, Baggaley, 2002). In addition to these, a study conducted in Rwanda showed that HIV testing and counselling was associated with reduced rates of gonorrhea (the prevalence of gonorrhea decreased from 13% to 6%, $p<0.05$) among sero-positive women following the HIV testing and counselling (Boswell, Baggaley, 2002).

2.2.4 HCT for elimination of HIV/AIDS

To control the HIV/AIDS epidemic, infectious individuals would have to be rendered non-infectious, or susceptible people protected from infection (Granich, Gilks, Dye, De Cock, Williams, 2009). Universal voluntary HIV testing and immediate ART, combined with present prevention approaches, could have a major effect on severe generalised HIV/AIDS epidemics (Granich, et al., 2009). Antiretroviral therapy that reduces viral replication could limit the transmission of human immunodeficiency virus type 1 (HIV-1) in serodiscordant couples. The early initiation of ART reduced rates of sexual transmission of HIV-1 and clinical events, indicating both personal and public health benefits from such therapy (Cohen, Chen, McCauley, Gamble, Hosseinipour, Kumarasamy, et al., 2011). Vertical transmission of HIV can be virtually eliminated by testing of mothers and blocking of transmission through the use of antiretroviral drugs, accompanied by elective caesarean section and the use of replacement infant feeding (Granich, et al., 2009).

A theoretical mathematical model was developed by WHO researchers on the potential impact of offering universal voluntary HIV testing and counselling followed by immediate antiretroviral therapy (ART), irrespective of clinical stage or CD4 count (Granich, et al., 2009). This mathematical model was used to determine the longevity of the HIV epidemic if all persons ≥15 years of age were tested annually for HIV and given ART if HIV-positive. For the modelling the researchers were used data

primarily on the South African experience. Assumptions in the model were a 10-fold increase in transmission during the acute infection, a reduction in transmission by 99% with successful ART, an estimated dropout from care of 8% in the first month followed by 1–3% per year, and 50% coverage by 2012 and 90% by 2016. The goal of treatment would be to reduce the transmission rate (Ro) to <1, with Ro being defined as the number of secondary infections resulting from one primary infection in an otherwise susceptible population. Results from this modelling exercise showed that a strategy of annual HIV testing and immediate ART would reduce the incidence of HIV and mortality to <1 case per thousand persons per year within 10 years of full implementation of the strategy, and the prevalence of HIV to <1% within 50 years.

2.3 Accessing maternal health services

There is now broad agreement that the focus of antenatal care interventions should be on improving maternal health, this being both an end in itself and necessary for improving the health and survival of infants (WHO, 2003). Today we have better evidence about what works and what does not work to reduce maternal mortality, and the role that ANC can play (WHO, 1999).

Antenatal care guarantees the transmission of essential information about the mother's pregnancy and health relevant to her physical, psychological, social, cultural and educational state in order to detect, predict, prevent and manage pregnancy related complications (Villar, Ba'aqeel, Piaggio, Lumbiganon, Miguel-Belizán, Farnot, et al., 2001; THPCT, 2007). The antenatal period clearly presents opportunities for reaching pregnant women with a number of interventions that may be vital to their health and well-being and that of their infants. This period is used to inform women and families about danger signs and symptoms and about the risks of labour and delivery, it may provide the route for ensuring that pregnant women do, in practice, deliver with the assistance of a skilled health care provider. Pregnancy complications are a primary source of maternal and child morbidity and mortality. Therefore, pregnant women should routinely receive information on the signs of complications and be tested for them at all antenatal care visits. The antenatal period provides an opportunity to supply information on birth spacing, which is recognized as an important factor in

improving infant survival. Scientific evidence has also shown the inverse relationship between health facility delivery and the occurrence of maternal and neonatal death (Babalola, Fatusi, 2009).

One of the objectives of the MDGs is to reduce MMR by an average of 5.5% every year over the period 1990–2015. At the global level, MMR decreased by less than 1% per year between 1990 and 2005 far below 5.5% to reach the target of MDG (UN, 2008). Most Sub- Saharan African countries are not on track for meeting the targets pertaining to MMR. Recent estimates suggest that the average annual rate of reduction in MMR in SSA countries is less than 1% (WHO, 2007). As the Ethiopian EDHS 2011 has shown, the MMR was 676 per 100,000 live births for the seven year period preceding the survey which is not significantly different from EDHS 2005 report (673 per 100,000 live births) (CSA, 2012). However there is a decline of 34% from the level of 1990 (WHO/UNICEIF/UNFPA/WORLD BANK, 2010), a report published by UN agency (2010) had mentioned an estimated 358,000 maternal deaths occurred worldwide in 2008. Despite this decline, low-income countries continue to account for 99% of maternal deaths primarily in Africa and South Asia (WHO, 2009).

Worldwide, the major causes of maternal mortality are haemorrhage (24%), infection (15%), unsafe abortion (13%), prolonged labour (12%) and eclampsia (12%) whereas primary causes of maternal mortality in Africa are haemorrhage (34%), other direct causes (17%), infection (10%), hypertensive disorders (9%) and obstructed labour (4%), abortion (4%) and anaemia (4%) (Hogan, Kyle, Mohsen, Stephanie, Mengru, Susanna, et al., 2010). The place of delivery is a crucial factor, affecting the health and well-being of mother and newborn (Dasgupta, Deb, 2009). These deaths could be avoided if preventive measures were taken and adequate care were available particularly during pregnancy, childbirth and postpartum period through obstetric care services. More than 60% of maternal deaths occur immediately following delivery, with more than half occurring within a day of delivery (WHO, 1994; 1999). Skilled birth attendance during labour, delivery and the early post-partum period could reduce an estimated 16–33% of maternal deaths (WHO, 1994; Bolam, Manadhar, Shestha, Ellis, Malla, Costello, 1998; Magadi, Diamond, Rodrigues, 2005). However, only 61% of births are attended by a skilled health worker globally.

The proportion of women who delivered with the assistance of a skilled birth attendant is one of the indicators in meeting the fifth MDG. In almost all countries where health professionals attend more than 80% of deliveries, MMR is below 200 per 100,000 live births (UNFPA, 2004). In Ethiopia, the proportions of births attended by skilled personnel are very much lower than SSA. Even for women who have access to the services, the proportion of births occurring in health facilities is very low. Only 6% of births were delivered in health facilities and, there is no significant difference in proportions of delivery service utilization between EDHS 2000 and 2005; however this figure moderately increased to 10% in EDHS 2011. Twenty eight percent of mothers delivered by TBAs; while the majority of births were attended by a relative or some other person (61%) and 5% of all births were delivered without any type of assistance at all (CSA, 2006; 2012).

According to the 2011 Ethiopian Demographic and Health Survey (EDHS), only 34% of mothers who had live births in the five years preceding the survey received antenatal care from health professionals, with little improvement from the preceding 5 years (CSA, 2012). Ethiopian women start ANC at relatively late stage (5.2 months) of their pregnancy, and only 19% of pregnant women have the recommended four ANC visits before birth (CSA, 2012). Only 10% of births in the past five years were delivered by a skilled provider, and more than 61% women stated that a health facility delivery was not necessary, while 30% stated that it was not customary. According to 2011 EDHS the most important barrier to access to health services that women mention is taking transport to a facility (71%), followed by lack of money (68%), and distance to a health facility (66%).

The antenatal period is also used as an entry point for HIV prevention and care, in particular for the prevention of HIV transmission from mother to child, which has led to renewed interest in access to and use of antenatal care services (Bergsjø, Villar, 1997; Villar, Bergsjø, 1997; Carroli, Villar, Piaggio, Khan-Neelofur, Gülmezoglu, Mugford, et al., 2001).

2.4 Mother-to-child HIV transmission (MTCT)

While HIV/AIDS depreciates health gains for the population as a whole, its malevolent effect has been particularly devastating on the health of children and pregnant women (Chopra, Doherty, Jackson, Ashworth, 2005). In the mid-1980s, MTCT was first recognized to be the major source of HIV infection among children under the age of 15 years (CDC, 1985). As a mode of transmission, MTCT accounts for more than 10% of all new HIV infections globally, and over 90% of new infections in infants and young children occur through MTCT (WHO, 2007). Most children living with HIV/AIDS in low and middle-income countries generally acquire the virus as a result of vertical transmission (WHO, 2006), which can take place in utero, intrapartum and through breastfeeding (Lyall, Blott, de Ruiter, Hawkins, Mercy, Mitchla, et al., 2001; Thorne, Newell, 2003). The majority of global MTCT cases occur in sub-Saharan Africa, which accounts for 90% of the cases for worldwide infections (Stringer et al., 2008). Sub-Saharan Africa accounts for 70% of worldwide HIV infections, and houses 90% of all HIV-infected children (Coovadia, 2005).

Immunological status and viral load of the mother are major predictors of MTCT (Lyall et al, 2001). MTCT is highest during the WHO stage 1 and stage 4 in the natural course of the HIV infection. During stage 1 of the infection there is high viral replication before the immune system takes control (Giuseppe, Cecilia, Anthony, 1993), and during stage 4, due to a compromised immune system, there is a decrease in the CD4 cell count accompanied by an increase in viral load which favour the risk of MTCT (Lyall et al, 2001). There is ample evidence that shows presence of other sexually transmitted infections during pregnancy, uterine infection, invasive obstetric procedures, modes of delivery and infant feeding practices are also risk factors favouring MTCT (Mandelbrot, Mayaux, Bongain, Berrebi, Moudoub-Jeanpetit, Bénifla, et al., 1996; Lyall et al., 2001; Read, Newell, 2005; Chasela, Chen, Fiscus, Hoffman, Young, Valentine, et al., 2008; Becquet, Bland, Leroy, Rollins, Ekouevi, Coutsoudis, et al., 2009; Gumbo, Duri, Kandawasvika, Kurewa, Mapingure, Munjoma, et al., 2010).

HIV is the leading cause of mortality among women of reproductive age worldwide and is a major contributor to maternal, infant and child morbidity and mortality (WHO, 2009; UNAIDS, 2009). Without treatment, one third of children living with HIV die before they reach one year of age and over 50% die by the second year of life (Newell, Mary-Louise, Coovadia, Cortina-Borja, Rollins, Gaillard et al., 2004). In 2008, an estimated 1.4 million pregnant women living with HIV in low- and middle-income countries gave birth, 91% of whom reside in sub-Saharan Africa (UNAIDS, 2009).

Without intervention, 25-45% of infants born to HIV-positive mothers will become infected. With current interventions, this risk can be reduced to less than 5%. Therefore, transmission of HIV from a pregnant woman to her infant is preventable. Effective provision of PMTCT interventions improves maternal health and infant HIV-free survival. PMTCT is a key component of overall HIV prevention efforts and represents a critical opportunity for stemming the tide of the HIV epidemic.

In Ethiopia the predominant mode of transmission is heterosexual intercourse. This is followed by MTCT. Ethiopia is one of ten countries accounting for two-thirds of all MTCT infections: South Africa, Uganda, Kenya, Tanzania, Zimbabwe, Mozambique, Nigeria, Democratic Republic of Congo, India and Ethiopia (Report Card on PMTCT, 2005). In Ethiopia around 14,000 children were estimated to acquire new HIV infections from their mothers and 4,000 of them died of AIDS related causes in 2009 (FHAPCO, 2010). The rate of transmission varies from 20% to 45% (De Cock, Fowler, Mercier, de Vincenzi, Saba, Hoff, et al., 2000). About 5-10% of the infections occur during pregnancy mainly towards the end of the pregnancy.

2.5 Prevention of mother-to-child HIV transmission programmes (PMTCT)

There are effective interventions that help reduce MTCT. In the absence of interventions, the risk of MTCT is 20-45%, with the highest rates in populations with prolonged breastfeeding, but the risk of MTCT can be reduced to less than 2% with a package of evidence-based interventions including ARV prophylaxis and treatments combined with elective caesarean section and avoidance of breastfeeding (UNAIDS,

1999; Cooper, et al., 2002; WHO, 2004; WHO, 2007). There is a four-pronged strategy encompassing primary, secondary and tertiary prevention to prevent HIV among infants and young children. This includes key interventions to be implemented as a component of overall maternal, newborn and child health services. To facilitate implementation of these strategies, since 2000 different guidelines have been developed internationally by the Joint UNAIDS and WHO, and at national levels governments often adapt the international guidelines taking into consideration the local contexts. These prevention strategies are integrated in existing maternal and child health programmes and are implemented mainly under the auspices of the health system (Mirkuzie, 2011). The first prong is HIV prevention among the mothers to be, the second prong is prevention of unintended pregnancies among HIV-positive mothers, the third prong is the prevention of vertical transmission and the fourth prong is provision of treatment, care and support to HIV-positive mothers, their children and family. The effectiveness of the PMTCT programmes is largely dependent on proper implementation and utilization of the recommended services. In industrialized countries, where the recommended services are properly implemented, MTCT is on the verge of elimination, whereas it still represents a threat to child survival in many resource-poor settings (WHO, 2007; UNAIDS, 2010).

There is ample evidence on the decline of vertical transmission of HIV in low- and middle-income countries after the introduction of PMTCT strategies from 20 - 45 to less than 5% in the best-case scenarios (Goga, Dinh, Jackson for the SAPMTCTE study group, 2012; FHI, 2004; Grimwood, Fatti, Mothibi, Eley, Jackson, 2012), and in wealthy countries, transmission rates are below 2% (Siegfried, Van der Merwe, Brocklehurst, Sint, 2011; Paintsil, Andman, 2009). The recent UNAIDS report has created optimism about the success of the PMTCT programmes all over the world (UNAIDS, 2010). The report highlights 32% reduction in global incidence of MTCT and 24% reduction in the sub-Saharan African region in the past five years largely due to proper implementation of the third and the fourth prongs. The third prong addressing the prevention of vertical HIV transmission has four major components. These are HIV counselling and testing, provision of prophylactic/therapeutic ARV drugs for mothers and their infants, safe obstetric practices for HIV-positive mothers and infant feeding counselling and support (UNAIDS, 2010). Moreover, partner involvement in PMTCT and exposed infant follow up are important aspects of the

prevention of vertical HIV transmission programmes (UNAIDS, 2010). All these services are integrated within the continuum of existing maternal and child health care services.

The majority of PMTCT services are facility-based in antenatal clinics, requiring women to attend an ANC service to access PMTCT services. One barrier to the PMTCT service delivery is lack of ANC attendance. Universal facility-based coverage does not translate to 100% population coverage if not all pregnant women attend ANC and access available services. Although in many settings the vast majority of women attend ANC at least once, the proportion varies. A much smaller proportion of women complete the WHO-recommended 4 ANC visits during their pregnancy (UNICEF, 2009). Women often present to ANC late in gestation, preventing the early initiation of ARVs for either treatment or prophylaxis. Therefore, identifying mechanisms to encourage more pregnant women to attend ANC early and repeatedly and to reach those not attending ANC are critical gaps that must be addressed for the target of reaching 80% coverage of all pregnant women with PMTCT services to be achieved.

Although a critical focus of attention for prevention of MTCT is on the HIV-infected pregnant woman, primary prevention for pregnant women found to be uninfected is also important. While one study in Zimbabwe did not find pregnancy to be associated with increased risk of HIV infection (Sherr, Lopman, Kakowa, Dube, Chawira, 2007), in a large study in Rakai, Uganda, women had nearly twice the risk of acquiring HIV while pregnant compared with non-pregnant women, irrespective of their sexual behaviours or their partners' plasma viral load (Gray 2006). Increased risk of HIV acquisition during pregnancy, coupled with initial high levels of viral replication during acute infection, including in genital secretions, could make pregnancy itself a mechanism for efficient transmission of HIV from male sexual partners to pregnant women and subsequently to their infants. In resource-rich countries, a significant proportion of the remaining MTCT may be among women who having acquired HIV infection during pregnancy (Patterson, Leone, Fiscus, Kuruc, McCoy, Wolf, et al, 2007).

Prevention measures for MTCT were first introduced in Ethiopia in 2001, and now the programme has been implemented country-wide in 1324 public health facilities

(MoH, 2010). Despite the availability of these facilities, MTCT is unacceptably high ranging from an estimated 11% to more than 20% (FHAPCO, 2009).

Effective interventions for the prevention of mother to-child-transmission include antiretroviral prophylaxis, elective caesarean section and avoidance of breastfeeding (WHO, 2006). In resource-rich settings, where antenatal highly active antiretroviral therapy is extensively used, mother to-child-transmission rates have declined from around 16–25% in non-breastfeeding women to less than 1–2% (Townsend, Cortina-Borja, Peckham, Lyall, Tookey, 2008; Warszawski, Tubiana, Le Chenadec, Blanche, Teglas, Dollfus, et al., 2008; European Collaborative Study, 2006). In resource-limited settings, various abbreviated ARV prophylactic regimens have been shown to be effective PMTCT interventions, with single dose nevirapine being the most commonly used to date, although concerns exist regarding emergence of resistance following single dose nevirapine exposure (WHO, 2006; Arrive, Newell, Ekouevi, Chaix, Thiebaut, Masquelier, et al., 2007). There is also evidence that triple drug combinations are most beneficial for individual mother's health, as well as being the most effective in reducing mother-to-child transmission. By improving maternal health, it also improves prospects for the child's survival (Chersich, 2007; WHO, 2006). The benefits of these evidence based outcomes show that it is unquestionable that women need to be tested early and enter into PMTCT programs if infected.

2.6 History of Antiretroviral (ARV) prophylaxis in PMTCT

The first promising multi-centre clinical trial was conducted in 1994 by Connor and his colleagues in industrialized countries and reported the efficacy of the first ARV prophylaxis for PMTCT (Connor, Sperling, Gelber, Kiselev, Scott, O'Sullivan, et al., 1994). In this double blind clinical trial mothers were randomized to receive zidovudine (ZDV) prophylaxis or placebo. ZDV was initiated at 14-34 weeks of gestation to be taken five times daily, combined with intravenous doses during the intra-partum period. Infants were given ZDV syrup six times daily from birth up to six weeks postpartum. An interim analysis showed a 67.5% reduction in MTCT at the age of 18 months. ZDV became the first proven prophylaxis for PMTCT. ZDV is a class of ART called Nucleoside Reverse Transcriptase Inhibitor that can block the

action of an HIV enzyme called reverse transcriptase, which is necessary for viral replication (Rathbun, Lockhart, Stephens, 2006). However, the complexity and cost of this long course ZDV regimen hindered its potential benefit in resource-poor settings experiencing the highest HIV burden. By taking this into consideration Shaffer and his colleagues, in 1999, come up with a less complex and cheaper ZDV regimen, and a clinical trial was conducted in Thailand that enrolled 397 HIV-positive mothers from 1996 to 1997 (Shaffer, Chuachoowong, Mock, Bhadrakom, Siriwasin, Young, et al., 1999). ZDV was given to mothers from 36 weeks of gestation twice daily and every three hours during the intra-partum period. The findings showed a 51% reduction in the risk of HIV transmission among infants who were tested at two months postpartum. This simplified short course ZDV had substantially reduced the cost from $800 to $50 (CDC, 1998). Nonetheless, even the reduced cost was still not affordable in many resource-poor settings. In parallel, a clinical trial was conducted in Uganda from 1997 to 1999 (Guay, Musoke, Fleming, Bagenda, Allen, Nakabiito, et al., 1999). The trial enrolled 626 HIV-positive women to assess the efficacy of sdNVP regimen. NVP is one of the Non-Nucleoside Reverse Transcriptase Inhibitors, which prevents the action of reverse transcriptase that helps to translate viral deoxyribonucleic acid to ribonucleic acid (Rathbun et al., 2006). In this trial sdNVP was given to mothers to be taken during labour and to infants within 72 hours after birth. All the mothers were advised to exclusively breastfeed. The risk of HIV transmission was reduced by 47% at six weeks and by 41% at 18 months (Guay et al, 1999; Jackson, Musoke, Fleming, Guay, Bagenda, Allen, et al., 2003). The single-dose NVP regimen has shown comparable efficacy with the short course ZDV regimen. This regimen also provided additional cost saving with better infant survival at 18 months. Consequently, sdNVP regimen was scaled up in resource-poor settings. In the course of implementation, the safety of sdNVP regimen has become a growing concern for two major reasons (Lyall et al., 2001; MacIntyre, 2006; Rivero, Mira, Pineda, 2007). First, NVP is associated with liver toxicity (Rivero et al., 2007). Second, the regimen is prone to drug resistance as it is a mono-therapy and a single point mutation is enough for the NVP to confer drug resistance (Lyall et al, 2001; MacIntyre, 2006). To counteract the emergence of drug resistance and to achieve high level of viral suppression, a multi-drug prophylaxis regimen takes hold of the recommendations from 2006. Single-dose NVP (mothers & infants) combined with

short breastfeeding reduced MTCT to 16%, and when it is combined with replacement feeding reduced MTCT to 11% (WHO, 2007).

In the 2006 WHO recommendations, the cut-off point to initiate lifelong ART was CD4 cell count of less than 200 cells per micro liter (WHO, 2006). Whilst mothers with CD4 cell count over 200 cells per micro liter should receive ZDV twice daily from 28 weeks of gestation plus NVP and lamivudine during the intra-partum period and a seven days tail of ZDV and lamivudine during the postpartum. For the infants, ZDV plus sdNVP should be given at birth and a seven days tail of ZDV. However, if the mothers received the medication for less than one month, the infants' prophylaxis should be extended to one month.

The most recent revision in the WHO guidelines recommends prophylaxis initiation for mothers with a CD4 count above 350 cells per micro liter, otherwise lifelong ART irrespective of their clinical stage (WHO, 2010). Several first line recommendations are made available. Individual countries depending on their local circumstances can make the choice of appropriate regimen. This revision also highlights early initiation of the prophylaxis at 14 weeks gestation and to continue throughout the breast-feeding period. These multidrug extended medication regimens can substantially reduce the MTCT among breast-feeding infants. Despite availability of various efficacious prophylactic ARV drugs, ensuring the required level of medication utilization and adherence remains challenging especially in resource-poor settings (Manzi, Zachariah, Teck, Buhendwa, Kazima, Bakali, et al., 2005; Ahoua, Ayikoru, Gnauck, Odaru, Odar, Ondoa-Onama, et al., 2010). A report on 16 sub-Sahara African countries shows that over 85% of them have prophylaxis coverage less than 60%, worse still Ethiopia achieved only about 20% coverage. Proper adherence to a given medication regimen is mandatory in order to achieve high and sustained level of viral suppression (Nachega, Hislop, Dowdy, Chaisson, Regensberg, Maartens, 2007). Poor adherence could result in sub-optimal viral suppression favouring drug resistance, treatment failures and increased risk of MTCT. If there is good adherence AZT (from 28 weeks) and single-dose NVP (mothers & infants), combined with short breastfeeding: reduce MTCT to 10%, and combined with replacement feeding: reduce MTCT to 2% (WHO, 2007).

An estimated 25% of HIV-positive pregnant women are in need of antiretroviral therapy for their own health; however only 10% in low and middle-income countries received it in 2008 (UNAIDS/WHO/UNICEF 2009). HIV-positive pregnant women must be assessed using CD4 screening for eligibility and those in need provided antiretroviral treatment to improve and maximize health outcomes.

Ethiopia is one of many countries where antenatal attendance and facility-based delivery rates are very low, making identification of HIV-infected pregnant women and provision of antiretroviral interventions quite challenging. Innovative approaches and programs to provide PMTCT and HIV services to such populations are needed.

2.7 Factors affecting utilization of HCT and PMTCT

Demographic characteristics: Various demographic risk factors have been identified for the low uptake of HCT and subsequent entry into PMTCT. A study conducted in South Africa and Zimbabwe demonstrated that, being in the age group 25 to 34 years and increasing age were positively associated with knowledge of HIV status respectively (Peltzer, Matseke, Mzolo, Majaja, 2009; Sherr et al., 2007). But a study conducted in rural Uganda has found that the VCT uptake was 2.7 times higher among men aged 35 years and below, compared to greater than 35 years old (Bwambale et al., 2008). A study conducted in North Uganda by Fabiani, Cawthorne, Nattabi, Ayella, Ogwang. (2007) to investigate factors associated with VCT showed that having some education and being married were associated with VCT uptake. The South African population-based HIV survey showed that VCT uptake is associated with being in a non-Black population group, such as White, Coloured or Asian (Peltzer et al., 2009).

According to Peltzer et al. (2009) a higher educational level increases the likelihood of knowledge of HIV status and more individuals residing in urban areas know their HIV status than their rural counterparts. In Malawi the number of people accessing HIV testing and counselling increased more than threefold between 2002 and 2005, though there is more urban than rural in the uptake and more women access than men (Makiza, Nyirenda, Bongololo, Banda, Chimzizi, Theobald, 2009). Similarly, a study

conducted in Nigeria by Iliyasu, Abubakar, Kabir, Aliyu (2006) indicates that having formal education and being female significantly predicts positive attitudes towards VCT. In contrast to these, a study in rural Tanzania showed that men (12%) were more likely to access HCT than women (7%) (Wringe et al., 2008). This variability suggests that HCT/PMTCT may be affected by factors beyond the individual level.

Socio-economic characteristics: A Ugandan study, among married men aged 15-49, showed that a history of paying for sex, and household wealth are associated with an increased likelihood of HIV testing (Gage, Ali, 2005). Employed individuals are more likely to know their HIV status compared to their unemployed counterparts (Peltzer et al., 2009). According to Ma et al. (2007) VCT was associated with the individual's occupation.

Social characteristics: According to Bwambale et al. (2008), stigma and confidentiality of services are the major barriers to VCT uptake among men in rural western Uganda. A study conducted to assess knowledge of HIV/AIDS and attitude towards VCT among adults in a rural community in northern Nigeria confirmed that, the reasons for rejection of VCT included fear of stigma, marital disharmony, incurable nature of the disease and cost of treatment (Iliyasu et al., 2006). Fear of unsolicited disclosure, fear of stigma and discrimination are the main barriers to uptake of VCT in China (Ma et al., 2007). In addition to this, client-counselor dynamics including lack of confidentiality are negatively associated as a barrier to HCT (Haile et al., 2007; Radebe, 2006; Varga, Brookes, 2008). A study conducted in the US by Anderson, Koenig, Lampe, Wright, Leiss, Saul (2005) shows that the percent of providers reporting universal testing was positively associated with the degree to which testing was encouraged, in particular the encouragement to women perceived to be at low risk. Negative or judgmental attitudes of health care workers (HCW) towards HIV-infected women and stigma have been cited as contributing to women's reluctance to return to ANC after the initial visit (Chopra, Daviaud, Pattinson, Fonn, Lawn, 2009; Bwirire, Fitzgerald, Zachariah, Chikafa, Massaquoi, Moens, et al., 2008).

Because of fear of accusations of infidelity, abandonment, discrimination and violence family-focused programs with free access to antiretroviral therapy such as

the MTCT-Plus program in Cote d'Ivoire, only 53% of 568 women indicated that they had disclosed their HIV status to their male partner, (Tonwe-Gold, Ekouevi, Bosse, Toure, Koné, Becquet, et al, 2009).

Proximity and Access to HCT: Proximity to clinics, availability of rapid testing and outreach services are positively associated with the utilization of VCT (Hutchinson, Mahlalela, 2006). In Uganda, limited utilization of VCT is related to poor access to services (Bwambale et al, 2008), and according to Morin et al. (2006) reasons for not being tested previously were often associated with inconvenience of hours and location of VCT sites.

HIV knowledge including prior knowledge of VCT sites and HIV risk perception and HIV risk behaviour: Sherr et al. (2007) showed that having prior knowledge about HIV increases the uptake of VCT. In contrast to this, in Botswana, being interviewed at an urban site, having a high PMTCT knowledge score, knowing someone receiving PMTCT or ARV therapy, and having a partner who had been tested for HIV were associated with low uptake into testing (Creek, Ntumy, Mazhani, Moor, Smith, Han, et al., 2009). The same study reported that neither fear of stigma nor resistance from partners were frequent reasons for refusing an HIV test. Peltzer et al. (2009) found that awareness of a place nearby where one could be tested for HIV, impact of HIV on the household and having had two or more sexual partners in the past year were associated with knowledge of HIV status. This finding is supported by a study conducted in rural Tanzania that indicated self-perceived risk of HIV, prior knowledge of VCT, and sex with a high risk partner emerged as important predictors on accessing VCT (Wringe et al., 2008)

According to Babalola (2006), a study conducted to examine the predictors of readiness for HIV testing among young people in northern Nigeria showed that there are commonalities and differences in the correlates among men and women. Namely knowledge about HIV prevention, knowledge about a source for VCT, discussion about condom use for HIV prevention and perceived risk are strong predictors.

Health status: Ma et al. (2007) considered health status and high-risk behaviours of the individual as positive contributor to seek VCT in China.

HIV testing and counselling model used: There is some evidence that the uptake of HCT differs depending on the counselling and testing model used, such as the use of HCT kits other than rapid testing kits across different populations of high HIV prevalence (Etiebet, Fransman, Forsyth, Coetzee, Hussey, 2004; Doherty, McCoy, Donohue, 2005; Coovadia, 2000; Cartoux, Meda, Perre, Newell, de Vicenzi, Dabis, 1998). In a cluster-randomized trial, subjects randomized to an optional testing location (including home based testing) were 4.6 times (CI 3.6-6.2) more likely to accept VCT than those in the facility arm (Bateganya, Abdulwadud, Kiene, 2007).

Provision of couples counselling and testing has been shown to increase acceptance of HIV testing by pregnant women in a number of studies from Burkina Faso, Cambodia, Kenya, Tanzania, and Uganda (Msuya, Mbizvo, Hussain, Uriyo, Sam, Stray-Pedersen, 2008; Farquhar, Kiarie, Richardson, kabura, John, Nduati, et al., 2004).

Qualitative case studies conducted in Limpopo, South Africa, described client counsellor dynamics during pretest counselling as pivotal in determining uptake and participation, and also highlighted that counsellor profile strongly influenced the nature of the interaction (Verga, Brookes, 2008). In Botswana, a shift from patient-initiated testing to provider-initiated routine testing increased the proportion of antenatal clients who accepted HIV testing from 76% to 95%; and in urban Zimbabwe HIV testing rates increased from 65% to 99% when an opt-out provider-initiated testing program was implemented (Creek, Ntumy, Seipone, Smith, Mogodi, Smit, et al., 2007; Chandisarewa, Stranix-Chibanda, Chirapa, Miller, Simoyi, Mahomva, et al., 2007). In the absence of provider-initiated testing and counselling in antenatal clinics, testing rates remain low, even where antenatal care attendance rates are high.

2.8 Factors affecting utilization of maternal health services

Utilization of maternal health services is a complex behavioural phenomenon. The use of maternal health services is related to availability, quality and cost of services as

well as social structure, health beliefs and personal characteristics of the users (Chakraborty, Islam, Chowdhury, Bari, Akhter, 2003).

In the utilization of maternal health services, the evidence show that women's current age plays an important role, mostly decrease when the age increase (Letamo, Rakgoasi, 2003; Stanton, Blanc, Croft, Choi, 2007; Mpembeni, Killewo, Leshabari, Massawe, Jahn, Mushi, et al., 2007). While mothers' age may sometimes serve as a proxy for women's accumulated knowledge of health care services, which may have a positive influence on the use of health services, it does not uniformly work for all settings. For instance, according to Letamo, Rakgoasi (2003) Botswana teenagers were at eleven times higher risk of utilizing an unqualified birth assistant than women 35 years and above. Women aged 35 and above, who are at greatest risk of maternal death, are the least likely to receive professional delivery care (Stanton et al., 2007). On the other hand, because of developments in modern medicine and improvements in educational opportunities for women in recent years, younger women might have an enhanced knowledge of modern health care services and place more value upon modern medicine (Stanton et al., 2007; Mpembeni et al., 2007).

According to Chakraborty et al. (2003), family size is one of the demographic factors that determine the use of maternal health services in rural Bangladesh. Women from large families underutilize various health care services because of excessive demands on their time. Larger families also cause resource constraints, which have a negative effect on health care utilization (Chakraborty et al., 2003).

There is ample evidence that, birth order and parity are individual level important determinants for the use of maternal health care services, with births order and parity inversely related with the likelihood of utilizing the services (Celik, Hotchkiss, 2000; Letamo, Rakgoasi, 2003; Mekonnen, Mekonnen, 2003; Stanton, et al., 2007). The 1993 Turkish Demographic Health Survey analysis by Celik and Hotchkiss (2000), found that low parity women were significantly more likely to select a facility-based delivery. According Stanton et al. (2007), compiled data from national surveys from all continents showed that low parity women were more likely to seek skilled birth attendance. High birth order was found to be a predisposing factor of home delivery. After an uneventful birth of the first child at home, subsequent deliveries are

perceived to be low risk thus increasing the likelihood of delivering the subsequent babies at home (Navaneetham, Dharmalingamb, 2002; Thind, Mohani, Banerjee, Hagigi, 2008). However, a Botswana study that analyzed data from the 1996 Family Health Survey found that the proportion of not utilizing maternal services among lower parity women was consistently higher than among higher parity women (Letamo, Rakgoasi, 2003).

Education level among women their husbands or potential partners is an important predictor for the use of maternal health care services (Celik, Hotchkiss, 2000; Navaneetham, Dharmalingamb, 2002; Chakraborty et al., 2003; Letamo, Rakgoasi, 2003; Stephenson, Baschieri, Clements, Hennink, Madise, 2006; Houweling, Ronsmans, Campbell, Kunst, 2007; Mpembeni et al., 2007). It is well recognized that a woman's educational level has a positive impact on health care utilization. According to Stephenson et al. (2006) increased education influences service use by increasing female decision-making power, increasing awareness of health services, changing marriage patterns, and creating shifts in household dynamics. Chakraborty et al. (2003) argued that women's education may also act as a proxy variable of a number of background variables representing women's higher socioeconomic status, thus enabling them to seek proper medical care whenever they perceive it as necessary.

Socioeconomic factors also have been shown to be of greater importance in determining maternal health service utilization (Stephenson et al., 2006; Houweling et al., 2007). There is evidence showing increased income has a positive effect on the utilization of modern health care services, whereas low income and the cost of services are important constraints on service utilization (Letamo, Rakgoasi, 2003; Houweling et al., 2007; Stanton et al., 2007). In the resource-limited countries there is a huge inequality in the use of ANC and skilled birth attendants, with the poor being at a stark disadvantage (Houweling et al., 2007; Mayhew, Hansen, Peters, Edward, Singh, Dwivedi, et al., 2008).

A pregnant woman who is living in urban areas has greater probability of using trained professionals for maternal health services (Celik, Hotchkiss, 2000; Letamo,

Rakgoasi, 2003). According to Navaneetham and Dharmalingamb (2002) urban residence increased the likelihood of institutional delivery compared to rural residence. Place of residence was found to be an important predictor for the use of delivery services in Ethiopia (Mekonnen, Mekonnen, 2003) as well as in Nigeria (Babalola, Fatusi, 2009), with urban women more likely to use institutional deliveries compared to rural women. According to these researchers in many sub-Saharan African countries, rural areas have poor road networks, inadequate transportation and fewer health facilities compared to urban areas, making women from rural areas less likely to have access to health facility deliveries (Mekonnen, Mekonnen, 2003; Babalola, Fatusi, 2009).

Amooti-Kaguna and Nuwaha (2000) who studied factors influencing choice of delivery sites in Rakai district of Uganda described a model, which predicts various health related behaviours. According to their model (Attitudes-Social influence-Self efficacy model), behaviour such as choice of delivery site is considered to be a result of behaviour intention. They further explained three main psychosocial factors that have been identified to predict behaviour intention: attitudes, social influences and self-efficacy. The implication of this model is that a person's health behaviour can be changed, by changing one's attitudes, perception of social norms, and social support and self-efficacy expectations.

Some of the barriers to initial and on-going ANC attendance include: high cost of transport for women in rural areas; user fees associated with institutional care and delivery services; poor quality of services (real or perceived); poor facility conditions; lack of organization and efficiency of services leading to overcrowding and long delays; and lack of privacy (Agyepong, 1999; Chopra, et al., 2009; Doherty, 2009; Bwirire et al., 2008; Turan 2008).

Stephenson et al. (2006), found that an individual's cultural environment provides a strong influence on the extent to which these factors can lead to the use of maternal health services. This study revealed that a community where most women deliver in a health facility has a strong positive influence on other women's decision to seek care for childbirth; the practice is therefore likely to be seen as a norm, influencing

individual behaviour. This is the confirmation that perception and knowledge of the community members about maternal health problems play a role in their care seeking behaviour.

There is significant evidence that shows proximity to health care services, especially in resource limited countries, plays an important role in the utilization of maternal health services (Amooti-Kaguna, Nuwaha, 2000; Celik, Hotchkiss, 2000; Chakraborty et al., 2003; Gage, Callixte, 2006; Onah, Ikeako, Iloabachie, 2006). The study conducted in Uganda by Amooti-Kaguna et al. (2000), described that access to maternity services was an important determinant of the choice of delivery site. The effect of distance on the use of health services has been attributed to the time and cost of travel, compounded by unhelpful topography, poor road conditions and a lack of public transport (Gage, Callixte, 2006). Because of this the utilization of biomedical care during pregnancy diminished with increasing distance from a government-sponsored clinic and from the capital city.

2.9 Hierarchical (Multilevel) modelling

According to Diez-Roux (1998) paradoxically, epidemiology, the study of disease in populations, has largely been reduced to the study of individual-level risk factors for disease. Multilevel analysis is one way to begin to restore a population or societal dimension to epidemiologic research (i.e., the idea that factors operating at the levels of groups or societies affect the health of individuals within them) (Diez-Roux, 1998).

Hierarchical modelling has become increasingly popular (Bingenheimer, Raudenbush, 2004) and has many features (Diez-Roux, 2000) that may be of use in public health research. However, in the investigation of contextual determinants of health, hierarchical modelling has been underused in the literature as compared with more traditional measures of association (Merlo, Chaix, Yang, Lynch, Rastam, 2005). Merlo et al. (2005) clarified that contextual factors may modify the effect of individual characteristics on health, and that individual and contextual factors can be used to explain compositional and contextual neighborhood differences in health.

There are differences between single-level and multilevel modelling in real-world clustered data and the multilevel technique lead to more accurate results. Krull and Mackinnon (2001) in their mediational effects study compared the performance of multilevel mediational models with that of single-level mediational models in clustered data with individual- or group-level initial independent variables, individual- or group-level mediators, and individual level outcomes using a simulation study. The standard errors of mediated effects from the multilevel solution were generally accurate, while those from the single-level procedure were downwardly biased, often by 20% or more. The multilevel advantage was greatest in those situations involving group-level variables, larger group sizes, and higher intra class correlations in mediator and outcome variables.

Wright and Subramanian (2007) discussed that asthma epidemiology has focused on individual-level risk factors and family factors. Far less attention has been given to the broader social context in which individuals live. A multilevel approach that explicitly recognizes the embedding of asthma within its biological, psycho-socioeconomic, environmental, and community contexts, is likely to provide a better understanding of asthma disparities at different stages in the life course (Wright, Subramanian, 2007).

In their studies Bentley, Kavanagn, Subramanian, Turrell, (2008) found that area disadvantage and individual socioeconomic position were independently associated with premature cancer mortality, suggesting that interventions to reduce inequalities should focus on places and people. Additionally Babalola, and Fatusi, (2009), described that factors influencing maternal health services utilization operate at various levels – individual, household, community and state. And they have suggested that depending on the indicator of maternal health services, the relevant determinants vary.

Another study conducted by Sundquist, Malmstrom, and Johansson, (2004) confirmed that high levels of neighborhood deprivation independently predict coronary heart disease for both women and men. Both individual and neighborhood level approaches are important in health care policies (Sundquist et al., 2004).

2.10 Theoretical framework of the Multilevel Model to address ANC, HCT and PMTCT

There is evidence that utilization of health services is a complex behavioural phenomenon (Chakraborty, Islam, Chowdhury, Bari, 2002). Sociological theories are the origins for the concept that focuses on the importance of the group level (such as social and environmental) factors determining human behaviour and health outcomes (Huang, Drewnowski, Kumanyika, Glass, 2009). This study applies conceptual framework of 'Andersen's Behavioural Model of Health Services Use' (Andersen, McCutcheon, Aday, Chiu, Bell, 1983; Andersen, 1995; Andersen, Yu, Wyn, Davidson, Brown, Teleki, 2002), and a framework of maternal health use suggested by the World Health Organization (AbouZahr, Royston, 1991). The Behavioural Model developed originally in the late 1960s by Andersen has been further developed and expanded to include health systems aspects (Aday, Andersen, 1981), use of services, client satisfaction, and population characteristics (Andersen, 1995; Ricketts, Goldsmith, 2005).

Figure 2: Andersen's health care utilization behavioural model(R.M. Andersen 1995 [78]

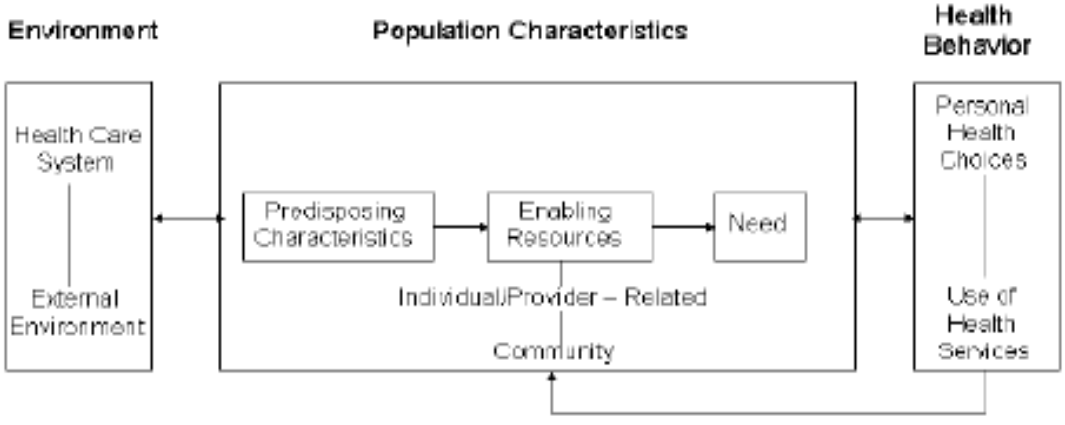

Figure 3. Andersen's health care utilization behavioural model

Andersen's Behavioural Model of Health Services Use was considered most appropriate for this study allowing the depiction of factors at different levels, as well as, their interactions. According to the Behavioural Model, three types of predictors are defined: predisposing variables, enabling factors, and need. Predisposing variables

are individual or household characteristics that exist prior to the onset of illness or the health status that requires health attention. These include demographic characteristics such as age, gender, ethnicity, and educational backgrounds.

Enabling factors are defined as the "means" including financial and organizational factors that allow individuals to use the health services. Individual enabling factors include income, health insurance, knowledge of where and how to obtain health services, and travel time to health services. On the delivery side, enabling factors include availability of health providers and geographical or special distribution of these providers (Andersen, 1995). In addition to these enabling factors, structural and process indicators of quality of services provided by the health facility is included in the analysis.

In analyzing access to and use of curative care, variables such as age and perceived health that predict potential need for health services are important to include. However, in this study need is considered as given since the study population is restricted to all women who were pregnant and delivered in the past two years, and by definition everyone in the study had the need to seek maternal health services. This model (figure 2), integrates individual level (such as: age, education level, ethnicity, and so on), household level (household income, parity, and so on) and district level (nurse load, PHC, district SES quintile, and so on) influences on accessing HCT and PMTCT.

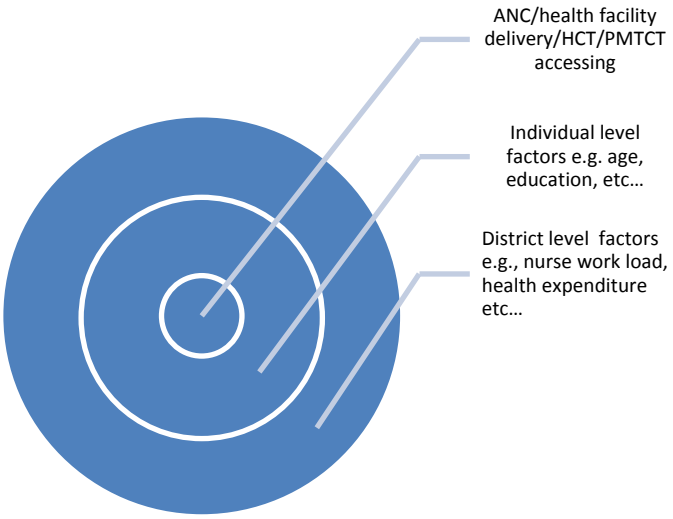

Figure 4. Theoretical frame-work of the study

Each layer from center to outer part shows a nested hierarchy of systems including individual, health facility (district level) influences. This model shows that the behaviour of accessing ANC, health facility delivery, HCT and PMTCT, not just the uptake per se, are influenced by individual or contextual factors.

People are assumed to engage in behaviours based on preferences and attitudes (Huang et al., 2009). It becomes hierarchical in that a person is constrained by factors that exert regulatory control on those behaviours. For instance, ANC/facility delivery/HCT/PMTCT uptake is not accessed just on the basis of preferences to take but also on the basis of the availability of the services, cost of the services, confidentiality of the services, knowing the center that gives the services, partners/friend support and so on. The distribution of these parameters constitutes a behavioural slot, to which the individual must adapt and respond according to particular goals and intentions. The movement in time of higher or lower uptake of ANC/health facility delivery/HCT/PMTCT is, therefore, the results of multiply dependent and interlocking systems. There are four possible implications. First, single level factors on the uptake of ANC/health facility delivery/HCT/PMTCT are unlikely. Second, the processes that give rise to increasing uptake on average probably involve the combinations of factors at multiple levels of influence. Third, a given change in one or more key factors may have large and potentially nonlinear influences on the uptake of ANC/health facility delivery/HCT/PMTCT. Finally, micro and macro level factors are involved in the uptake of ANC/health facility delivery/HCT/PMTCT.

Earlier studies have found association between individual level factors such as education, occupation, and household wealth and the utilization of ANC/health delivery/HCT/PMTCT facility. Despite these arrays of evidence linking preventive care to individual level factors, the role of community level factors has been clearly neglected. Most of the studies have not been able to give insight into the effect of community level factors on uptake of ANC/health facility delivery/HCT/PMTCT. Given the fact that most of these interventions are community based, it is probable that community level factors may impede their uptake. In the light of these findings, understanding how community level characteristics - in addition to individual level factors - are linked to the uptake ANC/health facility delivery/HCT/PMTCT, is

crucial to targeting interventions at those most in need. In the following chapter, the details of methodology were shown.

CHAPTER THREE

AIM AND OBJECTIVES

3.1 Aim of the study

The aim of this thesis is to investigate factors associated with ANC, health facility delivery, HCT and PMTCT uptake in Ethiopia at the individual - and contextual level using a hierarchical (multilevel) modelling approach.

3.2 Objectives of the study

- To describe the individual and contextual level factors that affect the uptake of ANC, health facility delivery, HCT and PMTCT in Tigray region, Ethiopia
- To explore the determinants of uneven distribution of ANC, health facility delivery, HCT and PMTCT uptake inter and intra districts in Tigray region, Ethiopia
- To determine which (contextual or individual) factor has a greater influence on the uptake of ANC, health facility delivery, HCT and PMTCT in Tigray region, Ethiopia

CHAPTER FOUR

METHODODLOGY

4.1 Study setting

Ethiopia has a federal system of government, and political leaders are elected every five years. Major changes in the administrative boundaries within the country have been made three times since the mid-1970s. At present Ethiopia is administratively structured into nine regional states—Tigray, Affar, Amhara, Oromiya, Somali, Benishangul-Gumuz, Southern Nations Nationalities and Peoples (SNNP), Gambela, and Harari—and two city administrations, that is, Addis Ababa and Dire Dawa Administration Councils. Ethiopia embraces a complex variety of nationalities, peoples, and linguistic groups. Its peoples altogether speak over 80 different languages, constituting 12 Semitic, 22 Cushitic, 18 Omotic, and 18 Nilo-Saharan languages (MOI, 2004).

Ethiopia has great geographical diversity; its topographic features range from the highest peak at Ras Dashen, 4,550 metres above sea level, down to the Affar Depression, 110 metres below sea level (CSA, 2009). The climate varies with the topography, from as high as 47 degrees Celsius in the Affar Depression to as low as 10 degrees Celsius in the highlands. Ethiopia's total surface area is about 1.1 million square kilometres. Djibouti, Eritrea, the Republic of the Sudan, the Republic of the Southern Sudan, Kenya, and Somalia border the country.

Ethiopia is an agrarian country and agriculture accounts for 43 percent of the gross domestic product or GDP (CSA, 2009). Coffee has long been one of the main export items of the country; however, other agricultural products are currently being introduced on the international market. The Ethiopian currency is the Birr and at the current exchange rate, 1 US dollar is equivalent to about 17.5 Birr. Between 1974 and 1991 the country operated a central command economy but has since moved toward a market-oriented economy. Currently, the country has one commercial and two

specialized government owned banks and 14 privately owned commercial banks, one government-owned insurance company and eleven private insurance companies. There are also 30 micro-financing institutions established by private organizations (NBE, 2010).

To help attain the Millennium Development Goals (MDGs) by 2015, Ethiopia adopted the Plan for Accelerated and Sustained Development to End Poverty (PASDEP), the second poverty reduction strategy, covering the period 2005/06 to 2009/10. In keeping with this plan, the economy has grown in real GDP at a rate of 11 percent per annum in the past five years. With an average population growth rate of 2.6 percent, the GDP growth rate translates to an 8.4 percent growth in average annual per capita income. This rapid growth is the result of diversification and commercialization of small-scale agriculture, expansion of non-agricultural production in services and industry, capacity-building and good governance, off-farm employment especially through small enterprises, and investment in infrastructure (MOFED, 2010).

The Growth and Transformation Plan (GTP) has been developed for the next five years, designed to maintain rapid and broad-based economic growth and eventually to end poverty (MOFED, 2010). One of the primary objectives of the GTP is to expand and ensure education and health services, thereby achieving the MDGs in the social sectors.

Despite Ethiopia's long history, there were no estimates of its total population prior to the 1930s. The population has increased steadily over the last three decades, from 42.6 million in 1984 to 53.5 million in 1994 and 73.8 million in 2007. There were slight declines in the population growth rates over these periods, from 3.1 percent per annum in 1984 to 2.9 percent in 1994 and 2.6 percent in 2007.

Ethiopia is one of the least urbanized countries in the world; only 16 percent of the population lives in urban areas (CSA, 2010). The majority of the population lives in the highland areas. The main occupation of the settled rural population is farming, while the lowland areas are mostly inhabited by a pastoral people, who depend mainly on livestock production and move from place to place in search of grass and water.

More than 80 percent of the country's total population lives in the regional states of Amhara, Oromiya, and SNNP.

Christianity and Islam are the main religions; about half of the population are Orthodox Christians, one-third are Muslims, about one in every five (18 percent) are Protestants, and 3 percent are followers of traditional religion. The country is home to more than 80 ethnic groups, which vary in population size from more than 26 million people to fewer than 100 (CSA, 2010).

The Ethiopian government, to realize the objectives of the health policy, established the Health Sector Development Programme (HSDP), which is a 20-year health development strategy implemented through a series of four consecutive 5-year investment programmes (MOH, 2010). The first phase (HSDP I) was initiated in 1996/97. The core elements of the HSDP include: democratization and decentralization of the health care system; development of the preventive and curative components of health care; ensuring accessibility of health care for all segments of the population; and, promotion of private sector and NGO participation in the health sector. The HSDP prioritizes maternal and new-born care, and child health, and aims to halt and reverse the spread of major communicable disease for instance HIV/AIDS, TB, and malaria. The Health Extension Programme (HEP) serves as the primary vehicle for prevention, health promotion, behavioural change communication, and basic curative care. The HEP is an innovative health service delivery program that aims at universal coverage of primary health care. The programme is based on expanding physical health infrastructure and developing Health Extension Workers (HEWs) who provide basic preventive and curative health services in the rural community (MOH, 2010).

The fourth phase of (HSDP IV) is designed to provide massive training of health workers to improve the provision of quality health services and the development of a community health insurance strategy for the country. In addition, HSDP IV will prioritize maternal and new-born care, and child health, and aim to halt and reverse the spread of major communicable disease such as HIV/AIDS, TB and Malaria. In line with the government's current five-year national plan, the health sector continues to emphasize primary health care and preventive services; with focus on extending

services to those who have not yet been reached and on improving the effectiveness of services, especially addressing difficulties in staffing and the flow of drugs.

With an estimated 1.1 million people living with HIV, Ethiopia has one of the largest populations of HIV infected people in the world (UNAIDS, 2010). The Government of Ethiopia has started integrating services such as PMTCT and HCT with family planning and maternal, new-born and child health services. HCT is still underutilized; even though the program increased by 22% in 2008/09 with 1823 health facilities providing HCT (FHAPCO, 2010).

4.2 Study sites

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), the Tigray Region has an estimated total population of 4,314,456, of whom 2,124,853 are men and 2,189,603 women; urban inhabitants number 842,723 or 19.53% of the population. With an estimated area of 50,078.64 square kilometers, this region has an estimated density of 86.15 people per square kilometers. For the entire region 985,654 households were counted, which results in an average for the Region of 4.4 persons to a household, with urban households having on average 3.4 and rural households 4.6 people. At 96.55% of the local population, the region is predominantly inhabited by people from the Semitic-speaking Tigray ethnic group. Most other residents hail from other Afro-Asiatic communities, including the Amhara (1.63%), Saho (0.71%), Afar (0.29%), Agaw (0.19%) and Oromo (0.17%). There are also a minority of Nilo-Saharan-speaking Kunama Nilotes (0.07%). 95.6% of the Tigray region's population is Orthodox Christians, 4.0% Muslim, 0.4% Catholics and 0.1% Protestant.

According to CSA (2008), in Ethiopia “urban areas” refer to “…all capitals of regions, zones and woredas/districts, and it also includes localities with urban kebeles (the lowest administrative level) whose inhabitants are primarily engaged in non-agricultural activities.” All the other areas are considered rural. Based on this definition the rural areas consist of 84 percent of the total population.

Access to health services is very limited in Ethiopia. Only 51 percent of the population has access to health services. The ANC coverage in Tigray region in 2009 was 73%, from this only 43% have tested for HIV, and 3.1% have tested HIV positive. Only 51% of HIV positive pregnant women and 38% of babies born to HIV positive mothers were given Nevirapine/ARV.

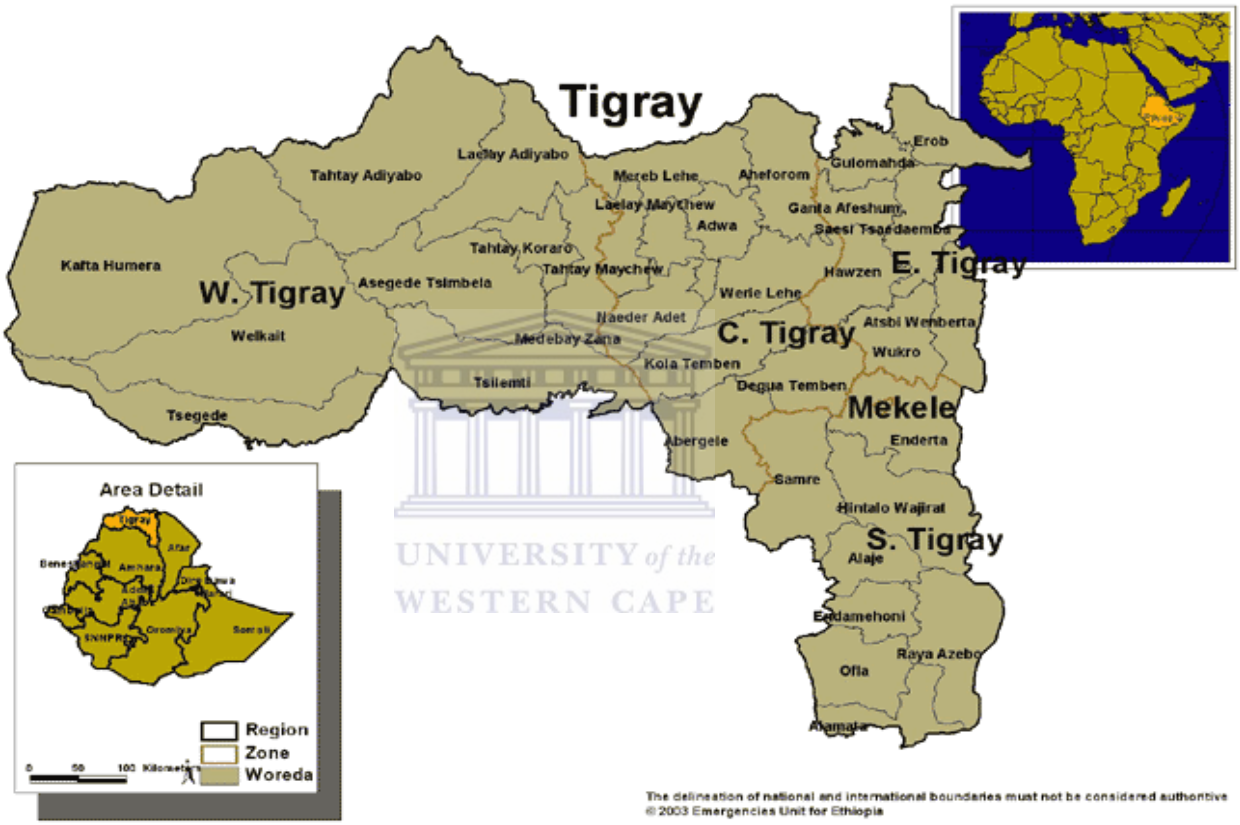

Figure 5. Map of the study setting

4.3 Study design

The study was a facility based cross-sectional, multistage sampling design in which health facilities were first selected (stage 1), followed by recruitment of post-partum women who came for child immunization from each health facility (stage 2) in Tigray region. This two stage sampling scheme result in a two level data structure (i.e. health facilities and then post-partum women within health facilities), with health facilities

corresponding to the primary sampling unit, and post-partum women within each primary sampling unit to the secondary unit.

4.4 Study population and sampling procedures

The population of this study constituted the post-partum women who were attending the health facility for child immunization in the Tigray region Ethiopia. In our hierarchically nested data, we have two sample sizes. First the group size, that means the number of individuals N_j in group J, and second the number of groups, that is the number of J groups. Both conditions have influence on the estimates of the above specified parameters. According to Maas and Hox (2005) only a small sample size at stage (level) two (meaning a sample of 50 or less) leads to biased estimates of the second level standard errors at the second level. They also mentioned that a large number of groups appear more important than a large number of individuals per group. A group size of 30 is normal in educational research, and a group size of five is normal in family research and in longitudinal research, where the measurement occasions from the lowest level (Mass, Hox, 2005). Kreft (1996) suggests a rule of thumb which she calls the '30/30' rule, which means a sample of at least 30 groups with at least 30 individuals per group is necessary. Based on these facts, and in order to obtain a robust estimate, we took 60 of 200 health facilities in the region. In the region there are 47 different woredas/districts for the second level, and after taking one health facility from each woredas randomly, the rest included all 13 hospitals in the region. At the second stage for the first level, from each health facility purposefully and systematically sampled 30-36 post-partum women were interviewed.

When the selected health facility was medium (immunizing less than 1000 children per annum), the sampling was purposive until we got the needed sample size. In large size health facilities (immunizing greater than 1000 per annum) a systematic random selection method was used. In such facilities, instead of taking postpartum women in their consecutive order we took every third number of postpartum mother starting from a certain randomly selected first number.

4.6 Data collection

A structured interview, in English, was developed by modifying the South African National PMTCT Evaluation questionnaires (Goga et al. 2012) and reviewing literature of similar studies carried out previously. The final modified English questionnaire was translated to Tigirigna (local language in the study setting) and retranslated back to English by another person to ensure its consistency and clarity. The questionnaire was pre-tested at three health facilities (not in the study population) to check clarity, consistency, skipping pattern and order of questions. Modifications were then made based on the finding on the pilot study.

Trained nurse interviewers administered interviews in the health facility, the principal investigator and four senior nurses (who were trained) supervised the data collection process. They received two days training on the tools and operating procedures for this study, as well as a refresher on general research issues prior to the start of data collection. Interviews were conducted in the language preference of the participant and lasted approximately 30-45 minutes. Questionnaires included information of demographic factors, socio-economic factors, social factors, waiting times, distance of health center, HIV knowledge, knowledge of HCT/PMTCT sites and HIV risk perception and risk. Facility managers provided data on availability of HIV test kits / ARV, number of different health workers in the health facility and from the woreda, health expenditure of woreda, and the population size of the woreda.

4.7 Data management & data analysis

Data cleaning

Data cleaning was started in the field by the supervisors. Data entry was conducted in the field as soon as the data were collected, by the principal investigator. This enabled the researcher to crosscheck logically inconsistent data with the data collectors, and if necessary to follow up with the mother given that information. Twenty percent of the questionnaires were double-entered and checked for the consistency and found to be consistent.

Data cleaning continued once the data was compiled. One of the main areas for cleaning at this stage was ensuring that there were no duplicates of unique identifications numbers. Each respondent and each questionnaire has a unique code that consists of questionnaire code, and a health facility code or district code. These unique identification codes allow linking of data from women and data from the main health facility questionnaire.

Construction of the data file

Several datasets from the survey were merged to create a dataset with the hierarchical structure to enable the multilevel analysis. The data files merged included: data from the main household questionnaire; mothers' questionnaires that contained mothers' experiences during pregnancy and maternal service use; the questionnaire for the regional representative that contained questions on characteristics of the districts; and the questionnaire for the health facility representative on health facility characteristics. Characteristics of midwives, all types of health workers were averaged at the district level and linked to the database. Each of these data files were linked using the unique respondent identifier codes and district identifier codes.

The analysis

The first steps of the analysis were descriptive data analyses and creating cross tabulations, which facilitated the creation of the definitions of categorical variables. Prior to defining the hierarchical models, modelling processes such as testing of collinearity, selection of coefficients, and testing for interactions were conducted with logistic regressions using robust and standard variance estimators taking clustering into account, whenever appropriate. Two-level hierarchical logistic random-intercept models were run for each of the four outcome variables under study: use of antenatal care, delivery by skilled assistant, HCT utilization and getting PMTCT services. Individual characteristics were modeled at level-1, and district level characteristics at level-2 (see section on Statistical Analysis). All statistical analysis used STATA 11 (Stata Corporation, College Station, TX (2010)) and multilevel logistic regressions were run using the command 'xtmelogit' with binomial link function (Rabe-Hesketh, Skrondal, Pickles, 2004).

4.7.1 Construction of Study Variables

Dependent variables

The four dependent variables in this analysis are principal maternal health service use variables.

Utilization of antenatal care services is a binary outcome variable, which measures whether a mother accessed ANC or not at the time of pregnancy for this child, and defined by combining two questions.

Place of delivery is also a binary outcome variable that was defined based on the question of where the delivery took place. The binary location of delivery is defined as home delivery versus delivery at health facility, with the analysis for this outcome variable restricted to mothers who had had a delivery. Delivery at a facility includes deliveries at: hospital, health center, or health post. Home deliveries include delivery at: own home, relative's home, or traditional birth attendant's home.

Utilization of HCT is a binary outcome variable that was defined based on the question whether the mother was tested for HIV infection during the pregnancy for this child.

Getting PMTCT service is also a binary outcome variable, defined by combining mother responses to eight questions – four for the mother and four regarding for the child. In accordance with the Ministry of Health PMTCT guidelines, before, after or/and at the time of labour the mother is expected to take the prophylaxis depending on her clinical stage, and the child is expected to get prophylaxis at the time of birth or/and after birth depending on the mother clinical stage.

In all cases the binary outcome variable was coded as "1 or 0" if the response is "*yes*", it is coded as 1 or 0 if "*no*".

Explanatory variables

The selection of explanatory variables was based on findings from the literature. In keeping with the research objectives – and given the effects of the outcome variables at more than one level– and where study participants are nested within health facility,

which are in turn nested within communities, two levels of explanatory variables were considered. These were individual-level and community-level explanatory variables.

Individual-level explanatory variables:

The individual level variables included in the model were taken from the mother questionnaire. Predisposing factors included in the model were: a categorical variable of mother age (in years) grouped as <25, 25-34, >34 years, education level of the mother or father defined as no education, primary school and secondary school or higher education; religion grouped as Orthodox, non-Orthodox; household size defined as ≤3, >3 people; age of first pregnancy defined as ≤25, >25 years; number of live births defined as ≤2, >2; number of pregnancy grouped as ≤2, >2 times and planned pregnancy grouped as yes, no.

Enabling factors included in the model were: Get encouragement from husband to attend HCT defined as yes, no; waiting time too long in HF defined as yes, no; socio-economic level of the household defined in quintiles. For the construction of SES the methodology known as principal component analysis (Montgomery, Gragnolati, Burke, Paredes, 2000; ORCMacro, Bank, 2002; Vyas, Kumaranayake, 2006) was adopted based on a set of household assets. This surrogate measure of household economic status, represents a better way of quantifying wealth status based on ownership of durable items such as type of toilet, main household fuel, main wall material, water source, employment status of mother and father and household income. The final scores were then used to group households and their members into wealth quintiles as poorest, poor, middle, richer and richest.

Need factors included in the model were: Know any traditional birth attendant defined as yes, no; Knowledge level of HIV grouped as poor, good; and Know a health facility that gives HCT defined as yes, no.

Community-level explanatory variables:

The community level variables included in the model were taken from the mother and health facility manager questionnaire. Predisposing factors included in the model were: a categorical variable of place of residence grouped as urban, rural; proportion of women with no education in the district grouped as <30%, 30-50%, >50%.

Enabling factors included in the model were: proximity grouped as <1km, 1-5kms, >5kms; nurse workload defined as ≤1500, >1500 people per nurse; proportion of poor and poorest household in the district grouped as <30%, 30-60%, >60%; people per health worker defined as ≤500, >500; people per health facility defined as ≤25000, >25000; lab technician workload defined as ≤3100, >3100 people; and people per HCT site grouped as ≤25000, >25000.

4.7.2 Statistical Modelling

Often in statistics researchers have a response or dependent variable *Y* that is their main interest. The researcher selects a sample of size *n* from the population of interest and observes values $Y_i, i = 1, \ldots n$. The aim then is to infer properties of the variable *Y* in terms of other observed predictor or explanatory variables $X_i = (x_{1i},\ldots,x_{ki}), i = 1,\ldots,n$. The main use of these explanatory variables is to account for differences in the response variable or, to put it another way, to explain the variation in *Y*.

4.7.3 Hierarchical Modelling

In this study, the researcher will apply the hierarchical modelling (multilevel analysis) that has mostly been used in the fields of education, demography and social sciences to describe an analytical approach that allows the simultaneous examination of the effects of group level and individual level variables on individual level outcomes (Diez-Roux, 2000). The choice of this analytical strategy for this study was driven by a theoretical model as well as by the nature of the survey data. The data present a natural hierarchical structure with mothers (with 1,493 deliveries recorded) clustered in 50 districts. Since it was hypothesized that district characteristics influence individual health care choices, two-level random effects generalized linear models were applied. With the assumption that only one mother could be found in each household, the lowest level of analysis was the respondent or household. Thus, it is possible to explore variability of the outcome variable at each level of analysis. That is, at both the respondent or individual-level and the district or community-level. In the context of preventive care, the propensity of women from different households,

but with similar characteristics, to utilize or choose a provider will depend on their discretion as determined by the economic ability of the household (Aremu, 2011). Appropriate methodology is required in understanding association between shared characteristics of individuals and that of the administrative area or household they belong (Rice, Jones, 1997). This is important, in order to control for correlation between individuals within a defined district.

Multilevel modelling is an approach that can be used to handle clustered or grouped data (Buxton, 2008). The basic concept behind hierarchical modelling is similar to that of ordinary linear simple regression (Osborne, 2000), and the dependent variable is located at the lowest level (Hartigen, Misselhorn, 2006). The major advancement in the past two decades in statistical techniques and concern in exploring micro- and macro-level attributes led to the use of the multilevel models (DiPrete, Forristal, 1994; Congdon, Shouls, Curtis, 1997; Rice, Jones, 1997). When there is a high level of clustering in the data, it is well known that disaggregation of the data by using ordinary least squares (OLS) or traditional regression analysis leads to an elevated risk of Type I error (concluding that there are significant effects when in fact these effects may have occurred by chance) (Kreft, Yoon, 1994). By pretending that the observations are independent, the standard errors of the regression coefficients are biased downwards, generating artificially narrow confidence intervals. Multilevel models which incorporate the use of regression models at more than one level hierarchy is capable of appropriately partitioning within-group and between group effects; so that a high level of clustering within groups is statistically accounted for and it is a powerful and technically robust with numerous strength (Rice, Jones, 1997; Snijders, Bosker, 1999; Greenland, 2000; Austin, Goel, van Walraven, 2001; Diez Roux, 2001; Moerbeek, van Breukelen, Berger, 2003; Merlo, et al., 2005; Sophia, Anders, 2008; Wright, London, 2009). First multilevel modelling allows for estimation of outcome variables at more than one level (O'Campo, Xue, Wang, Caughy, 1997; Rice, Jones, 1997; Wight, Cummings, Miller-Martinez, Karlamangla, Seeman, Aneshensel, 2008; Ngnie-Teta, Kaute-Defo, Receveur, 2009). Second multilevel modelling corrects the estimated standard errors that tend to be underestimated due to clustering of observations within units and accommodates the hierarchical structure of the data (Goldstein, 1995). Third multilevel modelling applies the conditionally specified random effects model to estimate cluster-specific

effects (Zeger, Liang, Albert, 1988). The cluster-specific effects are the unobserved factors that influence the outcome in the form of residual variation in the outcomes by estimating the degree of correlation between the outcome while controlling for factors at the individual, community and other levels (Stephenson, Tsui, 2002).

According to DiPrete and Forristal (1994), whereas older models can be characterized as single level or fixed effects regression models, new models specify the multilevel regression coefficients as random effects. In a single level regression model, the micro-level coefficient is expressed as an exact function of macro-level variables. Multi-level models, in contrast, contain error terms in the macro equations. The inclusion of these error terms at the macro level implies a more complex error structure in the single-equation version of the multilevel model. The use of random coefficient models allows the data analyst to decompose the variance in the dependent variable into the within-context variance and the between context variance, and to study these two sources of variation for the individual level outcome. Thus, random coefficient multilevel models are a type of variance components model.

Human health outcomes are shaped by complex interactions between individuals and the diverse social and environmental contexts (eg households, neighbourhoods, health facilities, districts and regions) in which they are situated over the life course (Yen, Syme, 1999; O'Campo et al., 1997; Yen, Kaplan, 1999; Barr, Diez-Roux, Knirsch, Pablos-Mendez, 2001; Clarke, George, 2005). The recent increase in the use of multilevel models to examine associations between group level characteristics and a wide range of individual health indicators (Pickett, Pearl, 2001; Ahern, Pickett, Selvin, Abrams, 2003; Buka, Brennan, Rich-Edwards, Raudenbush, Earls, 2003; Merlo J, Lynch JW, Yang M, Lindström M, Östergren P-O, Rasmussen NK, Et al., 2003) attest to their value as a statistical method for analysing grouped or clustered data.

The aim of this study is to discover the factors that affect a woman's utilization behaviour of health outcomes. The sample of women involved in this study received health services in a health facility, within districts. The researcher is interested in the effect of a mix of women level factors (for instance, the education level, SES, knowledge level) and district level factors (for example, proximity of health facility, place of residence). Multilevel modelling provides a useful framework for thinking

about problems with this type of hierarchical structure.

While the researcher is interested in factors at the level of the individual woman, still there is a need to take account of the clustering in the sample. For example, the utilization levels of two women in the same district tend to be more similar than the levels of two women in different districts. If statistical techniques used ignore the clustering - e.g. multiple regression - the standard errors and confidence intervals that obtained become unrealistic and may well conclude that there are real effects, when simply looking at random variation (Buxton, 2008).

For each woman, the health outcome accessing behaviour appears to be non-linear, but for the sake of elaboration let us start by assuming that it is linear, and model it by a simple linear regression model of the form:

$$Y = \beta_0 + \beta_1 X + \varepsilon \qquad (1)$$

Where Y and X represent dependent and explanatory variable and ε represents the variation in dependent variable that cannot be explained by the linear relationship with the explanatory variable. Equation (1) explains variation in Y by allowing predictors X to describe differences in mean behaviour. The amount of variance explained can be calculated via R^2 statistics for the model. Note that X can contain both continuous and categorical explanatory variables.

To extend the model beyond a single woman, the researcher needed to allow for the variation in dependent variable pattern among different individuals. To make the model more realistic, we allowed the intercept in equation 1 to vary from individual to individual.

Multilevel regression models assume hierarchical data, with one response variable measured at the lowest level and explanatory variables at all existing levels. In general, the two-level model can be conceptualised as a hierarchical system of regression equations within J districts, with N_j women in each level-2 group (Raudenbush, Bryk, 2002). Individual factors hypothesized to be enabling factors and

pre-disposing factors are modeled at level-1. Districts characteristics are modeled as enabling factors at level-2, with mother *i* nested in district *j*. At the individual level (level 1) there are separate regression equations for each group. For linear models the identity link function regresses the dependent variable Y_{ij} on a linear predictor set of one (or more) independent variable X_{ij}, with normally distributed residuals (ε_{ij}) having a mean of 0 and variance σ^2 (the variation between women):

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + \varepsilon_{ij} \qquad (2a)$$

Notice that the intercept β_{0j} now has a subscript *j*, indicating that it vary from individual to individual. For non-linear models, various link functions linearise an underlying non-linear predictor component (Clarke, 2008). For the case of a binary outcome with a binomial error distribution, the logit link function is used to regress the log odds of the response probability, or proportion π_{ij}, on a linear predictor set of independent variables:

$$\text{Logit}(\pi_{ij}) = \ln\left(\frac{\pi ij}{1 - \pi ij}\right) = \beta_{0j} + \beta_{1j}X_{ij} \qquad (2b)$$

For both the linear and non-linear models these level-1 coefficients can then be modelled by explanatory variables at the contextual level-2: The β_j is modeled by explanatory variables at the group level: and on the group level we have the explanatory variable Z_j. Thus, we have a separate regression equation in each group:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}Z_j + u_{0j}, \qquad (3)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}Z_j + u_{1j}, \qquad (4)$$

The model in equation 2 accounts for the variation in the individual outcome on a single district, while models in equations (3) and (4) accounts for the variation from one district to another. The combination of these three models gives what is known as a multilevel model.

To show the difference between a multilevel model and a single level regression model, return to the model with varying intercepts and substitute equations (3) and (4) into equations (2a) and (2b) and rearranging terms, we get the full two-level linear model:

$$Y_{ij} = \gamma_{00} + \gamma_{10}X_{ij} + \gamma_{01}Z_j + \gamma_{11}Z_jX_{ij} + u_{1j}X_{ij} + u_{0j} + \varepsilon_{ij} \qquad (5a)$$

The feature that distinguishes this model from a single level regression model is the presence of two random variables – the individual level (women) random variable ε_{ij} and the group (district) level random variable $u_{0j.}$

And the full two level logistic model:

$$\text{Logit}\,(\pi_{ij}) = \gamma_{00} + \gamma_{10}X_{ij} + \gamma_{01}Z_j + \gamma_{11}Z_jX_{ij} + u_{1j}X_{ij} + u_{0j} \qquad (5b)$$

In both models, u_{0j} represents group level variability around the intercept, which is assumed to be normally distributed with a mean of 0 and variance τ_{00} (variation between districts), and u_{1j} represents group level variability around the regression slope, which is assumed to be normally distributed with mean of 0 and variance τ_{11}. The covariance between the group level variance terms u_{0j} and u_{1j} is τ_{01}, which is generally assumed to be greater than or less than zero. All residual errors at the group level are assumed to be independent from the individual level within-group residuals (ε_{ij}). For the binomial error distribution (equation 5b), the level-1 error variance is a function of the population proportion ($\sigma^2=(\pi_{ij}/(1-\pi_{ij}))$) and is not estimated separately (by using a scale factor of 1) (Hox, 2002). In general there will be more than one explanatory variable at the lowest level and also more than one explanatory variable at the highest level. Assume that we have *P* explanatory variables X at the lowest level, indicated by the subscript p (p=1…P), and *Q* explanatory variables Z at the highest level, indicated by the subscript q (q=1…*Q).* Then, equations (5a) and (5b) becomes the more general equation:

$$Y_{ij} = \gamma_{00} + \gamma_{p0}X_{pij} + \gamma_{0q}Z_{qj} + \gamma_{pq}Z_{qj}X_{pij} + u_{pj}X_{pij} + u_{0j} + \varepsilon_{ij} \qquad (6a)$$

$$\text{Logit}\,(\pi_{ij}) = \gamma_{00} + \gamma_{p0}X_{pij} + \gamma_{0q}Z_{qj} + \gamma_{pq}Z_{qj}X_{pij} + u_{pj}X_{pij} + u_{0j} \quad (6b)$$

The estimators generally used in multilevel analysis are Maximum Likelihood (ML) estimators, with standard errors estimated from the inverse of the information matrix. The distribution of ML under the null hypothesis (Ho: $\tau_{00} \geq 0$) is not X^2 with 1 degree of freedom, since τ_{00} cannot be negative and it will be estimated as positive half of the time and as zero the other half of the time. These standard errors are in the Wald test (Wald, 1943): the correct p-value therefore must be derived by dividing the p-value based on X^2 with 1 degree of freedom by 2 (Liang, Self, 1985; Stram, Lee, 1994; Crainiceanu, Ruppert, 2004; Crainiceanu, Ruppert, Claeskens, Wand, 2005; Greven, Crainiceanu, Kuchenhoff, Peters, 2008; Rabe- Hesketh, Skrondal, 2008).

Taking advantage of the cluster-specific effects estimated by the conditionally specified model, the analysis took a cumulative approach in model building by adding fixed effects variables at each level: individual- and district-levels. This approach allows the estimation of the relative effect of adding the group of factors in explaining the district variations in the outcomes by assessing the changes in the variance components τ_{00} (Bingenheimer, Raudenbush, 2004; Crainiceanu, Stediger, Ruppert, Behr, 2003).

If there are no explanatory variables at levels 1 or 2, equations (5a) and (5b) reduce to:

$$Y_{ij} = \gamma_{00} + u_{0j} + \varepsilon_{ij} \quad (7a)$$

$$\text{Logit}\,(\pi_{ij}) = \gamma_{00} + u_{0j} \quad (7b)$$

which are the fully unconditional, or one-way ANOVA, models for the linear and logistic case, respectively. Partitioning the variance components yields a useful statistic, the intraclass correlation coefficient (ICC), which measures the proportion of variance in the outcome that is accounted for by the group level (Raudenbush, Bryk, 2002). For the linear model the ICC is defined as:

$$\rho = \frac{\tau_{00}}{\tau_{00} + \sigma^2} \quad (8)$$

The dependence among dichotomous responses for mothers in the same districts can be quantified by the residual intraclass correlation coefficient *(ρ)* in the form of an underlying continuous latent model (Heagerty, 1999). The multilevel logistic model can also be formulated in the latent form as:

$$Y^*_{ij} = \gamma_{00} + \gamma_{p0}X_{pij} + \gamma_{0q}Z_{qj} + \gamma_{pq}Z_{qj}X_{pij} + u_{pj}X_{pij} + u_{0j} + \varepsilon_{ij} \quad (9)$$

Where $\varepsilon_{ij} \mid X_{ij}$, u_{0j} is an error term associated with the i^{th} mother in j^{th} district, and has the binomial distribution for the logistic link function with mean zero and variance $\pi^2/3$ (Hox, 2002). The observed dichotomous responses are presumed to be generated from the threshold model (Rabe-Hesketh, Skrondal, 2008):

$$Y^*_{ij} = \begin{cases} 1 \; if \; Y^*_{ij} > 0 \\ 0 \; otherwise \end{cases}$$

Intraclass correlations for the latent responses of two deliveries Y^*_{ij} and $Y^*_{i'j}$ in different district j and j' is obtained by:

$$\rho(\text{district}) = \frac{\tau_{00}}{\tau_{00} + \pi^2/3} \quad (10)$$

This intra-district correlation measures the extent to which outcomes cluster at the district-level is expressed as the ratio of the district variance to the total variance (Goldstein, 1995; Stephenson, Tsui, 2002; Bingenheimer, Raudenbush, 2004; Pebley, Goldman, Rodriguez, 1996).

For full models (with covariates), a conditional ICC can be calculated based on an adjusted value of τ_{00}, representing the degree of dependence among observations within groups at a given value on the covariates (Raudenbush, Bryk, 2002).

Community differences in utilization of health service outcomes may be attributable to contextual influences or differences in individual composition of communities

(including unobserved individual characteristics) (Merlo, Mann, 2004). In view of this, while adjusting for the individual characteristics in the multilevel models, some part of the compositional differences were taken into consideration to explain some of the community differences observed in the empty model. Thus the equation for the proportional change in community (PCV) variance is:

$$\text{PCV} = \frac{V_{n-1} - V_{n-2}}{V_{n-1}}$$

Where; V_{n-1} is the community variance in the empty model and V_{n-2} is the community variance in the models including individual characteristics or community characteristics

Compared to odds ratios obtained from marginal logistic regression models that fit overall community-average probabilities, conditional odds ratios obtained from subject- specific or cluster-specific random-intercept logistic regression models are more extreme (further away from 1). Conditional estimates are larger than marginal estimates because the total residual variance is much larger for the conditional estimates (variance + $\pi^2/3$) while the residual variance for the marginal estimates are only $\pi^2/3$ (Rabe-Hesketh, Skrondal, 2008; Heagerty, 1999; Zeger et al., 1988).

There are important differences in interpretation of these odds ratios. The probabilities of community-average models are only conditioned on covariates, while the probabilities obtained from cluster-specific conditional probabilities are conditioned on the cluster-specific random intercepts (u_{0j}) and the covariates (Heagerty, 1999; Zeger et al., 1988; Carlin, Wolfe, Brown, Gelman, 2001).

4.7.4 Model building

In the present study, for the development of the model the explanatory variables of outcome variables were identified using stepwise selection. Overall, four models containing variables of interest were fitted for the outcome variables.

The first model, which is usually, called the "empty" or "null model" (equation 7b) was fitted without explanatory variables. In other words, it contained no independent variables, but decomposes the total variance into individual and community components. The empty model is also used to determine whether the overall difference between communities and individuals in terms of contraceptive use was significant.

The second model (individual level model) was adjusted for individual level variables alone (only the random effects results were reported). This model allows the assessment of the impact of individual level variables on the outcome variables. The model containing the individual level variables was used to determine whether the variation across communities could be explained by the characteristics of the individuals residing within that community or not.

A third model (community level model) was adjusted for community level variables alone (only the random effects results were reported). This model allows the assessment of the impact of the community level variables on the outcome variables.

Lastly a fourth model (final model) was adjusted for individual and community level variables, both the fixed and random effect results were reported. The final model was used to test for the independent effect of community contextual variables and the individual variables on the outcome variables.

Parameter estimation

Parameter estimation for multilevel logistic regression model is not straightforward like the methods for logistic regression. The most common methods for estimating multilevel logistic regression models are based on likelihood. From the methods for the present study, "Maximum Likelihood" approximation procedure was used. The maximum likelihood was evaluated by integrating out the random effects using the adaptive Gaussian quadrature (AGQ) (Gutierrez, 2007) available in Stata (version 11). While the likelihood ratio (LR) statistics was used to test the null hypothesis that the community level variance is equal to zero.

Goodness of fit test

We used Deviance Information Criterion (DIC) estimates to appraise the fitness of our model, with successive decrease in the value of DIC indicating a well-fitted model.

Variance inflation factors

Variance inflation factors (VIFs) can be used to quantify collinearity between variables. For models that are fitted with maximum likelihood estimation, the information matrix is scaled to correlation form, and the VIF is the diagonal of the inverse of this scaled. These VIFs allow the identification of variables which are responsible for highly correlated parameter estimates. Variables with highest VIF (>10) are removed from the full model (Davis, Elhammer, Russell, Schneider, Kornfeld, Brown, et al., 1986). For this study VIF were used to check multi-collinearity between the explanatory variables.

Interaction effect

Interaction effect between the individual level explanatory variables and community level variables and also cross-level interaction (interaction between level 1 variables and level 2 variables) were checked during model development.

4.8 Validity and reliability of the study

Validity is an indication of the extent to which an instrument measures what we think it is supposed to be measuring (Sarantakos, 1998). Hence, all questionnaires were translated in Tigrigna and then translated questionnaires were translated back to English for verification of the content. Tools were reviewed by content experts and a pilot study with people who were similar to the intended study participants as described in section 4.4 to ensure content and construct validity was completed.

Reliability refers to dependability or the extent to which a tool such as questionnaire produces similar results in different circumstances if nothing changes (Sarantakos, 1998). Therefore, reliability was assured by training interviews on questionnaires and checking that they conducted interviews in a consistently similar way.

4.9 Ethical Considerations

Permission to conduct the study was granted from the Ethics Committee of the University of the Western Cape and from Tigray region Bureau of Health. This thesis research was appeared to the Higher Degrees Committee and the Ethics Committee of the University of the Western Cape for approval.

4.9.1 Informed Consent

Verbal informed consent was obtained from each participant in the health facility based interview. After hearing the staff member read the information sheet aloud, the potential participant was asked to report back a description of the procedures in his or her own words and explain the reasons why they wanted to participate to the interviewers. This ensured comprehension of the informed consent and assisted staff in determining contra-indications to participation. Individuals were provided with information on how to contact the study staff to report adverse events associated with study. All individuals were informed that they could withdraw from any aspect of the study at any time without giving any reasons.

4.7.2 Confidentiality

Confidentiality of all study participants was strictly maintained. The purpose of the study was not to encourage participants to break their own confidentiality; rather, an expected ancillary outcome is that increased discussion of HIV in communities could lead to greater de-stigmatization. All the information from the survey was anonymous to afford the highest level of confidentiality.

All interviewers signed a confidentiality agreement. Signing of the agreement indicated that the staff member agreed to uphold the confidentiality specific to their work, that all participant information is confidential and shall not be divulged or made known to unauthorized persons, and that a breach of confidentiality would be grounds for disciplinary action.

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CHAPTER FIVE

RESULTS

5.1 Introduction

This chapter presents the results of the study in the form of three papers, instead of presenting only in the form of descriptive and analytic results. Due to this the descriptive and analytic part of the study are followed by the topic of the paper, authors, abstract, introduction, methodology, and all the results were also followed by discussion, conclusion, references and tables.

The three papers are:

PAPER 1: **Multilevel modelling approach to identify factors affecting HIV testing and counselling among women who were attending antenatal care services in Ethiopia**
Wondwossen Lerebo[1], Debra Jackson[1], Christina Zarowsky[1], Marleen Temmerman[2], Steven Callens[3]

PAPER 2: **A multilevel analysis of individual and community level factors affecting maternal health services in Ethiopia**
Wondwossen Lerebo[1], Debra Jackson[1], Christina Zarowsky[1], Marleen Temmerman[2], Steven Callens[3]

PAPER 3: **Identifying factors associated with the uptake of prevention of mother to child HIV transmission programme in Ethiopia: A multilevel modelling approach**
Wondwossen Lerebo[1], Steven Callens[2], Debra Jackson[1], Christina Zarowsky[1], Marleen Temmerman[3]

Paper I

Multilevel modelling approach to identify factors affecting HIV testing and counselling among women who were attending antenatal care services in Ethiopia

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Abstract

Background: HIV counselling and testing (HCT) enables individuals to make informed choices and actions concerning their HIV status. This study examined individual and contextual predictors of HCT uptake among women attending antenatal care (ANC) in Tigray region, Ethiopia.

Methods: Between May 05 and July 15 2011, 1493 post-partum women attending child immunization services at 50 health facilities in 46 districts of Ethiopia, were enrolled in this cross-sectional study using multistage probability sampling. Women were interviewed using a structured questionnaire. Due to the nested nature of the data, we used multilevel modelling methods and assessed macro-level random-effects.

Results: 74.6% of women accessed HCT services during their most recent pregnancy. The multivariate multilevel model found individual-level significant predictors for HCT included: attending ANC (OR=4.54; 95%CI 2.82,7.33) and getting encouragement from husband (OR=1.97; 95%CI 1.25,3.10). At community-level, for the addition of one health facility per 25000 and HCT site 24000 people increased the likelihood of HCT utilization by 2.1 and 2.4 fold, respectively. Findings also showed that HCT utilization is nested according to district of residence, contributing 11.3% of the variance.

Conclusions: This study highlights that factors influencing HCT utilization operate at the individual and community-levels. Multilevel modelling allows identification of factors at personal and societal-level impeding antenatal HCT uptake. The government should focus on increasing ANC access, educating couples on importance of health services utilization, increasing health facility and HCT sites per population to improve HCT utilization.

Introduction

The human immunodeficiency virus (HIV) epidemic has proven to be an unbeaten challenge for three decades. Since the identification of the epidemic in early 1980s, 25 million people have died of HIV-related complications and nearly 58 million people have become infected with the virus. Developing countries, especially in sub-Saharan Africa, continue to bear the devastating impact of HIV infections. The region encompasses 67% of HIV infections worldwide, 68% of new HIV infections among adults and 91% of new HIV infections among children.[1]

Increasing access to HIV counselling and testing (HCT) is the main precondition for accelerating access to HIV-related interventions and care programs,[2-7] and a key component for the prevention of HIV transmission. According to Kenya AIDS indicator survey, in Kenya, 44% of married HIV-positive persons have an HIV-negative spouse, and 57% of eligible individuals are not taking ART because they do not know their status.[8]

Ethiopia is one of six countries that account for 50% of under-5 child deaths worldwide, with approximately 350,000 Ethiopian children dying each year.[9] Eleven percent of child deaths result from HIV/AIDS.[10] To avert premature deaths, early detection of HIV-positive pregnant women and access to antiretroviral prophylaxis is crucial. Generally the uptake of these interventions remains low, due to low antenatal care (ANC) uptake and poor antenatal HIV testing rates.

Several demographic and socioeconomic determinants of HCT uptake, mostly at the individual-level, have been studied. Examples of barriers to HCT access have been identified, such as: a) demographic factors (age, education level, place of residence, ethnicity, marital status and religion[11-17]); b) socio-economic factors (employment status[13], household income[16]); c) social factors (gender based violence, fear of stigma, discrimination[18,19] and lack of confidentiality[20,21]); d) health facility related factors (long waiting times, and poor accesability[15]); and e) knowledge (prior knowledge of HCT/PMTCT sites, risk perception and risk behaviour[13,14,22]).

The use of single-level analytical techniques in prior research ignores possible clustering. In addition, it discards the multilevel or hierarchical structure of data on individuals living in different households, neighbourhoods, cities, and provinces. Multilevel modelling that can simultaneously account for factors at individual and neighbourhood levels is likely to provide a more robust and sophisticated understanding of HCT and the factors associated with uptake.

Multilevel modelling is mostly used in the fields of education, demography and social sciences to describe an analytical approach that allows the simultaneous examination of the effects of group level and individual-level variables on individual-level outcomes[23]. The main reason to apply this modelling is that many kinds of data, including observational data collected in the human and biological sciences have a hierarchical or clustered structure[24]. The general concept is that individuals interact with the social contexts to which they belong, meaning that individual persons are influenced by their social groups or contexts, and that the properties of those groups are in turn influenced by the individuals who make up that group. Generally, the individuals and the social groups are conceptualized as a hierarchical system of individuals and groups, with individuals and groups defined at separate levels of this hierarchical system. Naturally, such systems can be observed at different hierarchical levels, and variables may be defined at each level[25]. Because of growing statistical techniques and increasing interest in societal influences on individual health status, group level and individual-level factors in regression models have prompted interest in contextual research in epidemiology[26]. The statistical issues involved in multilevel studies have been well-described, and hierarchical regression analysis is becoming widely accepted as an appropriate tool for examining group level effects on individual health[27]. However, as far as this researcher can assert, this variation in health has received less attention in public health until recently and almost not inculcated in African studies and HCT significantly.

By explicitly acknowledging the existence of groups, modelling group-to-group variation simultaneously with individual-to-individual variation, and including group-level properties with individual-level variables in the analyses, multilevel models allow for the importance of both groups and individuals in understanding health outcomes. It provides one way to link the traditionally distinct ecological- and individual-level studies and to overcome the limitations inherent in focusing only at

one level. Like other statistical methods, multilevel analysis will help describe, summarize, and quantify patterns present in the data[23].

Although several individual characteristics have been associated with HCT and PMTCT (e.g., age, education), associations with contextual characteristics, such as nurse load, PHC per population, have largely been understudied. Moreover, several theoretical frameworks[28,29] have stressed that the immediate environment (e.g., home or community context) may influence individuals health behaviour. Nevertheless, most studies on HCT have applied single-level analytic techniques, ignoring the social context within which individuals' live[30-32]. This study explicitly examined individual, and contextual level correlates of HCT by implementing a multilevel methodological approach.

The research questions that this paper seeks to answer include: What are the individual and contextual factors that affect accessing HCT? What are the determinants of uneven distribution of HCT? Which determinants (contextual or individual) influence more on accessing HCT inter and intra districts (woredas) in Tigray region Ethiopia?

Methods and materials

The Ethiopian economy is based on agriculture contributing 47% to the Gross National Product (GNP) and accounting for more than 80% of exports as well as providing employment for 85% of the population. According to the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), the Tigray Region has a total population of more than 4.3million, of whom 49.2% were men and 50.8% women. Urban inhabitants were 19.5% of the population. This region has an estimated density of 86.15 people per square kilometers. For the entire region almost 1million households were counted, which results in an average for the Region of 4.4 persons to a household. The region is predominantly (96.6%) inhabited by people from the Semitic-speaking Tigray ethnic group. 95.6% of the Tigray region's population is Orthodox Christian.

The ANC coverage in Tigray region in 2009 was 73.0%, from the mothers who utilized ANC 43% tested for HIV, and of these, 3.1% tested positive. Only 51% of HIV-positive pregnant women and 38% of babies born to HIV-positive mothers were given nevirapine or combination antiretroviral treatment (cART).

A health facility based cross-sectional study was conducted from May 05 to July 15, 2011, in Tigray region Ethiopia. A total of 1493 post-partum women coming for child immunization from 46 districts were enrolled to take part in a survey. Informed consent was obtained from each participant at the start of the survey. The study was approved by the ethics committee of University of the Western Cape, and Tigray region Health Bureau.

A multistage sampling method was used to select participants. The 46 districts, comprising 208 health centers and 13 hospitals were determined by the Tigray region Bureau of Health. One health center was chosen randomly from each district and all available hospitals, and 30-36 post-partum women were randomly selected from each chosen health facility.

The structured questionnaire was conducted by a trained nurse from the same health facility. All participants were interviewed face-to-face to collect information on demographic, socio-economic characteristics and on women's maternal healthcare, for instance prenatal care, delivery and postnatal care related to PMTCT. HIV testing during the last pregnancy was used as principal outcome indicator in the analysis of the demographic and socio-economic determinants at the individual and community-level.

A two-level logistic regression model was used to assess the explanatory effects of the independent variables on the utilization of HCT taking into consideration the hierarchical structure of the study sample, and single level logistic regression model also used to compare the results in both models. The first level represents the individual and the second level is the districts/ community, and effect coding was used for the 46 districts in two level logistic regression models. The community-level covariate was the geographical demarcation of the districts.

Individual-level covariates comprised: education which was categorized (no education, primary, or secondary/higher); ever utilized ANC (yes or no); get

encouragement from husband (yes or no); know health facility that gives HCT (yes or no); knowledge level of HIV (poor or good); socio-economic status (SES) quintile (1st quintile (poorest), 2nd quintile, 3rd quintile, 4th quintile, or 5th quintile (wealthiest)). The SES quintile is a commonly used measure of economic status of the households. Principle component analysis was used to develop it. The quintile combined information on a set of household assets and living conditions: household income, employment status, main source of water, type of toilet, main fuel used for cooking, and main house building material.

Using xtmelogit in Stata 11 (Stata Corp. Inc., TX, USA), community or district-level random-effects were estimated at a 2-level multilevel model as shown in equation 1:

$$\log\left(\frac{\pi ij}{1-\pi ij}\right) = \beta 0j + \beta 1jxij + (u0j + e0ij) \quad (1)$$

With β_0 as the intercept and the slope β_1, defined as the expected change in the utilization of HCT with an increase in the individual X of one unit. A set of intercepts was estimated for the district or community-level, where πij is the probability of utilizing HCT for a pregnant woman *i*, in a district *j*, and *β0j* is a parameter associated with the fixed part of the model. Therefore, for every 1-unit increase in *X* (a set of predictor variables) there is a corresponding effect on the probability of accepting HCT. In the previous equation and the traditional or single level logistic regression models the difference is that there are two subscripts one referring to the pregnant woman *i* and one the district level *j*. By assuming that each community has a different intercept β_{0j} and a different slope β_{1j} the clustered data structure and the within and between community variations is now taken into account. To capture the extent by which choice of different option of utilizing HCT, which are contrast specific, varies randomly at the individual-level, the results of random-effects (measures of variation) are presented as variance partition coefficient (VPC). This is illustrated in equation 2:

$$\text{VPC} = \frac{\sigma 2u0}{\sigma 2u0 + \sigma 2e0} \quad (2)$$

In this equation, $\sigma 2e0$ denotes the variance between pregnant women from the same district (individual-level) and $\sigma 2u0$ is the variance between districts (community-level variance).

The statistical significance of the explanatory variables was estimated using Wald statistics, with all results at 5% alpha level considered significant. The results of the fixed (measure of association) effects were presented as odds ratio (OR) at their 95% confidence intervals (95% CIs).

As this study used several explanatory variables that might be correlated to each other (such as mother's education, father's education and household wealth index), the multicollinearity assessment was conducted using the means of variance inflation factors (VIFs) as a post-estimation procedure following the regression analysis. The small VIF of 1.45 indicated the absence of any significant collinearity between explanatory variables in the regression model.

Results

Descriptive statistics

The community and individual-level features of the study sample by HCT uptake status as described above are reported in Table 2. A total of 1493 post-partum women were interviewed, nested within 46 districts. Of all 74.6% women tested for HIV in the previous pregnancy and 3.1% were missing, from these 78.4% women were from the age group 25-34 years.

Bivariate analysis (chi-squared test) in Table 2 showed that education level of the women and her husband were positively associated ($p<0.001$). SES quintile was significantly and positively associated in bivariate analysis, though women in the 3rd quintile utilized HCT (74.4%) less than women in the 2nd quintile (78.5%) ($p<0.001$). At the individual-level in the bivariate analysis women who ever utilized ANC, knew a health facility that provides HCT, got encouragement from her husband to access HCT, and had good knowledge level about HIV were significantly associated with increased utilization of HCT.

Bivariate analysis (chi-squared test) showed that at the community-level place of residence was associated significantly and favoured urban residence. In the same analysis proximity of HCT site, people per nurse (nurse work load), people per health worker, people per health facility and people per HCT site were significantly (p-

value<0.05) and negatively associated with the utilization of HCT. Although the proportion of poorest and poor household and proportion of women with no education in districts were significantly associated (p-value<0.01), the relationship is not linear with the utilization of HCT.

Single level logistic regression

All variables that showed statistically significant associations (p-value <0.05), at chi-squared test were considered to be included in the full model of single level logistic regression. Table 3 shows adjusted single level logistic regression and crude and adjusted multilevel logistic regression results for log odds of utilizing HCT. In single level logistic regression, education level of mother and father of the child, "Waiting time too long in HF", "Planned pregnancy" and "Household wealth index" were not significantly associated with utilizing HCT, after controlling for the other variables. Single level logistic regression depicted that, when other variables were controlled for, a woman who visited an ANC service in her last pregnancy was almost 4 times (OR=3.84; 95%CI 2.37,6.22) more likely to have utilized HCT than a woman who had not visited an ANC. A woman who got encouragement from her husband to take HCT was almost 2 times (OR=1.91; 95%CI 1.21, 3.02 more likely utilized HCT than her counterpart women who had not got encouragement, when other variables were controlled. And a woman who knew health facility or site that gives HCT (OR=1.64; 95%CI 1.00,2.71), and who had good knowledge about the transmission ways of HIV (OR=1.81; 95%CI 1.24,2.65) was more likely to have utilized HCT than their counterparts, when the other individual-level variables were controlled.

Though, it was not statistically significant women who were living in an urban area were 11% less (OR=0.89; 95%CI 0.53,1.51) likely to have utilized HCT than their counterparts living in rural area, after controlling the other variables. When single-level logistic regression has applied proximity, people per nurse (nurse work load) and people per health worker were not significantly associated, after controlling for other variables. Despite our expectation, after controlling for other variables, a woman who was living in a district with 30-60% proportion of poorest and poor households had a 93% (OR=1.93; 95%CI 1.08,3.48) higher chance of utilizing HCT than the

woman who was living with <30% proportion of poorest and poor households. When the proportion of women with no education in a given district was >50%, the woman likelihood of utilizing HCT decreased by 57% compared to no education <30% (OR=0.35; 95%CI 0.21,0.60), adjusted for other variables. In the single level logistic regression model, when both number of health facilities (OR=2.11; 95%CI 1.20,3.70) and HCT sites (OR=2.29; 95%CI 1.32,3.98) increased per population the odds of utilizing HCT also increased significantly, after adjusting for other variables.

Multilevel logistic regression

The null model in Table 3 indicates a significant variability in the log odds of utilizing HCT across the districts. The intercept variance coefficient showed that almost 20% of variability in the log odds of a woman utilizing HCT is due to district level factors. Multilevel logistic regression adjusted for individual and community-level variables simultaneously (in Table 4). All variables that showed statistical significance in the bivariate multilevel logistic regression (result not shown) were considered in the full model. (see Annex B1 for the further analysis)

In the multilevel regression modelling all individual level variables were significantly associated with HCT utilization, without adjusting for other variables (result not shown). However, when they were adjusted for individual and community level variables simultaneously, only women who ever accessed ANC and got encouragement from husband to utilize HCT were significantly associated with HCT utilization. Women who ever utilized ANC were almost 4 times (OR=3.89; 95%CI 2.33,6.48) more likely to have received HCT than women who had never utilized, and women who got encouragement from their husband were almost 2 times (OR=1.92; 95%CI 1.19,3.08) more likely to utilize HCT than her counterparts who had not got encouragement, after controlling for other individual and community-level variables in multilevel logistic regression. Women's knowledge level about HIV/AIDS and knowing a health facility, were significantly associated with HCT at adjusted single level logistic regression, but were not significantly associated after adjusting for all variables in multilevel logistic regression.

After applying multilevel logistic regression and controlling for other variables two of the significantly associated community level variables in the single level logistic regression, become no longer significantly associated with HCT. These are the proportion of poorest and poor household 30-60% (OR=1.69; 95%CI 0.83,3.46) and proportion of women with no education >50% (OR=0.50; 95%CI 0.21,1.21). Place of residence, proximity, nurse work load and people per health worker were not statistically significant with utilizing HCT after adjusting for other variables in both single and multilevel logistic regression modelling. In contrast, without adjusting for the other variables the first three variables were significantly associated with HCT utilization. A woman who was living in urban area had higher odds (OR=2.28; 95%CI 1.69,3.07) of utilizing HCT than a woman who was living in the rural area. When the proximity to health facility was <1km and 1-5kms the likelihood to utilize HCT increased by 2.52 (OR=2.52; 95%CI 1.58,4.01) and 83% (OR=1.83; 95%CI 1.14,2.94), respectively compared to >5kms. The third variable showed that, addition of one nurse for every 1500 people increase the odds of utilizing HCT by 99% (OR=1.99; 95%CI 1.07,3.68), nonetheless, this relationship significance disappeared when adjusted for the other variables.

The adjusted multilevel analysis revealed that from all the community level variables people per health facility and people per HCT site become very important factors that affect utilization of HCT in Ethiopia. For every addition of one health facility per 25000 people the odds increase of a woman utilizing HCT by 2.1 fold (OR=2.12, 95%CI 1.01, 4.45), and for every addition of one HCT site per 25000 people the odds increase of a woman utilizing HCT by 2.4 fold (OR=2.36, 95%CI 1.18,4.70), when adjusted for the other variables.

Discussion

This study sheds new insight into the association between HCT and different factors at the individual and community level. The current study, to the best of our understanding, is the first in Ethiopia and Africa to document that different micro- and macro-level factors are associated with the utilization of HCT. Our findings were not consistent with previous research suggesting that individuals with higher age, education and SES quintile were more likely to have had HCT.[33,35,39, 40,47] Even

though these variables were significantly associated in bivariate analysis, they were not significantly associated after adjusting for other variables both in single-level and multilevel logistic regression. This could be due to women attending immunization clinics having similar understanding about HCT utilization.

The results of the current study revealed that in single-level logistic regression and multilevel modelling, attending ANC was strongly associated with the utilization of HCT. It is consistent with studies conducted previously in Ethiopia[48] and elsewhere.[33,35] This is attributable to the exposure of mothers to the information regarding HIV and PMTCT during the ANC follow-up that may increase the chance of a mother to utilize HCT. The results of this study also showed persistent significant association between getting encouragement from husband to access HCT and utilization of HCT. Other studies also found that a supportive husband significantly increases the likelihood of utilizing HCT.[43,48-51] Possibly this is related to culture, traditional beliefs, and economic dependence of women on husbands, who do not have freedom to make decisions on their own health. Due to the nature of HCT scenario, getting encouragement is crucial in developing countries.

At the community-level, we found out that urban place of residence was not significantly associated with the utilization of HCT. The finding is inconsistent with previous studies which have reported a significantly higher uptake of HCT in urban compared to rural areas in Ethiopia and elsewhere[14,33,34,36,44] The possible explanation for this might be that in Ethiopia HIV testing at ANC is now provider initiated. It appears that if women attended ANC and got encouragement from their husbands, the difference in place of residence disappears in both single-level and multilevel modelling. The data appear significantly associated at single-level logistic regression modelling with proportion of poorest and poor household and proportion and utilization of HCT. However, this significant association disappeared when we applied multilevel modelling, at the individual level.

Community-level characteristics were important predictors of HCT utilization, as evidenced by the findings that women living in communities with fewer people per health facility and/or HCT site were associated with significantly higher likelihood of HCT utilization. This result is consistent in single-level and multilevel logistic

regression modelling. Our finding accentuates the idea that a woman who is living in a given community with a higher number of health facility and/or HCT site per population has a higher chance of utilizing HCT. One could argue that health facility and/or HCT site serving fewer people, raises the ability of health workers to reach all women living in a given area. Due to this women's health seeking behaviour improved, which improves their ability to access information, skills, services, and technologies.

Our study also revealed that the random-effects of the districts of HCT utilization have a significant effect on accessing HCT Basically, this finding showed that unmeasured factors operating at the community/ or district level play a significant role in determining accessing HCT beyond the influence of individual-level factors. This indicates the need for evidence based programing, and for programs to adopt a multilevel approach and address the factors affecting utilization of HCT at various micro- and macro-levels. Explicitly, programs need to explore effective ways of increasing ANC attendance, increasing the awareness of husbands on the use of health services, increasing health facility HCT site per population in order to increase the utilization of HCT.

Limitations of the study

Since this was a facility based study, mothers who did not come for the child immunization in the participating facilities were eliminated and this could have introduced selection bias. The possibility of recall bias also exists, due to the fact that mothers were interviewed about events that occurred many months back. Internal validity could be affected by several employed data collectors. To minimize this risk the data collectors were all midwives, who were well acquainted with the issue under study, and were given training. Even though the purpose of the study was explained in an effort to reduce social desirability bias, such bias might have been introduced due to the fact that we relied on self-reported data. Unmeasured individual factors may partly account for the community-level variations observed in our study. Additionally, defining districts based on the administratively defined boundaries might misclassify individuals into an inappropriate administrative boundary, and the health facility that selected purposively could generate information biases and reduce the validity

analysis.

Conclusion

Our study has reported the influence of both individual and community-level factors on the utilization of HCT and compared single level logistic regression and multilevel logistic regression models. At the individual-level utilizing ANC, and getting approval from spouse, and at the community level people per health facility and people per HCT site were consistently strong predictors of utilization of HCT in single level logistic regression and multilevel logistic regression, while, other factors generally vary in magnitude and significance level. Of direct relevance to policy is the issue of getting approval from spouse, attendance of ANC, increasing the number of health facility and increasing HCT site per people in the utilization of HCT. A woman who cannot get approval from her spouse and does not attend ANC has been identified as less liekly to access HCT. At the community-level people per health facility and people per HCT site in a given community were significant predictors of utilizing HCT. These show that high proportion of people per health facility and HCT site were an impediment to utilize HCT in Tigray region, Ethiopia.

In implementing the interventions to promote utilization of HCT, programmes should take into consideration these findings. They should focus on the underlying individual and community-level factors. More importantly, interventions are needed to increase spouse involvement in HCT utilization, explore effective ways of increasing ANC attendance, increasing the number of health facility per people and increasing HCT site per people.

Competing interests

The authors declare that they have no competing interests.

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Table 2. Background individual and community-level characteristics of post-partum women who were attending health facility for the child immunization and utilized HCT in Tigray region Ethiopia

Variables	**HIV tested**		
Age group (years)	n	yes %	p-value
≤24	506	76,3	0,390
25-34	724	78,4	
≥35	210	74,3	
Mother education level			
None	515	68,5	0,000
Primary	491	78,8	
Secondary/Higher	440	84,5	
Father education level			
None	392	66,6	0,000
Primary	483	78,3	
Secondary/Higher	561	82,9	
Religion			
Orthodox	1292	77,0	0,838
Non-Orthodox	156	76,3	
Household size			
≤3	947	80,8	0,066
>3	276	75,7	
Age of first pregnancy			
≤25 years	1216	77,1	0,256
>25 years	159	81,1	
Number of live birth			
≤2	834	78,8	0,284
>2	571	76,4	
Number of pregnancy			
≤2 times	736	79,9	0,028
>2 times	609	74,9	
Know any traditional birth attendant			
Yes	840	73,3	0,000
No	588	82,1	
Visited ANC			
Yes	1157	82,9	0,000
No	287	53,0	
Knowledge level of HIV			
poor	783	71,7	0,000
good	659	83,2	
Know HF that gives HCT			
Yes	1229	80,0	0,000
No	214	59,4	
Get encouragements from husband to attend HCT			
Yes	1090	83,6	0,000
No	345	56,2	

Table 2. Continued…

Waiting time too long in HF			
Yes	328	68,9	0,000
No	1076	80,2	
Planned pregnancy			
Yes	969	80.4	0.000
No	435	69.0	
Household wealth index			
1st quintile(poorest)	334	65.9	0.000
2nd quintile	321	78.5	
3rd quintile	340	74.4	
4th quintile	215	83.3	
5th quintile (richest)	238	88.2	
Place of residence			
Urban	872	83.0	0.000
Rural	564	67.4	
Proximity			
<1km	465	83.9	0.000
1-5kms	260	80.0	
>5kms	242	70.2	
Nurse work load			
≤1500	478	83,1	0,000
>1500	970	73,9	
Proportion of poorest and poor household			
<30%	422	77,2	0,000
30-60%	547	83,4	
>60%	479	69,3	
Proportion of women with no education			
<30%	611	77,9	0,009
30-50%	583	79,1	
>50%	254	69,7	
People per health worker			
≤500	414	80,4	0,045
>500	1034	75,5	
People per health facility			
≤25000	1166	78,0	0,041
>25000	282	72,3	
lab technicians work load			
≤3100	750	78,4	0,170
>3100	698	75,4	
People per HCT site			
≤25000	670	81,2	0,000
>25000	778	73,3	

Table 3. Single level logistic regression and multilevel logistic regression results for log odds of post-partum women who were attending health facility for the child immunization and utilized HCT in Tigray region Ethiopia

Variables	Adj.Single lev. OR	Crude Mult.lev OR	Adj.Mult.lev. OR
Mother education level			
None	1	1	1
Primary	1.44(0.885-2.334)	1.69(1.226-2.319)	1.38(0.834-2.277)
Secondary/Higher	1.19(0.643-2.201)	2.82(1.980-4.027)	1.21(0.638-2.281)
Father education			
None	1	1	1
Primary	1.32(0.826-2.111)	2.09(1.478-2.944)	1.45(0.883-2.366)
Secondary/Higher	1.13(0.635-2.022)	2.74(1.942-3.879)	1.30(0.702-2.398)
Visited ANC			
Yes	3.84(2.366-6.224)	4.84(3.472-6.753)	3.89(2.334-6.485)
No	1	1	1
Knowledge level of HIV			
poor	1	1	1
good	1.67(1.116-2.513)	1.76(1.279-2.430)	1.42(0.884-2.273)
Know HF that gives HCT			
Yes	1.40(1.000-2.397)	3.84(2.612-5.634)	1.61(0.902-2.879)
No	1	1	1
Get encouragements from husband to attend HCT			
Yes	1.91(1.210-3.017)	4.12(3.030-5.600)	1.92(1.192-3.082)
No	1	1	1
Waiting time too long in HF			
Yes	1	1	1
No	1.13(0.721-1.767)	1.99(1.446-2.739)	1.17(0.729-1.865)
Planned pregnancy			
Yes	1.18(0.761-1.837)	1.68(1.255-2.249)	1.11(0.699-1.753
No	1	1	1
Household wealth index			
1st quintile(poorest)	1	1	1
2nd quintile	1.29(0.730-2.271)	1.94(1.313-2.853)	1.30(0.715-2.349)
3rd quintile	0.60(0.321-1.118)	1.73(1.180-2.536)	0.62(0.321-1.201)
4th quintile	1.67(0.732-3.833)	3.24(2.006-5.243)	1.77(0.747-4.188)
5th quintile (richest)	1.57(0.663-3.724)	4.55(2.721-7.613)	1.53(0.617-3.797)
Place of residence			
Urban	0.89(0.527-1.510)	2.28(1.692-3.074)	0.89(0.509-1.569)
Rural	1	1	1
Proximity			
<1km	1.25(0.755-2.075)	2.52(1.580-4.006)	1.29(0.759-2.206)
1-5kms	1.60(0.973-2.626)	1.83(1.138-2.935)	1.66(0.957-2.863)
>5kms	1	1	1

Table 3. Continued…

Nurse work load			
≤1500	1.77(0.633-4.943)	1.99(1.072-3.679)	1.74(0.520-5.818)
>1500	1	1	1
Proportion of poorest and poor household			
<30%	1	1	1
30-60%	1.93(1.076-3.475)	1.23(0.725-2.086)	1.69(0.828-3.463)
>60%	1.04(0.541-2.015)	0.85(0.528-1.382)	0.99(0.462-2.114)
Proportion of women with no education			
<30%	1	1	1
30-50%	0.62(0.358-1.082)	0.95(0.624-1.444)	0.67(0.356-1.249)
>50%	0.43(0.202-0.913)	0.79(0.463-1.344)	0.50(0.208-1.212)
People per health worker			
≤500	0.37(0.128-1.078)	1.38(0.723-2.649)	0.35(0.098-1.233)
>500	1	1	1
People per health facility			
≤25000	2.11(1.201-3.702)	1.36(0.657-2.802)	2.12(1.014-4.454)
>25000	1	1	1
People per HCT site			
≤24000	2.29(1.315-3.976)	1.61(0.909-2.837)	2.36(1.181-4.702)
>24000	1	1	1

Table 4. Random effect results for log odds of post-partum women who were attending health facility for the child immunization and utilized HCT in Tigray region Ethiopia

Random Effect	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Intercept	1.37(0.149)	-1.22(0.296)	-0.21(0.624)	-0.11(0.434)
Community-level variance (SE)	0.81(0.236)***	0.77(0.243)***	0.41(0.174)***	0.42(0.198)***
VPC (%)	19.8	19.0	11.1	11.3
PVC(%)	Reference	4.9	49.4	48.1
Model fit statistics				
DIC(-2log likelihood)	1466.1848	1185.2234	897.7536	697.9674

*** Significant at p-value<0.001; ** significant at p-value<0.01; * significant at p-value<0.05

PAPER II

A multilevel analysis of individual and community level factors affecting maternal health services in Ethiopia

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Abstract

Background: Maternal health services utilization is linked with improved maternal and neonatal mortality. Previous studies of utilization of ANC and place of delivery have been limited to micro level factors and single level models. However, these have been able to explain only a small proportion of overall variability. Moreover, macro level community factors are also presently considered to contribute to health outcomes. This study examined the determinants of maternal health services utilization in Ethiopia, with a focus on individual and community-level factors.

Methods: Between May 05 and July 15 2011, 1493 post-partum women attending child immunization services at 50 health facilities in 46 districts of Ethiopia, were enrolled in the study. A multistage probability sampling method was used for this cross-sectional study. Women were interviewed using a structured questionnaire. Due to the nested nature of the data, we used multilevel modelling methods and assessed macro level random effects.

Results: Four-fifths (80.0%) of mothers used antenatal services at least once during their most recent pregnancy, and 69% had delivered at health facility. For both outcomes place of residence is significantly associated, with women living in urban area almost 2 times (OR=1.75, 95% CI 1.06, 2.92) more likely to deliver at a health facility, when other variables are controlled. For every addition of one health facility per 25000 people, the likelihood of delivering at health facility increases by 2.45 fold (OR=2.45, 95% CI 1.04, 5.78), when other individual and community level factors were controlled. Community-level random-effects are also significant and there is confirmation of nesting at the community-level even after controlling for individual and community-level variables.

Conclusion: Factors influencing utilization of maternal health services work at different levels, individual and community. Interventions are needed to increase spouse involvement in ANC utilization, and explore effective ways of increasing health facility delivery among poorly educated, poor women in rural areas and increasing the number of health facility per population.

Introduction

Maternal and child morbidity and mortality remain significant public health challenges in low and middle-income countries. Every day, almost 1600 women and 5000 newborns succumb to preventable complications during pregnancy, birth and the postnatal period.[1] Almost all deaths occur in low and middle income countries, [2, 3] and of these deaths approximately 75% are considered avoidable.[4] Sub-Saharan African countries contribute nearly 60% of maternal deaths.[3] There are large disparities between countries, with some countries having extremely high maternal mortality ratios of 1000 or more per 100 000 live births.[5] There are also large disparities within countries, between people with high and low income and between people living in rural and urban areas.[6] While maternal mortality has dramatically decreased over the last decade in Ethiopia from 937/100,000 in 2000 to 676/100,000 in 2011,[7] it is higher than the regional average and one of the six countries accounting for more than 50% of all maternal deaths in the world.[8]

Antenatal care (ANC) enables the transmission of essential information about the mother's pregnancy and health relevant to her physical, psychological, social, cultural and educational state in order to detect, predict, prevent and manage pregnancy related complications.[9,10] Scientific evidence has also shown the inverse relationship between health facility delivery and the occurrence of maternal and neonatal death.[11] According to the 2011 Ethiopian Demographic and Health Survey (EDHS), only 34% of mothers who had live births in the five years preceding the survey received antenatal care from health professionals, with little improvement from the preceding 5 years.[7] Ethiopian women start ANC at a relatively late stage (5.2 months) of their pregnancy, and only 19% of pregnant women have the recommended four ANC visits before birth.[7] Only 10% of births in the past five years were delivered by a skilled provider, and more than 61% women stated that a health facility delivery was not

necessary, while 30% stated that it was not customary. According to the 2011 EDHS the most important barrier to access to health services that women mention is taking transport to a facility (71%), followed by lack of money (68%), and distance to a health facility (66%).

Previous studies of utilization of ANC and place of delivery have been limited to micro-level factors and individual-level models[12-15]. However, these have been able to explain only a small proportion of overall variability. In addition, macro-level community factors are also presently considered to contribute to the health outcomes[16-18].

The studies conducted at micro-level have not yielded a consistent pattern of relationships between health outcome and lower-level predictors. Maternal health services utilization affecting factors, important in one country, context and culture were not significant in another[19]. For instance, studies in a variety of settings reported that higher education level increases the chance of utilizing recommended number of ANC visits, giving birth at health facility, [20,21] and to start early ANC visits earlier in pregnancy.[22,23] In other settings education level was not an important factor and did not show statistically significant associations.[24-26] Similarly, studies showed a statistically significant association between utilization of maternal health services and women who were married,[27,28] of higher age,[29,30] and lower parity.[31-33] However, there are studies that did not show statistically significant associations with marital staus[34], age of mother[35-38] and parity, with utilization of maternal health services.[39]

Although several individual characteristics have been associated with ANC and place of delivery, contextual characteristics have largely been understudied. Several theoretical frameworks[40,] have, however, stressed that the immediate environment (e.g., home or community) may influence individuals health behaviour. Nevertheless, most studies on ANC and place of delivery have applied traditional single-level analytic techniques, ignoring the social context within which individuals live.[42-44] This study explicitly examined both individual, contextual level correlates with ANC and place of delivery simultaneously by implementing a multilevel methodological approach.

Methods

Study Site

The Ethiopian economy is based on agriculture contributing 47% to the Gross National Product (GNP) and accounting for more than 80% of exports, as well as, providing employment for 85% of the population. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), the Tigray Region has a total population of more than 4.3 million, of whom 49.2% were men and 50.8% women; and urban inhabitants were 19.5% of the population. This region has an estimated density of 86.15 people per square kilometers. For the entire region almost 1 million households were counted, with an average of 4.4 persons to a household. The region is predominantly (96.6%) inhabited by people from the Semitic-speaking Tigray ethnic group. From Tigray region's population 95.6% are Orthodox Christians.

ANC coverage in Tigray region in 2009 was 73.0%. From the mothers who have utilized ANC 43% tested for HIV, and of these, 3.1% tested positive. Only 51% of HIV positive pregnant women and 38% of babies born to HIV positive mothers were given nevirapine or combination antiretroviral treatment (cART).

Study Design and Sampling procedure

This study was a cross-sectional, multistage sampling design in which health facilities were first selected (stage 1), followed by recruitment of post-partum women coming for child immunization from each health facility (stage 2) in Tigray region. Two-stage sampling scheme resulted in a two-level data structure (i.e. health facilities, and post-partum women within health facilities), with health facilities corresponding to the primary sampling unit, and post-partum women secondary sampling unit.

Informed consent was obtained from each participant at the start of the survey. The study was approved by the ethics committee of University of the Western Cape, and Tigray region Health Bureau. The 46 districts, comprising 208 health centers and 13 hospitals were determined by the Tigray region Bureau of Health. One health center from each district randomly and all available hospitals were chosen, 30-36 post-partum women were randomly selected from each chosen health facility. The

structured questionnaire survey was conducted by a trained nurse from the same health facility. Participants were interviewed face-to-face to collect information on demographic, socio-economic characteristics and on women's maternal healthcare. Definitions and measures of individual and community level variables in the study are shown in the Table 5.

Statistical analysis

First, we computed descriptive statistics, analyzing the proportion of women who utilized ANC, and place of delivery for each category in the explanatory variables. This study applied multilevel modelling techniques, considering multiple options for the choice of utilization of ANC in the most recent pregnancy, place of delivery and the clustered structure of the data where women are nested within communities or districts.[16,18,27-31] Thus, a multilevel model with two levels was fitted to assess the influences of measured individual and community (fixed-effects) on the utilization of ANC and place of delivery. We estimated the community-level random-effects using the xtmelogit command in Stata 11 (Stata Corp. Inc., TX, USA). For each of the two outcome variables (utilization of ANC, and place of delivery), four models were constructed. In model 1 (empty model) no explanatory variable was included. This model represented the total variance in the use of two maternal health services between the communities. In Model 2, individual- and community-level factors were included together. The results of fixed-effects (measures of association) are shown as odds ratios (ORs) with standard error (SE). The results of random-effects (measures of variation) are presented as variance partition coefficient (VPC) [1].

As this study used several explanatory variables that might be correlated to each other (such as mother's education, father's education and household wealth index), the multicollinearity assessment was conducted using the means of variance inflation factors (VIFs) as a post-estimation procedure following the regression analysis. The small VIF of 1.98 indicated the absence of any significant collinearity between explanatory variables in the regression model.

1 In two-level logistic regression models, the VPC is calculated as: VPC = $VPC = \frac{s^2}{s^2 + 3.29}$

Where σ^2 represents community level variance and 3.29 individual level variance

Results

Of the 1493 post-partum women who had participated on this study, 50% were aged 25 to 34 years, almost 36% had no formal education. Most of the women (89%) knew a health facility that offers ANC, 85% get encouragement from their husband to utilize ANC, and 46% were from the poor and poorest socio-economic quintile.

Table 6 shows that a high proportion (85.4%) of women do not know a traditional birth attendant around where they live; 84.9% women who planned pregnancy had utilized ANC. Though, 80% (data not shown) first utilized ANC after the second trimester, nearly 87% of women had utilized ANC at least once and 31% women had their most recent birth at home.

Multilevel models

The first step in the multilevel model analysis was to consider if our data justified the decision to assess random effects at the community levels. The results of the random intercept only model are shown in Table 8 and 9 (Null model). There was a significant amount of variation in the use of two maternal health care indicators across the communities. Based on the variation partition coefficient (VPC) values, 33% of the total variance in the utilization of ANC and 25% variance in the health facility delivery variance was attributable to the differences across communities. Table 7 shows the results of the final model when individual, and community-level variables were included together. Both fixed and random-effects are included. When controlled for individual and community-level factors, the variances in the utilization of ANC attributed to the differences across communities increased to 37%. There were only small increases observed in the variance at community-level for the use of health facility delivery. (see Annex B2 and B3 for the further analysis).

Antenatal Care

Simple association was checked by using cross-tabulation and chi-squared test, except two variables “Religion” (p-value=0.702) and “Age of first pregnancy” (p-value=0.613) of the women, all other variables were significantly associated (p-value<<0.05) with ANC utilization (see table 6). All variables, which showed

significant association by chi-squared test with ANC utilization, were checked by using bivariate multilevel modelling, if they were statistically significant predictors they were then included in the main model.

Bivariate multilevel modelling

Table 7 shows that, from the variables statistically significantly associated by chi-square test "Age group", "Household size", "know any traditional birth attendant", "proportion of poor and poorest household", "proportion of women with no education >50%", "people per health worker" and "people per health facility" were not statistically significant predictors in bivariate multilevel modelling. Mother and father education level, knowing health facility that gives ANC service, getting encouragement from husband to attend ANC, planned pregnancy, and SES were positively associated with utilization of ANC at the individual level. However, at the individual level bivariate multilevel modelling showed that number of live birth, number of pregnancy, and waiting time too long at health facility were negatively associated with utilization of ANC.

At the community level the bivariate multilevel modelling showed that, the women who are living in an urban area are 3 times (OR=2.99 95% CI 2.14, 4.17) more likely to have utilized ANC than their rural counterparts. Women living within less than 1km radius reach of health facility were 3 times (OR=3.09 95% CI 1.85, 5.17) more likely to have utilized ANC than the women living in greater than 5km radius. Every addition of one nurse per 1500 people increased the odds of utilizing ANC by 3 (OR=2.91, 95% CI 1.24, 6.83) fold. When the proportion of women with no education was 30-50%, the odds of utilizing ANC increased by 73% compared to women living in a district with <30% proportion of women with no education. From the community level variables "proportion of poorest and poor household", "proportion of women with no education >50%", "people per health worker" and "people per health facility" were not statistically significant variables at the bivariate multilevel modelling.

Multivariate multilevel modelling

All statistically significant variables at 95% confidence interval were considered to be potential predictors, and included at the main model. Stepwise model building method was used and the following results were found. The two-level logistic regression

models (Table 7) showed that the most significant individual-level predictors of utilization of ANC services were mother education level, getting encouragement from husband and waiting time at health facility, and from community level variables only urban place of residence was significant. When the other variables were controlled, a woman with primary and secondary/higher education level has 1.75 and 2.13 times higher odds of utilizing ANC respectively, than a woman with no education. A woman who got her husband's encouragement or approval to attend ANC services was almost four (OR=3.85, 95%CI 2.23,6.64) times more likely to utilize ANC than a woman without her spouses' approval, after adjusting for other variables. The odds of utilization of ANC services was four (OR=3.98, 95% CI 2.50,6.36) times higher among a women who thought waiting time at the health facility is not long, when other variables were controlled.

Community-level variables included in the model were not significant predictors of ANC services utilization, except place of residence. Women in urban areas were 2.3 (OR=2.29, 95% CI 1.36,3.87) times more likely utilizing ANC services compared to rural counterparts, when it was controlled for other variables. In conclusion, VPC are appreciably large, showing that even after controlling for first level (individual) and second level (community) factors, there is still considerable nesting of ANC utilization at the district level. (see Annex B2 for the further analysis).

Health Facility Delivery

When simple association was checked, by using cross-tabulation and chi-squared test, except for two variables "know health facility that gives ANC" (p-value=0.327) and "proportion of women with no education" (p-value=0.361), all other variables were significantly associated (p-value<<0.05) with the place of delivery (see table 6).

Bivariate multilevel modelling

All variables which showed significant association by chi-squared test with place of delivery were checked by using bivariate multilevel modelling, and all the variables which were become statistically significant at 95% CI were considered to be potential candidates and included at the main model.

Table 7 shows that, of the variables showed which were statistically significant by the chi-square test, “Age group”, “Age of first pregnancy”, and “proportion of poor and poorest household” were not statistically significant predictors in bivariate multilevel model. Mother and father education level, religion non-Orthodox, getting encouragement from husband to attend ANC, planned pregnancy, and SES increased the likelihood of health facility delivery at the individual level. While, at the individual level bivariate multilevel modelling showed that household size, number of live birth, number of pregnancy, knowing traditional birth attendant and waiting time too long at health facility increased the odds of home delivery.

At the community level the bivariate multilevel modelling showed that, the women who live in an urban area were 4.6 times (OR=4.56, 95% CI 3.36, 6.18) more likely to have delivered at a health facility than their rural counterpart women. Women living within less than 1km radius of a health facility were 4 times (OR=4.03 95% CI 2.25, 6.45) more likely to have delivered at a health facility than the women who live greater than 5km radius. Every addition of one nurse per 1500 people increases the odds of health facility delivery by 3 fold (OR=2.96, 95% CI 1.56, 5.60). Also, every addition of one health worker per 500 people increases the likelihood of health facility delivery by 2.7 fold (OR=2.69, 95% CI 1.35,5.36). Additionally, increasing the number of health facilities by one for every 25000 people increased the odds of health facility delivery by 2.8 fold (OR=2.80, 95% CI 1.31,6.00). From the community level variables only “proportion of poorest and poor household” was not statistically significant in the bivariate multilevel modelling of place of delivery.

Multivariate multilevel modelling

Finally, stepwise model building methods were used and the following results were found. Women with secondary/higher education level were more than 2 times at higher odds to give birth in a health facility than women with no education (OR=2.16, 95% CI 1.16,4.01), when other variables were controlled. Women whose husband had secondary/higher education level had almost 3 times (OR=2.71, 95% CI 1.52, 4.82) higher chance to deliver at health facility than women whose husband had no education, when other variables controlled. Unlike ANC utilization, women’s knowledge of any traditional birth attendant around her increased the use of delivery

at home by 2.3 times (OR=2.33, 95% CI 1.55, 3.49), when other variables controlled. Parity is another strongly associated factor in the main (full) model, women who have <3 parity were 74% (OR=1.74, 95% CI 1.14,2.66) more likely have given birth at health facility than their counterparts who have ≥3, when adjusted for the other variables. The likelihood of using a health facility compared to home delivery increased with increasing household wealth index. Women from the richest households were almost 4 times more likely to choose delivery at health facility than women from the poorest households (OR 3.66; 95% CI 1.46, 9.16), when adjusted for other variables. The variables strongly associated in the ANC utilization at the individual level, such as getting encouragement from husband, and waiting time at health facility, were not associated with the place of delivery.

More of the community-level variables are associated with the place of delivery than ANC utilization. For both outcomes place of residence is significantly associated, with women living in urban area almost 2 times (OR=1.75, 95% CI 1.06, 2.92) more likely to deliver at a health facility, when other variables are controlled. For every addition of one health facility per 25000 people, the likelihood of delivering at health facility increases by 2.45 fold (OR=2.45, 95% CI 1.04, 5.78), when other individual and community level factors were controlled. Community-level random-effects are also significant and there is confirmation of nesting at the community-level even after controlling for individual and community-level variables. (see Annex B3 for the further analysis).

Discussion

We have described the situation of antenatal care service utilization and place of delivery in 50 health facilities of Tigray region northern Ethiopia in 2011, compared the differences among 46 districts, and analyzed the predictors associated with ANC utilization and place of delivery by using multilevel modelling approach. Our study shows that 80% and 69% of the respondents received at least one ANC visit and had a health facility delivery, respectively. This relatively high level of utilization is not in agreement with most prior studies in Ethiopia.[32,33,35-39] These differences may be due to the time gap and coverage of the surveys, especially the household based surveys (compared to this facility based survey which may have been biased towards women with higher use of health services than might be seen in household surveys), and

regional differences where the study was conducted in Ethiopia. However, there is consistency with one study in Ethiopia.[34]

The current study confirms that there were significant differences in utilization of ANC and place of delivery among women in 50 health facilities that could not be explained alone by first level (individual) or second level (district) factors, but that could be explained better by multilevel modelling. The findings were consistent with previous studies from different settings on the healthcare utilization in Africa[11] and Asia.[40]

The use of ANC services being higher than health facility delivery was in agreement with the results of previous studies conducted in Ethiopia[7,34,38] and elsewhere.[11] A possible explanation for this disparity could be the unpredictable nature of the onset of labor, and the difficulty of traveling due to poor road networks and limited transportation access.

The study has identified several factors that have important influence on the utilization of ANC and health facility delivery in Tigray region. These include: at the individual level mother's education level, father's education level, number of live birth, knowing a traditional birth attendant, getting encouragement from husband, waiting time in health facilities, and household wealth index; and at the community level place of residence and people per health facility. Only the mother's education level at the individual level and place of residence at the community level were common predictors for ANC utilization and health facility delivery.

Several studies have found a significant association between women's education level and utilization of ANC and choosing place of delivery. Our findings show evidence of such an effect even after controlling for the other variables. The current study found a strong influence of maternal education both on accessing ANC and on the use of a health facility delivery. Multilevel modelling analysis shows that women with a higher level of education were more likely to access ANC and use health facility than home for delivery. This finding was consistent with previous studies.[20-23] This may be explained by the fact that educational attainment can be a source of economic resources which empower women to take charge of their own health and facilitate easy access to quality maternal care. Our study goes further, and supports other studies in Ethiopia[32-34] and abroad,[43,44] in documenting the role of the partner's

education in the choice of place of delivery. In particular the result shows that women having partners with a higher level of education tend to use health facility for delivery rather than delivering at home. Other studies acknowledge that getting encouragement from a husband to access ANC services, and also expecting long waiting time at health facility were important predictors to use the services and our study revealed this[11-15].

The present study revealed that knowing a traditional birth attendant around where the woman was living and the number of live births substantially decreases the probability of delivering at the health facility, and this finding was in agreement with previous studies.[35,36,43] While this study shows no association between household wealth index and ANC attendance, our assertion that increasing household wealth index was associated with health facilities delivery, and thus corroborates what has been previously reported, confirming positive association.[11,41] This is consistent with other studies in Ethiopia,[21,23] and from other parts of the world.[11,41-44]

At the community-level, we found a significant association between place of residence and both maternal health services outcomes, which was in agreement with previous studies in Ethiopia[32-36] and abroad.[42] Most studies suggest that urban woman in Ethiopia utilized more ANC and health facility for delivery than their rural counterparts. This difference was likely attributable to more accessible health facilities, better infrastructure, and more exposure to the mass media. At the community-level, we found out that the number of people per health facility was negatively associated with health facility delivery. This finding revealed that adding one health facility in a given community improves significantly the probability of giving birth at a health facility rather than at home.

At the time of interpreting the study findings, there were some limitations that needed to be considered. As the study is facility based, mothers who did not patronize the immunization facilities were eliminated. Because the mothers were interviewed about events that occurred many months back, there was possibly recall bias. In general the purpose of the study was explained to reduce social desirability bias, yet it might have been introduced due to the fact that we relied on self-reported data. Resource wise employing several data collectors was useful, but it could have affected the internal validity. To minimize this risk the data collectors were all midwives, who were well

acquainted with the issue under study, and were given training. It is possible that unmeasured individual factors may partly account for the community-level variations observed in the current study. Additionally, defining districts based on the administratively defined boundaries might non-differentially misclassify individuals into inappropriate cultural and social boundaries.

The main focus of the current study was to go beyond individual-level factors and investigate the effects of community-level factors on the utilization of ANC and health facility delivery. Factors influencing the utilization of ANC and place of delivery operate at various individual and community-levels. Whereas mother's education level and urban residence were consistently strong predictors of utilization of ANC and place of delivery, other factors generally vary in magnitude and significance level. Of direct relevance to policy was the issue of the mother's education level, getting approval from her spouse, waiting time at the health facility and place of residence for the utilization of ANC; and mother's and her partner's education level, number of live births, knowing traditional birth attendant, household wealth, place of delivery and people per health facility for health facility delivery.

In implementing interventions to promote utilization of ANC and health facility delivery it is necessary to take into consideration these findings and for programmes to focus on the underlying individual and community-level factors. Interventions are needed to increase spouse involvement in ANC utilization, and explore effective ways of increasing health facility delivery among poorly educated, poor women in rural areas and increasing the number of health facility per people is also very important.

Competing interests

The authors declare that they have no competing interests.

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Table 5. Definitions and measures of individual and community level variables in the study

Variables	Measurement
Individual level variables	
Mother age	Categorized as (≤24, 25 - 34, ≥35) years
Mother education	Categorized as (No education, Primary, Secondary/Higher)
Father education	Categorized as (No education, Primary, Secondary/Higher)
Encouragement of husband	Yes or No
Too long	Yes or No
Know traditional birth attendant	Yes or No
Number of pregnancy	Categorized as (≤2, ≥3) times
Know health facility ANC	Yes or No
Planned pregnancy	Yes or No
Household wealth index	Household socio-economic status constructed based on the information of type of toilet, main household fuel, main wall material, water source, employment status of mother and father and household income. The resulting scale was divided into quintiles
Community level	
Place of residence	Urban or rural
Number of people per Nurse	Constructed by dividing the number of people living in a given district to the number of nurses in a given district; data comes from CSA and bureau of health
Proximity	Categorized as (<1, 1-5, >5) kilo meters
Nurse work load	Categorized as (<1500, 1500-4000, >4000) people
Proportion of poorest and poor household	Categorized as (<30, 30-60, >60) percent
Proportion of women with no education	Categorized as (<30, 30-50, >50) percent

Table 6. Background individual and community-level characteristics of post-partum women who were attending health facility for the child immunization and ANC attendance and place of delivery in Tigray region Ethiopia

Variables	ANC Attendance			Place of delivery		
Age group (years)	no	yes	p-value	home	health facility	p-value
≤24	101(19.4)	419(80.6)	0.009	134(26.4)	373(73.6)	0.000
25-34	137(18.5)	605(81.5)		223(30.4)	511(69.6)	
≥35	60(27.9)	155(72.1)		92(42.8)	123(57.2)	
Mother education level						
None	151(28.5)	378(71.5)	0.000	253(48.5)	269(51.5)	0.000
Primary	86(17.1)	417(82.9)		136(27.4)	361(72.6)	
Secondary/Higher	65(14.4)	386(85.6)		61(13.8)	382(86.2)	
Father education level						
None	114(28.4)	287(71.6)	0.000	192(48.6)	203(51.4)	0.000
Primary	95(19.1)	403(80.9)		181(36.9)	310(63.1)	
Secondary/Higher	89(15.5)	485(84.5)		77(13.6)	490(86.4)	
Religion						
Orthodox	272(20.5)	1052(79.5)	0.702	418(32.1)	886(67.9)	0.003
Non-Orthodox	31(19.2)	130(80.8)		33(20.6)	127(79.4)	
Household size						
≤3	172(17.8)	797(82.2)	0.049	248(25.8)	714(74.2)	0.000
>3	65(23.0)	218(77.0)		143(51.2)	136(48.8)	
Age of first pregnancy						
≤25 years	229(18.4)	1019(81.6)	0.613	397(32.2)	838(67.8)	0.006
>25 years	32(20.0)	128(80.0)		34(21.4)	125(78.6)	
Number of live birth						
≤2	146(17.2)	703(82.8)	0.015	178(21.1)	665(78.9)	0.000
>2	132(22.3)	459(77.7)		263(44.7)	325(55.3)	
Number of pregnancy						
≤2 times	126(16.8)	624(83.2)	0.016	162(21.9)	578(78.1)	0.000
>2 times	138(21.9)	492(78.1)		269(43.0)	356(57.0)	
Know any traditional birth attendant						
Yes	88(14.6)	516(85.4)	0.000	316(37.2)	533(62.8)	0.000
No	210(24.4)	651(75.6)		132(22.2)	464(77.8)	
Know HF that gives ANC						
Yes	53(33.1)	107(66.9)	0.000	54(34.4)	103(65.6)	0.327
No	244(18.7)	1063(81.3)		394(30.6)	895(69.4)	
Get encouragements from husband to attend ANC						
Yes	105(48.4)	112(51.6)	0.000	104(48.6)	110(51.4)	0.000
No	194(15.5)	1058(84.5)		345(28.0)	889(72.0)	
Waiting time too long in HF						
Yes	122(36.3)	214(63.7)	0.000	124(37.7)	205(62.3)	0.001
No	147(13.4)	953(86.6)		306(28.1)	784(71.9)	

Table 6. Continued…

Planned pregnancy						
Yes	140(31.2)	309(68.8)	0.000	196(44.6)	244(55.4)	0.000
No	150(15.1)	843(84.9)		246(25.0)	737(75.0)	
Household wealth index						
1st quintile(poorest)	121(34.7)	228(65.3)	0.000	198(57.4)	147(42.6)	0.000
2nd quintile	63(19.2)	265(80.8)		127(39.2)	197(60.8)	
3rd quintile	52(15.0)	294(85.0)		73(21.4)	268(78.6)	
4th quintile	31(14.0)	191(86.0)		36(16.4)	184(83.6)	
5th quintile (richest)	36(15.0)	204(85.0)		17(7.7)	217(92.7)	
Place of residence						
Urban	181(31.2)	399(68.8)	0.000	171(19.5)	707(80.5)	0.000
Rural	119(13.3)	774(86.7)		276(48.1)	298(51.9)	
Proximity						
<1km	58(12.3)	412(87.7)	0.000	117(25.2)	348(74.8)	0.000
1-5kms	60(12.5)	219(78.5)		92(33.6)	182(66.4)	
>5kms	71(28.4)	179(71.6)		113(45.9)	133(54.1)	
Nurse work load						
≤1500	65(13.5)	417(86.5)	0.000	84(17.7)	390(82.3)	0.000
>1500	238(23.7)	765(76.3)		367(37.1)	623(62.9)	
Proportion of poorest and poor household						
<30%	100(23.5)	325(76.5)	0.001	124(29.7)	294(70.3)	0.016
30-60%	85(15.4)	467(84.6)		150(27.4)	397(72.6)	
>60%	118(23.2)	390(76.8)		177(35.5)	322(64.5)	
Proportion of women with no education						
<30%	149(24.4)	463(75.6)	0.001	196(32.2)	413(67.8)	0.361
30-50%	97(16.0)	509(84.0)		170(28.7)	422(71.3)	
>50%	57(21.4)	210(78.6)		85(32.3)	178(67.7)	
People per health worker						
≤500	64(15.3)	354(84.7)	0.002	75(18.3)	335(81.7)	0.000
>500	239(22.4)	828(77.6)		376(35.7)	678(64.3)	
People per health facility						
≤25000	268(22.3)	935(77.7)	0.000	319(27.0)	862(73.0)	0.000
>25000	35(12.4)	247(87.6)		132(46.6)	151(53.4)	

Table 7. Results (fixed effect) of the multilevel analysis of post-partum women who were attending health facility for the child immunization and ANC attendance and place of delivery in Tigray region Ethiopia

	ANC attendance		Place of delivery	
Variables	crude OR(CI)	adjusted OR(CI)	crude OR(CI)	adjusted OR(CI)
Age group (years)				
≤24	1		1	
25-34	1.17(0.845-1.620)		0.80(0.600-1.054)	
≥35	0.71(0.461-1.103)		0.40(0.274-0.595)	
Mother education level				
None	1	1	1	1
Primary	2.01(1.409-2.862)	1.75(1.032-2.981)	2.52(1.869-3.402)	1.30(0.835-2.062)
Secondary/Higher	2.94(2.005-4.325)	2.13(1.162-3.901)	6.05(4.220-8.670)	2.16(1.160-4.010)
Father education level				
None	1		1	1
Primary	1.63(1.122-2.367)		1.85(1.339-2.552)	1.22(0.788-1.885)
Secondary/Higher	2.24(1.532-3.269)		6.59(4.582-9.468)	2.71(1.524-4.823)
Religion				
Orthodox			1	
Non-Orthodox			1.81(1.140-2.870)	
Household size				
≤3	1.39(0.956-2.027)		2.62(1.928-3.562)	
>3	1		1	
Age of first pregnancy				
≤25 years			1.18(0.948-1.480)	
>25 years			1	
Number of live birth				
≤2	1.49(1.099-2.022)		2.76(2.126-3.571)	1.74(1.137-2.660)
>2	1		1	1
Number of pregnancy				
≤2 times	1.38(1.016-1.886)		2.43(1.869-3.164)	
>2 times	1		1	
Know any traditional birth attendant				
Yes	1		1	1
No	1.33(0.946-1.868)		2.30(1.723-3.072)	2.33(1.550-3.490)
Know HF that gives ANC				
Yes	2.72(1.690-4.367)			
No	1			
Get encouragements from husband to attend ANC				
Yes	5.31(3.650-7.736)	3.85(2.233-6.643)	2.84(2.088-3.863)	
No	1	1	1	
Waiting time too long in HF				
Yes	1	1	1	
No	4.09(2.892-5.771)	3.98(2.497-6.356)	1.73(1.273-2.354)	
Planned pregnancy				
Yes	2.83(2.047-3.914)		2.35(1.776-3.100)	
No	1		1	

Table 7. Continued…

Household wealth index						
1st quintile(poorest)	1			1		1
2nd quintile	2.16(1.429-3.265)				1.90(1.153-3.124)	
3rd quintile	3.81(2.441-5.959)			6.35(4.264-9.471)	2.12(1.219-4.106)	
4th quintile	3.72(2.212-6.254)			8.49(5.269-13.672)	2.15(1.029-4.492)	
5th quintile (richest)	4.44(2.610-7.565)			18.61(10.224-33.862)	3.66(1.461-9.165)	
Place of residence						
Urban	2.99(2.141-4.172)	2.29(1.361-3.866)		4.56(3.364-6.180)	1.75(1.056-2.915)	
Rural	1	1		1		1
Proximity						
<1km	3.09(1.850-5.172)	1.24(0.694-2.227)		4.03(2.520-6.447)	1.24(0.747-2.063)	
1-5kms	1.99(1.216-3.254)	1.24(0.643-2.405)		2.03(1.295-3.175)	1.52(0.871-2.642)	
>5kms	1	1		1		1
Nurse work load						
≤1500	2.91(1.240-6.836)			2.96(1.562-5.597)		
>1500	1			1		
Proportion of poorest and poor household						
<30%	1			1		
30-60%	1.78(0.952-3.330)			1.18(0.679-2.067)		
>60%	1.64(0.924-2.911)			0.81(0.487-1.337)		
Proportion of women with no education						
<30%	1					
30-50%	1.73(1.067-2.814)					
>50%	1.39(0.781-2.475)					
People per health worker						
≤500	2.11(0.860-5.204)			2.69(1.352-5.362)		
>500	1			1		
People per health facility						
≤25000	1			2.80(1.310-6.000)	2.45(1.038-5.781)	
>25000	0.50(0.180-1.368)			1		1

Table 8. Random effect results of post-partum women who were attending health facility for the child immunization and ANC attendance in Tigray region Ethiopia

Random Effect	Model 1	Model 2	Model 3	Model 4
Intercept	1.72(0.204)	-1.90(1.362)	1.64(1.003)	0.63(0.788)
Community-level variance (SE)	1.63(0.442)***	2.24(0.725)***	1.24(0.406)***	1.94(0.707)***
VPC (%)	33.1	40.5	27.4	37.1
PVC	Reference	37.4	23.9	19.0
Model fit statistics				
DIC(-2log likelihood)	1308.2664	720.1216	794.6862	434.4763

*** Significant at p-value<0.001; ** significant at p-value<0.01; * significant at p-value<0.05

Table 9. Random effect results of post-partum women who were attending health facility for the child immunization and place of delivery in Tigray region Ethiopia

Random Effect	Model 1	Model 2	Model 3	Model 4
Intercept	1.01(0.167)	-4.12(0.766)	-1.66(0.861)	0.14(0.709)
Community-level variance (SE)	1.11(0.293)	0.79(0.272)***	1.06(0.331)***	1.25(0.453)
VPC (%)	25.2	19.4	24.4	27.5
PVC	Reference	28.8	4.5	12.6
Model fit statistics				
DIC(-2log likelihood)	1640.4724	1012.8328	1006.0546	789.5639

*** Significant at p-value<0.001; ** significant at p-value<0.01; * significant at p-value<0.05

PAPER III

Identifying factors associated with the uptake of prevention of mother to child HIV transmission programme in Ethiopia: A multilevel modelling approach

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Abstract

Background: Implementation of the prevention of mother to child transmission (PMTCT) of HIV infection remains a challenge in low and middle income countries, despite effective strategies to eliminate MTCT. This study examined individual and community level determinants of mother and child accessing PMTCT services in the Tigray, Ethiopia.

Methods: Between May 05 and July 15 2011, 220 HIV positive post-partum women attending child immunization services at 50 health facilities in 46 districts of Ethiopia, were enrolled in the study. A multistage probability sampling method was used for this cross-sectional study. The women were interviewed using a structured questionnaire. In view of the nested nature of the data, we used multilevel modelling methods and assessed macro level random effects.

Results: Seventy nine percent of mothers and 55.7% of their children had received PMTCT services. Multivariate multilevel modelling found that mothers who delivered at a health facility were 18 times (OR=18.21; 95%CI 4.37,75.91) and children born at a health facility were 5 times (OR=4.77; 95%CI 1.21,18.83) more likely to receive PMTCT services, compared to mothers delivering at home. For every addition of one nurse per 1500 people, the likelihood of getting PMTCT services for a mother increases by 7.22 fold (OR=7.22; 95% CI 1.02,51.26), when other individual and community level factors were controlled simultaneously. In addition, the findings showed that the variation of mothers getting PMTCT services between districts were only 0.6%, but were 27.2% for children.

Conclusions: This study sheds light on the factors that determine mother and child getting PMTCT services, operating at individual and community levels. The multilevel modelling approach allows identifying several factors at individual and community level that hinder access to PMTCT services. This may allow differentiating and accentuating approaches for different settings in Ethiopia. The government should therefore focus on increasing health facility delivery and HCT coverage to advance getting PMTCT services for mothers at the individual level and for children at both individual and community level.

Introduction

With an estimated 1.1 million people living with HIV, Ethiopia has one of the largest populations of HIV infected people in the world.[1] The Government of Ethiopia has started integrating services such as prevention of mother to child HIV transmission (PMTCT) and HIV counselling and testing (HCT) within family planning and maternal, newborn and child health services.

Regardless of the overall increase in the proportion of PMTCT uptake in developing countries, it is still often at unacceptably low levels, unevenly distributed and access to PMTCT services remains a big challenge in the fight against HIV/AIDS and mother to child HIV transmission (MTCT), as well as, for reaching the Millennium Development Goals (MDGs) in Ethiopia. Concerning MTCT, UNAIDS estimated that almost 430,000 children are infected, and 280,000 children died under fourteen years of age in the year 2008.[2] Around 91% of child infections occur in sub-Saharan Africa,[2] and Ethiopia is not an exception.

In Ethiopia the predominant mode of HIV transmission is heterosexual intercourse. This is followed by MTCT. Over 90% of the infections in children occur through MTCT, which can take place in pregnancy, during child birth or through breastfeeding. There are effective interventions that help reduce MTCT from 20% - 45% to less than 1% - 2%.[3-5] There is ample evidence on the decline of vertical transmission of HIV in low- and middle-income countries after the introduction PMTCT strategies from 20 - 45% to less than 5% in the best-case scenarios,[6-8] and in wealthy countries, transmission rates are below 2%.[9,10]

Although Ethiopia has made progress in the provision of services to reduce MTCT by increasing the proportion of women getting tested and knowing their results through expanding rapid testing to many PMTCT sites, national ANC coverage is only 66.3%, and coverage of skilled birth at a health institution is a mere 24.9%, both of which influence the utilization of PMTCT.[11]

Ethiopia is one of six countries that account for 50% of under-5 child deaths worldwide, with approximately 350, 000 Ethiopian children dying each year.[12] Eleven percent of child deaths result from HIV/AIDS.[13] To avert these deaths, detection of maternal infection early in pregnancy through HCT and access to antiretroviral prophylaxis is crucial. Generally, the uptake of these interventions remains low, primarily due to low ANC uptake and poor antenatal HIV testing rates.

In Ethiopia, a total of 1,023 health facilities were providing PMTCT services at the end of 2009. More than 616,763 pregnant women had at least one ANC visit in 2009, and 417,841 women underwent HCT, of whom 10,267 (2.4%) tested positive. Of all the pregnant women diagnosed with HIV, only 6,466 (63%) received antiretroviral prophylaxis (ARV/NVP) and only 5,025 infants received PMTCT prophylaxis in the same year. Of the total estimated 84,189 HIV-positive pregnant women in 2009 only 8% received ARV/NVP during childbirth.[11]

Several papers have studied the determinants of getting PMTCT services. Cultural and social barriers that may prevent receipt of PMTCT services has not received much attention.[14] In general, challenges cited include limited screening for HIV in children, lack of affordable, simple diagnostic testing technologies, lack of human capacity, insufficient advocacy and poor understanding that ART is efficacious in children.[15] Evidence also suggests that factors operate at both the micro and macro level in getting PMTCT services. Micro-level includes health seeking behaviour,[16] adherence,[17,18] home delivery,[19] non-attendance of ANC,[19] lack of knowledge,[20] stigma,[20] discrimination,[20] trust in the hospital,[21] while macro level includes underlying inequities in healthcare quality,[22] health services,[16] health policy,[16] distance and transport cost.[21]

Drawbacks of these studies have been the use of single level analytical techniques that ignore clustering and the hierarchical structure of data on individuals living in different households, neighbourhoods, cities, and provinces. Multilevel modelling accounts for factors at individual and community levels simultaneously and provides a robust and sophisticated understanding of the factors associated with receiving PMTCT services.[23]

The main reason for applying multilevel modelling is that many kinds of data, including observational data collected in the human and biological sciences, have a hierarchical or clustered structure[24]. The general concept is that individuals interact with the social contexts to which they belong, meaning that individuals are influenced by their social groups or contexts, and that the properties of those groups are in turn influenced by the individuals who make up that group. Generally, the individuals and the social groups are conceptualized as a hierarchical system, with individuals and groups defined at separate levels of this hierarchy. Naturally, such systems can be observed at different hierarchical levels, and variables may be defined at each level[25]. Because of growing statistical technology and increasing interest in societal influences on individual health status, group level and individual level factors in regression models have prompted interest in contextual research in epidemiology.[26] The statistical issues involved in multilevel studies have been well described, and hierarchical regression analysis is becoming widely accepted as the appropriate tool for examining group level effects on individual health.[27] However, as far as this researcher can assert, this variation in health has received less attention in public health until recently and almost not inculcated in African studies on receiving PMTCT services.

By explicitly acknowledging the existence of groups, modelling group-to-group variation simultaneously with individual-to-individual variation, and including group-level properties with individual-level variables in the analyses, multilevel models allow for the importance of both groups and individuals in understanding health outcomes. It provides one way to link the traditionally distinct ecological- and individual-level studies and to overcome the limitations inherent in focusing only at one level. Like other statistical methods, multilevel analysis assists to describe, summarize, and quantify patterns present in the data.[23]

Although several individual characteristics have been associated with getting PMTCT services (e.g., age, education), associations with contextual characteristics, such as nurse load, PHC per population, have largely been understudied. Several theoretical frameworks[28,29] have, however, stressed that the immediate environment (e.g., home or community context) may influence individuals health behaviour. Nevertheless, most studies on PMTCT have applied single-level analytic techniques, ignoring the social context within which individuals' live.[30-32] This study explicitly examined individual, contextual level correlates in getting PMTCT services by implementing a multilevel methodological approach.

The research questions that this paper answered are the following: What are the individual and contextual factors that affect receipt of PMTCT services? Which determinants (community or individual level) influence the probability of receiving PMTCT services inter and intra districts (woredas) in Tigray region Ethiopia?

Methods and materials

The economy of Ethiopia is dependent on agriculture, contributing 47% to the Gross National Product (GNP) and accounting for more than 80% of exports, as well as, providing employment for 85% of the population. The 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), revealed that the Tigray Region has a total population of more than 4.3 million, of whom 49.2% were men and 50.8% women; urban inhabitants make up 19.5% of the population. The estimated population density is 86.15 people per square kilometre. The region has 1 million households, resulting in an average of 4.4 persons to a household, with urban households having on average 3.4 and rural households 4.6 people.

Only half of the population has access to health services. The ANC coverage in Tigray region in 2009 was 73.0%, 43% of mothers utilizing ANC were tested for HIV, and of these, 3.1% tested positive. Only half of HIV positive pregnant women and 38% of babies born to HIV positive mothers were given single dose nevirapine (sdNVP) or combination antiretroviral treatment (cART).

From May 05 to July 15, 2011 a health facility based cross-sectional study was conducted in Tigray, Ethiopia. The participants were selected by using multistage sampling. Forty six districts, comprising 13 hospitals and 208 health centers were determined by the Tigray region Bureau of Health. One health center from each district randomly and all available hospital were chosen, 30 to 36 post-partum women were purposively selected from each chosen health facility.

All participants were interviewed face to face by a trained nurse using a structured questionnaire to collect information on demographic, socio-economic characteristics and on women's maternal healthcare status (e.g., prenatal care, delivery and postnatal care related to PMTCT). Informed consent was obtained from each participant at the start of the survey. The study was approved by the ethics committee of University of the Western Cape, and Tigray region Health Bureau.

Getting PMTCT service (defined as 1 "yes" 0 "no"; In accordance with the Ministry of Health PMTCT guidelines, before, after or/and at the time of labour the mother is expected to take the prophylaxis depending on her clinical stage, and the child is expected to get prophylaxis at the time of birth or/and after birth depending on the mother clinical stage) during the last pregnancy and delivery was used as the principal outcome indicator in the analysis of the demographic and socio-economic determinants at the individual and community level.

A two-level logistic regression model was used to assess the explanatory effects of the independent variables on getting PMTCT services by considering the hierarchical structure of the study sample. The first level represents the individual and the second level the district/community. The community level covariate was the geographical demarcation of the districts.

Individual level covariates comprised age group (≤24, 25-34, or ≥35) years; education (categorized as none, primary, or secondary/higher); number of pregnancy (≤2 or ≥3); place of delivery (home or health facility); ever stigmatized (yes or no); ever discriminated (yes or no); planned pregnancy (yes or no); any CD_4 count done (yes or no); time of HIV status knowledge (before being pregnant, during pregnancy, at the time of delivery, or after giving birth); HIV status disclosure to the spouse (yes or no); who attended the birth of child (traditional birth attended, doctor, or nurse/mid-wife/other); and socio-economic status (SES) quintile (1^{st} quintile (poorest), 2^{nd}

quintile, 3rd quintile, 4th quintile, or 5th quintile (wealthiest)). The quintile combined information on a set of household assets and living conditions: the household income, employment status, main source of water, type of toilet, main fuel used for cooking, and main material the house built.

The community level random effects were estimated, using xtmelogit function in Stata 11, at a 2-level multilevel model as shown:

$$\log\left(\frac{\pi ij}{1-\pi ij}\right) = \beta 0j + \beta 1jxij + (u0j + e0ij)$$

With β_0 as the intercept and the slope β_1, defined as the expected change in getting PMTCT service. A set of intercepts was estimated for the community level, where π_{ij} is the probability of utilizing HCT for a pregnant woman *i*, in a district *j*, and β0j is a parameter associated with the fixed part of the model. Therefore, for every one unit increase in X (a set of predictor variables) there is a corresponding effect on the probability mother or child getting PMTCT service. By assuming that each community has a different intercept β_{0j} and a different slope β_{1j} the clustered data structure and the within and between community variations is now taken into account. To capture the extent by which choice of different option of getting PMTCT service, which are contrast specific, varies randomly at the individual level, the results of random effects (measures of variation) are presented as variance partition coefficient (VPC):

$$\text{VPC} = \frac{\sigma 2u0}{\sigma 2u0 + \sigma 2e0}$$

Where, $\sigma 2e0$ denotes the variance between mother or child from the same district (individual level) and $\sigma 2u0$ is the variance between districts (community level variance).

Data analyses were conducted using Stata 11 (Stata Corp. Inc., TX, USA). The statistical significance of the explanatory variables was estimated using Wald statistics, with all results at <5% alpha level considered significant. The results of the fixed (measure of association) effects were presented as odds ratio (OR) at their 95% confidence intervals (95% CIs).

As this study used several explanatory variables that might be correlated to each other (such as mother's education, father's education and household wealth index), the multicollinearity assessment was conducted using the means of variance inflation factors and it is small (1.22) indicated the absence of any significant collinearity between explanatory variables in the regression model.

Results

Among 220 HIV positive mothers 95.4% gave information about PMTCT. Of these 79% of mothers and 55.7% of children got PMTCT services.

Bivariate analysis

At the individual level (Table 10) age group most factors were not significantly associated (p-value >0.05) with the mother getting PMTCT services. These included: the education level of mother and father, religion, household size, number of pregnancies, age of first pregnancy, utilizing ANC, stigmatization, discrimination, confidentiality, knowledge level of HIV, planned pregnancy, discussing the best way how to feed the exposed child, father of child tested for HIV, get encouragement from husband to HCT, disclosing the HIV status to anyone, knowing HCT site, and SES quintile.. Similarly, at the community level, most factors were not significantly associated (p-value >0.05) with the mother getting PMTCT service. These factors included: number of people per nurse, number of people per health worker, number of people per health facility, number of people per laboratory technician, proportion of poorest and poor household in the district, proportion of women with no education in the district, ever ART run out of stock, test syphilis during pregnancy, the number of HCT site in the district, and the number of PMTCT site in the district

At the individual level, except household size, planned pregnancy, and getting encouragement from husband to HCT the rest of the variables were similarly not significantly associated (p-value >0.05) with child getting PMTCT service. At the community level, in addition to those variables not associated for mother getting PMTCT services, place of residence, proximity, and number of people per laboratory

technician were not significantly associated (p-value >0.05) with child getting PMTCT services.

At the individual level getting PMTCT services for both mother and child, were significantly associated (p-value <0.05) with place of delivery, having CD4 count, time of the HIV status known, and who attended the delivery. Household size was significantly associated with only child PMTCT services (p-value=0.026). Eighty six percent of mothers who deliver at health facility and 60.4% of children born at a health facility received PMTCT services, but only 33.3% of mothers who delivered at home and 25.9% children who were born at home received PMTCT services (p-value <0.001). Also 65.3% children born with planned pregnancy and 50.8% born without received PMTCT services (p=0.046). At the community level place of residence, and proximity to the health facility was strongly associated with receiving PMTCT services, and number of people per nurse was weakly associated.

Multilevel analysis

The variables that were significantly associated (p-value <0.05) with PMTCT services using the chi-square test, were included in the bivariate multilevel logistic regression (crude multilevel modelling), and the variables that kept the significance in bivariate multilevel logistic regression and considered to be important predictors were considered in the multivariate multilevel model (adjusted multilevel modelling).

In crude multilevel modelling the odds of getting PMTCT service were 14 times (OR=13.99; 95%CI 4.94,39.60) higher for a mother delivering at health facility, and children born at a health facility were 7 times (OR=6.93; 95%CI 2.27,21.14) more likely to get PMTCT services than the mother delivering and child born at home, respectively. The bivariate multilevel modelling showed that, having a CD4 count increased significantly the odds of receiving PMTCT services for both mother (OR=8.30; 95%CI 3.39,20.34) and child (OR=3.11; 95%CI 1.17,8.25), compared to who do not have CD4 count. Even though, it was against the expectation, planned pregnancy (OR=0.54; 95%CI 0.28,1.05) and getting encouragement from husband to access HCT (OR=0.42; 95%CI 0.21,0.83) decreased the chance of getting PMTCT services for a child. As expected, mothers coming from an urban area were 3.2 times (OR=3.19; 95%CI 1.46,6.97) more likely to receive PMTCT services compared to

their rural counterparts. The proximity to health facility and the laboratory technician workload were associated with getting PMTCT services.

Multivariate multilevel modelling (adjusted) showed results, after controlling for the variables that were significant in bivariate multilevel modelling and assumed by the researcher to be important predictors. After adjusting for other variables a mother who was delivering at health facility had almost an 18 fold (OR=18.21; 95%CI 4.37,75.91) higher chance of receiving PMTCT services than a mother who gave birth at home. More of the community level variables were significantly associated with mother getting PMTCT services than the child. A mother who was living within the <1km radius proximity to health facility had higher odds (OR=4.57; 1.21,17.34) of getting PMTCT services than a mother who was living within >5kms radius, when other variables were controlled for. For every addition of one nurse per 1500 people, the likelihood of getting PMTCT services for a mother increases by 7.22 fold (OR=7.22; 95% CI 1.02,51.26), when other individual and community level factors were controlled for simultaneously. In addition, after adjusting for other individual and community level variables simultaneously, adding one laboratory technician for every 3100 people, improves the odds of getting PMTCT services for a mother by 9.27 fold (OR=9.27; 95%CI 1.55,55.24).

The community level PVC was 4.6%, showing there was a slight difference in getting PMTCT services for mothers at the community level; however, this slight difference disappeared (PVC=0.6%) when different variables were controlled for. This confirmed minimal difference in getting PMTCT services at the community level. (see Annex B4 for the further analysis).

The child multivariate multilevel modelling showed that the community level PVC was 12.5% for the null model. When the model is controlled for the variables that were significant in crude multilevel modelling and assumed to be important predictors by the researcher, the PVC increased to 27.2%. (see Annex B5 for the further analysis). The results in table 10 showed that, a child born at a health facility had almost 7 times (OR=6.93; 95%CI 2.27,21.14) and almost 5 times (OR=4.77; 95%CI 1.21,18.83) higher chance to get PMTCT services compared to a child born at home, before and after controlling for the variables, respectively. A child born to a mother who had a CD4 count was 3.5 times (OR=3.47; 95%CI 1.05,11.43) more likely to get

PMTCT services than the child born to a mother whose CD4 count was not done, when controlled for the other variables. Another individual level factor significantly associated with a child getting PMTCT service even after controlling for other variables was getting encouragement from husband to have HCT; a child born to a mother who got this encouragement was 63% less (OR=0.37; 95%CI 0.16,0.89) likely to receive PMTCT services than a child born to a mother who did not get the encouragement. From the community level variables "ever HIV test kit run out of stock" was significantly associated with child getting PMTCT services, even though, the significance disappeared when it was adjusted for the other variables. Nurse work load was the only community level variable that was significantly associated with child getting PMTCT service when other variables were controlled; but against our expectation adding one nurse for every 1500 people decrease the likelihood of child getting PMTCT service by 59% (OR=0.41; 95%CI 0.18,0.98).

Discussion

The implementation of strategies to eliminate MTCT remains a major challenge in developing countries.[33] To our knowledge, this study constitutes the first multilevel analysis in order to identify factors associated with receiving PMTCT services in Ethiopia. The proportion of mothers getting PMTCT services (79%) in Tigray region were comparatively higher than the findings reported from Tigray Bureau of Health in 2010 (47.9%),[34] Addis Ababa in 2009 (53.7%),[35] Oromia in 2008 (35%),[19] Ethiopia in 2009 (18%),[18] the Eastern and Southern Africa region in 2011 (64%),[36] and India (60%).[37] The proportion of children getting PMTCT services (55.7%) was higher than reported from Tigray Bureau of Health in 2010 (26.9%),[34] Addis Ababa in 2009 (40.7%).[35] Oromia in 2008 (29%),[19] Ethiopia in 2009 (15%).[18] This might be due to the fact that the study was limited to mothers who were attending health facilityiesand ignored the mothers who did not patronize the child immunization in the participating facilities.

This study revealed that the mothers delivering at a health facility and children born at a health facility have increased chances of getting PMTCT services in Ethiopia. This finding is consistent with the studies conducted in Ethiopia,[38] and elsewhere.[39,40] PMTCT services in Ethiopia are accessed only in health facilities. Children born elsewhere have less chance of getting PMTCT services if their parents did not bring them to a health facility. This underlines the importance of health facility based delivery in Ethiopia to decrease significantly MTCT and to achieve MDG goal 4. However, 16% mothers and almost 40% children did not get PMTCT services at delivery in spite of having given birth at a health facility. This puts the mothers and children at increased risk of MTCT, and implies a health system failure; especially of the birth attendant in the health facility. Therefore, having continued training on the PMTCT guidelines for birth attendants and supervising occasionally reduce the number of missed opportunities. At the individual level, mothers having a CD4 count were more prone receiving PMTCT services as well as their children, but when adjusted for the other variables the significant association for the mother disappeared. In contrast to our expectation getting encouragement from husband to HCT was decreasing the probability of child getting PMTCT service.

At the contextual level, the current study found facility proximity, nurse work load, and laboratory technician work load were significantly associated with mothers getting PMTCT services; even when adjusted for the other variables. Our study finding showed that when the health facility was nearer to the place where the mother lived, the probability of getting PMTCT services increased dramatically. In addition to this, our study revealed that increasing the number of nurses and laboratory technicians to a given community increases significantly the likelihood of mothers getting PMTCT services. This finding is consistent with the other studies conducted previously.[9,14,17-21] This might be due to proximity and large number of health workers; they know easily the status of the mother and are able give all the available services, including PMTCT when she comes to deliver. However, for the children, all except nurse load community level variables were not significantly associated in getting PMTCT services.

The current study showed that random effects of the contextual level were significant in mothers receiving PMTCT services. The finding implies that unmeasured factors at the contextual level determine receiving PMTCT services of mothers beyond individual level was 4.6% in null model and 0.6% in full model. This shows that the contextual level effect was very small and that mothers receiving PMTCT services were mostly dictated by the individual level variables. Although in children, the random effects showed great difference at the contextual level, it did not reach statistical significance.

The current study has several limitations. Causality could not be inferred, as it has a cross-sectional design. Due to the sensitive nature and interest to get sufficient participants for the study, the sample of HIV infected mothers was not selected randomly. The study was health facility based, therefore mothers who did not come for the child immunization to get services in the participating health facilities were excluded. Another limitation might be a recall bias, as the mothers were interviewed about events that occurred many months back. Furthermore internal validity could be affected by the different data collectors. To minimize this risk, data collectors were all midwifes well acquainted with the issue under study and were given training. Even though the purposes of the study were explained to reduce social desirability bias, it might have been introduced due to the self-report. Additionally, defining districts based on the administratively defined boundaries might misclassify individuals into

an inappropriate social and cultural boundary. This could generate information biases and reduce the validity of analysis.

This study sheds light on the factors that determine mother and child receiving PMTCT services, operating at individual and community levels. The multilevel modelling approach allows identifying several factors at individual (for instance, place of delivery, having CD4 count) and community level (for example proximity, nurse work load) hindering the application of PMTCT services simultaneously. This may allow differentiating and accentuating approaches for different settings in Ethiopia. The government should therefore focus on increasing health facility delivery and HCT coverage to increase mother-child pairs who are getting PMTCT service. Reducing the proximity to health facility, increasing the number of nurses and laboratory technicians are also important variables to be considered by the government.

Competing interests

The authors declare that they have no competing interests.

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Table 10. Background individual and community-level characteristics of post-partum women who were attending health facility for the child immunization and mother and child PMTCT service in Tigray region Ethiopia

Variables	n	Mother PMTCT %	p-value	Child PMTCT %	p-value
Age group (years)					
≤24	35	71,4	0,386	68,6	0,100
25-34	140	81,4		50,7	
≥34	33	75,8		63,6	
Mother education					
No education	90	77,8	0,233	61,1	0,308
Primary	81	76,5		53,1	
Secondary/Higher	38	89,5		47,4	
Father education					
No education	56	75,0	0,538	57,1	0,194
Primary	81	82,7		61,7	
Secondary/Higher	66	80,3		47,0	
Religion					
Orthodox	191	78,0	0,242	55,5	0,841
Non Orthodox	19	89,5		57,9	
Household size					
≤3	153	81,0	0,203	59,5	0,026
>3	23	69,6		34,8	
Number of pregnancy					
≤2 times	102	78,4	0,991	55,9	0,884
>2 times	93	78,5		54,8	
Age of first pregnancy					
≤25 years	167	78,4	0,427	55,1	0,542
>25 years	38	84,2		60,5	
Utilized ANC					
No	34	70,6	0,191	41,2	0,057
Yes	175	80,6		58,9	
Where was the child born?					
Home	27	33,3	0,000	25,9	0,001
Health facility	182	86,3		60,4	
Have you ever stigmatized?					
Yes	113	80,5	0,569	54,9	0,790
No	97	77,3		56,7	
Have you ever discriminated?					
Yes	81	77,8	0,484	59,3	0,524
No	126	81,8		54,8	
Confidentiality with health workers					
No	128	82,8	0,128	55,5	0,851
Yes	81	74,1		56,8	
Knowledge level of HIV					
Poor	98	78,6	0,874	49,0	0,066
Good	112	79,5		61,6	

Table 10. Continued…

Planned pregnancy					
No	72	81,9	0,509	65,3	0,046
Yes	132	78,0		50,8	
Discussed the best way to feed with anyone					
No	36	72,2	0,262	55,6	0,920
Yes	170	80,6		56,5	
Have you had CD4 count?					
Yes	183	84,7	0,000	59,0	0,030
No	25	40,0		36,0	
Father of child tested for HIV					
No/Don't Know	69	75,4	0,386	60,9	0,254
Yes	139	80,6		52,5	
Get encouragement from husband to HCT					
No	72	81,9	0,482	68,1	0,008
Yes	135	77,8		48,9	
Time you knew HIV status					
Before being pregnant	109	79,8	0,000	45,9	0,000
While I was pregnant	83	80,7		69,9	
At the time of delivery	13	92,3		69,2	
After giving birth	5	0,0		0,0	
Have you told your HIV status to anyone?					
Yes	55	70,9	0,093	61,5	0,124
No	153	81,7		50,9	
Know site that gives HCT					
No	20	80,0	0,947	50,0	0,571
Yes	189	79,4		56,6	
Who attended the birth of child?					
Traditional birth attendant	28	32,1	0,000	25,0	0,002
Doctor	26	80,8		61,5	
Nurse/Mid-wife/Other	155	87,7		60,7	
SES quintile					
1st quintile(poorest)	47	68,1	0,205	48,9	0,293
2nd quintile	59	78,0		59,3	
3rd quintile	56	82,1		55,4	
4th quintile	27	88,9		70,4	
5th quintile(richest)	21	85,7		42,9	
Place of residence					
Urban	72	85,4	0,002	57,7	0,386
Rural	137	66,7		51,4	
Proximity					
<1 km	62	88,7	0,001	54,8	0,161
1-5kms	42	85,7		69,1	
>5 kms	37	59,5		48,6	
Number of people per Nurse					
≤1500	86	84,9	0,084	47,7	0,051
>1500	124	75,0		61,3	

Table 10. Continued…

Number of people per health workers					
≤500	71	85,9	0,080	47,9	0,103
>500	139	75,5		59,7	
Number of people per health facility					
≤25000	170	78,2	0,551	55,3	0,800
>25000	40	82,5		57,5	
Number of people per laboratory technician					
≤3100	112	85,7	0,011	56,2	0,867
>3100	98	71,4		55,1	
Proportion of poorest and poor household					
<30%	73	78,1	0,418	58,9	0,483
30-60%	78	75,6		57,7	
>60%	59	84,8		49,2	
Proportion of women with no education					
<30%	104	77,9	0,307	54,8	0,611
30-50%	83	77,1		59,0	
>50%	23	91,3		47,8	
Ever HIV test kit run out of stock?					
No	40	67,5	0,046	40,0	0,026
Yes	170	81,8		59,4	
Ever ART run out of stock?					
No	145	77,9	0,553	55,2	0,813
Yes	65	81,5		56,9	
Test syphilis during pregnancy?					
No	21	85,7	0,429	66,7	0,287
Yes	189	78,3		54,5	
The number of HCT site in the district					
<3	78	85,9	0,148	47,4	0,175
3-5	108	74,1		60,2	
>5	24	79,2		62,5	
The number of PMTCT sites in the district					
None	8	75,0	0,727	37,5	0,561
≤2	171	80,1		56,7	
>2	31	74,2		54,8	

Table 11. Results of the multilevel analysis of post-partum women who were attending health facility for the child immunization and mother and child PMTCT services in Tigray region Ethiopia

Variables	PMTCT MOTHER		PMTCT CHILD	
	CRUDE OR(CI)	ADJUSTED OR(CI)	CRUDE OR(CI)	ADJUSTED OR(CI)
Household size				
≤3			2.85(1.088-7.456)	3.03(0.963-9.508)
>3			1	1
Where was the child born?				
Home	1	1	1	1
Health facility	13.99(4.940-39.595)	18.21(4.369-75.908)	6.93(2.274-21.142	4.77(1.209-18.834)
Planned pregnancy				
No			1	1
Yes			0.54(0.277-1.054)	0.39(0.157-0.960)
Have you had CD4 count?				
Yes	8.30(3.391-20.335)		3.11(1.170-8.250)	3.47(1.052-11.431)
No	1		1	1
Get encouragement from husband to HCT				
No			1	1
Yes			0.42(0.210-0.834)	0.37(0.156-0.892)
Time you knew HIV status				
Before being pregnant	1		1	
While I was pregnant	1.06(0.514-2.192)		3.50(1.675-7.293)	
At the time of delivery	3.04(0.373-24.804)		3.68(0.904-14.993)	
After giving birth	0.00(0.000-8)		0.00(0.000-8)	
Who attended the birth of child?				
Traditional birth attendant	1		1	
Doctor	9.06(2.471-33.233)		7.16(1.814-28.300)	
Nurse/Mid-wife/Other	15.55(5.718-42.308)		7.21(2.403-21.651)	
Place of residence				
Urban	3.19(1.461-6.968)			
Rural	1			
Proximity				
<1 km	5.36(1.923-14.921)	4.57(1.206-17.345)		
1-5kms	4.09(1.382-12.109)	2.36(0.666-8.390)		
>5 kms	1	1		
Number of people per Nurse				
≤1500	1.89(0.894-3.991)	7.22(1.016-51.265)	0.58(0.287-1.176)	0.41(0.175-0.976)
>1500	1	1	1	1
Number of people per health workers				
≤500	1.98(0.912-4.277)			
>500	1			

Table 11. Continued…				
Number of people per laboratory technician				
≤3100	2.40(1.207-4.771)	9.27(1.555-55.238)		
>3100	1	1		
Ever HIV test kit run out of stock?				
No	1	1	1	
Yes	2.38(0.948-5.974)	3.48(0.813-14.920)	2.83(1.062-7.524)	

Table 12. Random effect esults of the post-partum women who were attending health facility for the child immunization and mother PMTCT services in Tigray region Ethiopia

Random Effect	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Intercept	1.37(0.203)	-1.73(1.518)	-0.50(1.554)	-0.94(1.124)
Community-level variance (SE)	0.16(0.370)	0.07(0.741)	0.00(0.000)	0.02(0.789)
VPC (%)	4.6	2.1	0.0	0.6
PVC	Reference	56.2	100	87.5
Model fit statistics				
DIC(-2log likelihood)	215.3306	139.0594	115.3768	98.0654

*** Significant at p-value<0.001; ** significant at p-value<0.01; * significant at p-value<0.05

Table 13. Random effect esults of the post-partum women who were attending health facility for the child immunization and child PMTCT services in Tigray region Ethiopia

Random Effect	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Intercept	0.27(0.190)	-6.14(2.325)	0.99(1.345)	-2.32(1.242)
Community-level variance (SE)	0.47(0.401)*	0.70(0.650)*	0.27(0.379)	1.23(1.086)*
VPC (%)	12.5	17.5	7.6	27.2
PVC	Reference	48.9	42.6	61.8
Model fit statistics				
DIC(-2log likelihood)	285.2762	165.2646	178.6708	116.3478

*** Significant at p-value<0.001; ** significant at p-value<0.01; * significant at p-value<0.05

CHAPTER SIX

DISCUSSION, CONCLUSION AND RECOMMENDATION

6.1 Discussion

Main findings

This thesis examined the uptake of life saving preventive maternal and child public health interventions in Ethiopia taking into account individual and community level factors. In line with the Andersen model of health service utilization (Andersen, 1995), uptake of HCT was found to be marked with inequities.

The results of the cross sectional survey in the Tigray region in Ethiopia showed that there was a difference in the results that come from single level logistic regression modelling compared with multilevel logistic regression modelling. More variables were statistically significant at the single level logistic regression than the multilevel one, consistent with previous studies (Hox, 2002; Goldstein, 2003; Atkins, 2005). Additionally, the current study found that modelling individual and contextual levels simultaneously (in multivariate multilevel modelling) gives better explanatory models with improved fits to the data.

This study revealed that both individual and contextual level factors affect utilization and health service outcomes, but that these factors act differently across the different health services. Among the individual level factors, visiting ANC and getting encouragement from husband/partner to attend HCT; and among contextual level factors people per health facility and people per HCT site were found to be important factors that affect HCT utilization. Utilization of ANC was affected by the woman's education level, getting encouragement from husband/partner to attend ANC and waiting time at the health facility at the individual level and by place of residence among contextual level factors. Place of delivery was also affected by the different individual and contextual level factors. At the individual level, woman's and husband/partner's education, number of live births, knowing any traditional birth attendant close by and household wealth index influenced the place of delivery, while

at the contextual level a woman's place of residence and people per health facility were found to be important predictors of accessing health facilities for delivery. Mother getting PMTCT service was affected by health facility delivery at the individual level and, at the community level, by proximity, nurse and laboratory technician workload. Child getting PMTCT service was affected at the individual level by several factors: child born at the health facility, planned pregnancy, mother having CD4 count, mother getting support from her husband to get HCT, while at the community level nurse workload was the significant predictor of a child's receiving PMTCT services.

As expected, community level random intercepts (variances) for health outcomes were large and statistically significant indicating very important differences across communities, except for mother getting PMTCT services. In addition, after taking into account individual and community level characteristics there still remains considerable community variability in the propensity of women to utilize important health services, except for mother getting PMTCT services. This finding suggests that despite the uniform structures of local health service delivery systems established in Tigray, Ethiopia, implementation of the systems and their effectiveness varies considerably not only between the districts, but among women within the respective districts. This supports the application of multilevel modelling for this particular study (Godstein, 2003; Hox, 2002; Merlo et al, 2005). The current result revealed that, by taking unobserved predictors (variables not included on the analysis) into consideration; inter-district uneven distribution (variation) was higher for utilization of ANC followed by health facility delivery and HCT utilization; the least inter district variation (though it is not statistically significant) was found in mother getting PMTCT services. In other words there is a substantial difference between districts in the Tigray region, Ethiopia, in the utilization of ANC followed by health facility delivery. However, the intra district difference is higher for mother getting PMTCT services. The relatively small community level variations observed for mother and child getting PMTCT services compared to utilization of HCT, ANC and health facility delivery implies that the covariates included in the models were more relevant in explaining the determinants of use of mother and child getting PMTCT services than the other health outcomes. The smallest intra district variation is recorded in the utilization of ANC.

Finally, our finding confirmed that, among the observed (already mentioned) factors, for HCT utilization the contextual level factors matter more than individual level factors but, for other outcome variables (except mother getting PMTCT services), the individual level factors matter more than the contextual level factors.

The novel use of multilevel or hierarchical modelling in this area proved to add value to the understanding of women's use of different health service and outcome variables, with lesser random effects than in single level models. The strengths of this study are illustrated by its success in identifying factors associated at the individual and contextual level simultaneously, describing variation of different health outcomes inter and intra community by referring unobserved variables on the model, and finally comparing which (contextual or individual) level factor matters more in the utilization of different health services.

6.2 Limitations of the study

As this was a facility based study, mothers who did not come for the child immunization in the participating facilities were eliminated. Possibly there was a recall bias, due to the fact that mothers were interviewed about events that occurred many months back. Internal validity could be affected by having employed several data collectors. To minimize this risk, data collectors were all midwives, who were well acquainted with the issue under study, and were given training. Even though the purpose of the study had been explained to participants to reduce social desirability bias, it might have been introduced due to the self-report. Bias may also have been introduced by the researcher accepting at face value as the truth what respondents said. Possibly unmeasured individual factors may partly account for the community-level variations observed in our study. Additionally, defining districts based on the administratively defined boundaries might misclassify individuals into an inappropriate administrative boundary, and the health facility that selected purposively could generate information biases and reduce the validity analysis.

6.3 Conclusion and recommendations

Despite the above limitations, there is an advantage to modelling different health outcomes and service utilization in Ethiopia hierarchically, as it allows analysis and possible interventions both at the health service and community level and addressing the individual realities and needs of the women and nuclear family she lives in. Interventions to promote utilization of HCT should focus on the underlying individual and community-level factors. More specifically, interventions are needed to increase spouse involvement in HCT utilization, explore effective ways of increasing ANC attendance, increasing the number of health facility per people and increasing HCT site density per population.

Interventions to promote utilization of ANC also need increase spouse involvement in ANC utilization, and explore effective ways of increasing health facility delivery among poor women with little formal education living in rural areas and whilst increasing the number of health facilities per people.

The community-level coefficients included in the model explained a considerable portion of the total variance, particularly for the utilization of ANC, health facility delivery and HCT. In Tigray, Ethiopia, place of residence, people per health facility and people per HCT site combined to a certain degree to explain why some health facility areas do better than others in providing safe delivery. Health facility reforms to improve the provision of maternal health service delivery in Tigray, Ethiopa, must therefore start from these observed factors, but should not stop there. Health facilities must go beyond these observed factors and assess potential causes that affect the unobserved factors, hypothesized to be health provider reputation and trust. The relatively large community-level effects compared to individual level effects for the three outcomes (HCT, ANC and health facility delivery) suggests that the community level factors are more important than the individual level factors in a mother's decisions on use of services. Therefore, it is important that health providers intensify their efforts at the community level, working closely with mothers and members of the broader community to increase awareness, overcome cultural barriers and create a supportive environment for mothers to access maternal services.

Additionally, the study has identified factors that determine mother and child receiving PMTCT services, operating at individual and community levels. The

multilevel modelling approach allows identifying several factors at individual and community level, indicating that they are hindering the effective implementation of PMTCT services simultaneously. This may allow differentiating and tailoring approaches for different settings in Ethiopia. The government should focus on increasing health facility delivery and HCT coverage to increase uptake into PMTCT services by reducing the distance to health facility; increasing the number of nurses and laboratory technicians are also important variables to be considered by the government.

This study has also emphasized that in addition to the measured individual and community level factors, there are significant community variations indicating the presence of unobserved factors across communities that influence women's health seeking behaviour. Random effects represent omitted explanatory factors in the model, often considered to be unquantifiable factors such as perceptions and beliefs interacting in complex ways (Stephenson, Tsui, 2003). The community level unobserved effects in this study are hypothesized to represent unquantifiable factors such as cultural beliefs and practices, and levels of awareness that are not captured in the model. Therefore, addressing these type of issues with cultural leaders, religious leaders and significant others by the health system is important.

Findings of this study indicate a need to adopt a multilevel approach to address the factors affecting different health services utilization at various levels especially by incorporating it into the health extension program that the country is currently running.

- Future strategies and health interventions should target high risk groups including uneducated women, women with high birth orders, women from poorest households and women living in rural areas.
- As emphasized in the second MDG, the Ministry of Education should strengthen its efforts to promote and expand females' education. This can be achieved as a long term action but could also be achieved in the short term with the expansion of the basic adolescent education at the community level and provision of intensified health education programs by the health extension workers.

- The FMOH in collaboration with its partners should also scale up the construction and expansion of health facilities to ensure the geographic accessibility of delivery services with special focus in the rural areas and underserved regions.
- ANC utilization should be promoted at the community level and information on the complications related with childbirth and the importance of giving birth at health facilities should be given to all women who came for ANC visits.
- The unobserved community level factors variation demonstrates that there is a strong need to focus on community level interventions and to contextualize efforts tailored to specific local needs. This can be achieved by working closely with the larger community to increase awareness, overcome cultural barriers and create a supportive environment for mothers to access delivery care.
- Moreover, future research should investigate the unexplained community factors ultimately influencing women's decisions and health seeking behaviour.

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Annex 1

9 month report (Hamle 1999 –Megabit 2000)PMTCT performance

Facilitates	ANC	Pre Test counseled	Tested	Post Tested Counsel	Status		NVP		Infany	Partner tested	Partner +ve
	Total	Total	Total	Total	+ve	-ve	mother	baby	Feed		
Abi Adi HOSP	194	151	116	114	2	114	0	1	2	0	0
Adwa HOSP	3613	1027	1026	1026	30	996	24	27	221	0	0
Dansha HOSP	270	270	244	244	8	236	0	0	1	0	0
Alamata HOSP	580	539	462	452	60	402	9	4	54	0	0
Adigrat HOSP	927	921	449	300	18	431	24	11	40	0	0
Axum HOSP	2067	980	814	814	15	799	11	14	18	0	0
Humera HOSP	1034	1018	469	463	38	431	14	3	32	0	0
Mekelle HOSP	1187	334	314	314	69	245	79	96	72	0	0
Maichew HOSP	1273	462	417	416	21	396	6	2	8	0	0
Wukro HOSP	907	875	490	490	25	465	8	9	17	0	0
Quiha HOSP	1169	431	367	367	21	346	8	8	8	0	0
Shire HOSP	179	162	117	117	11	106	23	29	22	0	0
Hospital Total	**13,394**	**7.170**	**5,285**	**5,117**	**318**	**4,967**	**206**	**204**	**495**	**0**	**0**
Abi Adi Ketema HC	590	428	427	427	2	425	0	0	2	0	0
Adi Aynom HC	135	67	60	38	1	59	0	0	1	12	0
Adi Gosgu HC	968	439	414	414	10	404	3	0	6	44	0
Adi-daro HC	1357	940	746	746	11	735	6	3	16	165	0
Adigrat HC	3233	1269	1176	1173	27	149	18	9	25	56	1
Adi gudem HC	983	555	552	552	7	545	6	6	7	23	0
Adihageray HC	835	670	515	515	16	499	0	0	0	26	0
Adikeyh NHC HC	26	4	4	4	0	4	0	0	0	1	0
Adwa ketema HC	706	338	265	265	6	259	7	3	6	15	0
Adwa Rural HC	551	503	441	413	14	427	0	12	0	8	0
Agulae HC	0	0	0	0	0	0	0	0	0	0	0
Alaje(A.shu) HC	456	410	294	294	6	288	3	3	4	56	0
Alamata HC	1282	886	658	654	35	623	66	22	33	39	1
Atsbi HC	1429	946	873	872	29	844	2	7	15	59	0
Axum HC	1578	650	559	558	6	553	7	5	3	48	0
Azeba HC	148	144	68	68	0	68	0	0	0	3	0
Baeker HC	161	122	112	112	3	109	0	0	0	11	0
Belles HC	140	140	138	138	0	138	0	0	0	0	0
Bete Hawariat HC	222	188	176	157	6	170	0	0	1	0	0
Bizet HC	601	576	294	294	3	291	0	0	1	12	0
Dowhan HC	212	114	110	110	4	160	0	0	3	2	0
E.slassoe HC	1406	459	459	459	16	443	2	2	2	24	2
E.slassie HC HC	929	364	362	360	18	344	22	5	8	29	1
E/guna HC	775	53	37	32	1	36	0	2	2	0	0
Edaga Hamus HC	1281	745	737	740	10	727	6	4	7	141	0
Enticho HC	1463	671	604	604	12	592	0	2	12	128	0
Facolty HC	0	0	0	0	0	0	0	0	0	0	0
Fatsi HC	256	126	122	122	0	122	0	1	1	17	0
Freweini HC	1387	764	654	654	15	639	6	6	12	39	0
G.Afeshum HC	181	181	80	80	0	80	0	0	0	4	0
Guahgot HC	88	34	29	29	0	29	0	0	0	0	0
Gulomekeda HC	32	24	25	25	0	25	2	0	0	0	0
Hagere selam HC	814	627	582	582	16	566	6	3	15	13	2
Hareko HC	23	23	23	23	0	23	0	0	0	6	0
Hawzien HC	991	676	497	497	7	490	8	4	8	11	0
Humera HC	292	132	124	124	3	121	4	0	3	24	0

Annex

Random effect results

B1

HCT utilization

Model 1 (empty model or null model) in table 4 depicted that; there was a statistically significant variability in the odds of utilizing HCT across communities (τ=0.81, p=0.000). Hence the intra community correlation (VPC) is 0.198. This suggests that around 19.8% of the variation in HCT utilization is at the inter community level and the remaining variation is at the intra community or women level.

The results of the random effect in model 2 (Table 4) also showed that the variation in the odds of HCT utilization across communities remained statistically significant (τ=0.77, p=0.000). The variance partition coefficient (VPC) indicated that, after holding for the individual level factors 19.0% of the total unexplained variation in women's HCT utilization was attributable to differences across communities. According to the estimated proportional change in variance (PCV), 4.9% of the variance in HCT utilization across communities was explained by individual level factors included in model 2.

Model 3 (Table 4) depicted that, after considering the community level factors, differences across communities accounted for 11.1% of the variability in women's HCT utilization (τ=0.41, p=0.000). The calculated proportional change in variance (PCV) indicated that 49.4% of the variance in HCT utilization across communities was explained by community level factors included in model 3.

As shown by the estimated variance partition coefficient in model 4 (Table 4), taking the individual and community level factors in to account simultaneously 11.3% of the variability in HCT utilization was attributed to differences across communities (τ=0.42, p=0.000). The proportional change in variance indicated that, 48.1% of the variance in HCT utilization across communities was explained by both individual and community level factors included in model IV.

Interaction and confounding effects between predictors was also checked and no significant interaction term or confounding effect was identified. The subsequent

decrease in the values of DIC shown at the bottom of table 4 indicated that, Model 4 has the smallest value of DIC (697.9674**)** and it was the best explanatory model fitting the data very well.

B2

ANC utilization

Model 1 (empty model or null model) in table 8 depicted that; there was a statistically significant variability in the odds of accessing ANC across communities (τ=1.63, p=0.000). Hence the intra community correlation (VPC) is 0.331. This suggests that around 33.1% of the variation in accessing ANC is at the inter community level and the remaining variation is at the intra community or women level.

The results of the random effect in model 2 (Table 8) also showed that the variation in the odds of accessing ANC across communities remained statistically significant (τ=2.24, p=0.000). The variance partition coefficient (VPC) indicated that, after holding for the individual level factors 40.5% of the total unexplained variation in women's ANC utilization was attributable to differences across communities. According to the estimated proportional change in variance (PCV), 37.4% of the variance in ANC utilization across communities was explained by individual level factors included in model 2.

Model 3 (Table 8) depicted that, after considering the community level factors, differences across communities accounted for 27.4% of the variability in women's accessing ANC (τ=1.24, p=0.000). The calculated proportional change in variance (PCV) indicated that 23.9% of the variance in accessing ANC across communities was explained by community level factors included in model 3.

As shown by the estimated variance partition coefficient in model 4 (Table 8), taking the individual and community level factors in to account simultaneously 37.1% of the variability in accessing ANC was attributed to differences across communities (τ=0.42, p=0.000). The proportional change in variance indicated that, 19.0% of the variance in accessing ANC across communities was explained by both individual and community level factors included in model IV.

Interaction and confounding effects between predictors was also checked and no significant interaction term or confounding effect was identified. The subsequent decrease in the values of DIC shown at the bottom of table 8 indicated that, Model 4 has the smallest value of DIC (434.4763**)** and it was the best explanatory model fitting the data very well.

B3

Place of delivery

Model 1 (empty model or null model) in table 9 depicted that; there was a statistically significant variability in the odds of accessing health facility for delivery across communities (τ=1.11, p=0.000). Hence the intra community correlation (VPC) is 0.252. This suggests that around 25.2% of the variation in accessing health facility for delivery is at the inter community level and the remaining variation is at the intra community or individual level.

The results of the random effect in model 2 (Table 9) also showed that the variation in the odds of health facility delivery across communities remained statistically significant (τ=0.79, p=0.000). The variance partition coefficient (VPC) indicated that, after holding for the individual level factors 19.4% of the total unexplained variation in women's utilization of health facility for delivery was attributable to differences across communities. According to the estimated proportional change in variance (PCV), 37.4% of the variance in health facility utilization for delivery across communities was explained by individual level factors included in model 2.

Model 3 (Table 9) depicted that, after considering the community level factors, differences across communities accounted for 24.4% of the variability in women's accessing health facility for delivery (τ=1.06, p=0.000). The calculated proportional change in variance (PCV) indicated that 4.5% of the variance in accessing health facility for delivery across communities was explained by community level factors included in model 3.

As shown by the estimated variance partition coefficient in model 4 (Table 9), taking the individual and community level factors in to account simultaneously 27.5% of the variability in accessing health facility for delivery was attributed to differences across

communities (τ=1.25, p=0.000). The proportional change in variance indicated that, 12.6% of the variance in accessing ANC across communities was explained by both individual and community level factors included in model IV.

Interaction and confounding effects between predictors was also checked and no significant interaction term or confounding effect was identified. The subsequent decrease in the values of DIC shown at the bottom of table 8 indicated that, Model 4 has the smallest value of DIC (789.5639**)** and it was the best explanatory model fitting the data very well.

B4

Mother getting PMTCT service

Model 1 (empty model or null model) in table 12 depicted that; there was not statistically significant variability in the odds of mother getting PMTCT services across communities (τ=0.16, p=0.303). Hence the intra community correlation (VPC) is 0.046. This suggests that around 4.6% of the variation in mother getting PMTCT services is at the inter community level and the remaining variation is at the intra community or women level.

The results of the random effect in model 2 (Table 12) also showed that the variation in the odds of accessing ANC across communities remained not statistically significant (τ=0.07, p=0.463). The variance partition coefficient (VPC) indicated that, after holding for the individual level factors 2.1% of the total unexplained variation in mothers getting PMTCT services was attributable to differences across communities. According to the estimated proportional change in variance (PCV), 56.2% of the variance in mother getting PMTCT services across communities was explained by individual level factors included in model 2.

Model 3 (Table 12) depicted that, after considering the community level factors, differences across communities accounted for 0.0% of the variability in mother getting PMTCT services (τ=0.00, p=1.000). The calculated proportional change in variance (PCV) indicated that 100% of the variance in mother getting PMTCT services across communities was explained by community level factors included in model 3.

As shown by the estimated variance partition coefficient in model 4 (Table 12), taking the individual and community level factors in to account simultaneously 0.6% of the variability in accessing mother PMTCT services was attributed to differences across communities (τ=0.02, p=0.390). The proportional change in variance indicated that, 87.5% of the variance in mother getting PMTCT services across communities was explained by both individual and community level factors included in model IV.

Interaction and confounding effects between predictors was also checked and no significant interaction term or confounding effect was identified. The subsequent decrease in the values of DIC shown at the bottom of table 11 indicated that, Model 4 has the smallest value of DIC (98.0654**)** and it was the best explanatory model fitting the data very well.

B5

Child getting PMTCT service

Model 1 (empty model or null model) in table 13 depicted that; there was a statistically significant variability in the odds of child getting PMTCT services across communities (τ=0.47, p=0.039). Hence the intra community correlation (VPC) is 0.125. This suggests that around 12.5% of the variation in child getting PMTCT services is at the inter community level and the remaining variation is at the intra community or individual level.

The results of the random effect in model 2 (Table 13) also showed that the variation in the odds of child getting PMTCT services across communities remained statistically significant (τ=0.70, p=0.043). The variance partition coefficient (VPC) indicated that, after holding for the individual level factors 17.5% of the total unexplained variation in child getting PMTCT services was attributable to differences across communities. According to the estimated proportional change in variance (PCV), 48.9% of the variance in child getting PMTCT services across communities was explained by individual level factors included in model 2.

Model 3 (Table 13) depicted that, after considering the community level factors, differences across communities accounted for 7.6% of the variability in child getting PMTCT services (τ=0.27, p=0.179). The calculated proportional change in variance

(PCV) indicated that 42.6% of the variance in child getting PMTCT services across communities was explained by community level factors included in model 3.

As shown by the estimated variance partition coefficient in model 4 (Table 13), taking the individual and community level factors in to account simultaneously 27.2% of the variability in child getting PMTCT services was attributed to differences across communities (τ=1.23, p=0.030). The proportional change in variance indicated that, 61.8% of the variance in child getting PMTCT services across communities was explained by both individual and community level factors included in model IV.

Interaction and confounding effects between predictors was also checked and no significant interaction term or confounding effect was identified. The subsequent decrease in the values of DIC shown at the bottom of table 13 indicated that, Model 4 has the smallest value of DIC (116.3478**)** was the best explanatory model fitting the data very well.

9 month report (Hamle 1999 –Megabit 2000)PMTCT performance

Jijka NHC HC	177	175	175	175	0	175	0	0	0	0	0
Kasech HC	518	361	185	141	7	178	1	1	5	4	0
Kassech HC HC	1728	764	388	388	11	377	6	1	9	9	0
Kolla Tembien HC	1281	990	693	693	0	693	0	0	0	34	0
Korem HC	1550	920	473	473	21	452	9	12	21	25	0
M.Zana HC	1907	1907	1201	1201	45	1156	3	2	2	221	0
Mai Dumu HC	107	107	107	107	0	107	0	0	0	0	0
Mai Kadra HC	863	455	382	382	25	357	6	6	25	28	0
Maichew HC	548	347	202	202	8	194	0	0	8	20	0
MCH HC	4092	961	959	959	40	919	25	9	8	58	1
Mekelle HC	3314	3132	1101	756	50	1051	19	0	32	22	1
Millennium HC	86	27	25	25	1	24	0	0	1	0	0
Mohoni HC	2336	774	729	729	47	682	7	7	38	131	4
Mugulat HC	125	121	73	73	3	70	0	0	3	7	0
Naedier Adiet HC	532	466	419	419	3	416	1	2	3	27	0
Quiha NHC HC	376	182	91	71	4	87	0	0	0	0	0
Ruba keze HC	51	51	50	50	0	50	0	0	0	4	0
Samre HC	1064	976	872	872	1	871	0	0	1	186	0
Semema HC	242	139	139	139	1	138	0	0	1	0	0
Semien HC	2519	1239	915	915	25	890	14	7	13	38	0
Sheraro HC	708	688	376	376	12	364	2	2	12	78	2
Siheta HC	113	74	66	66	1	65	0	0	0	0	0
Siheta(gahgot) HC	50	18	18	18	0	18	0	0	0	0	0
T.koraro HC	191	154	151	133	0	151	0	0	0	0	0
Tselemti HC	2023	2023	597	597	3	594	0	0	2	8	0
W.maray HC	1344	976	770	770	1	769	1	1	3	69	0
Welkait HC	0	0	0	0	0	0	0	0	0	0	0
Weri-Leke HC	2956	2206	1353	1353	15	1338	2	2	4	11	0
Wukro HC	50	50	36	36	1	35	0	0	0	0	0
Yechila HC	568	553	400	400	5	395	0	0	3	12	0
Wereda Total	**56,950**	**35,104**	**25,163**	**24,674**	**614**	**24,549**	**270**	**151**	**387**	**2,008**	**15**
Grand Total	**70,344**	**42,274**	**30,448**	**29,791**	**932**	**29,516**	**476**	**355**	**882**	**2,008**	**15**

ብሄራዊ ክልላዊ መንግስቲ ትግራይ
ቢሮ ሓለዋ ጥዕና
ኣውራ ክ/ስ/ምስንም ጥ/ምክልኻል ሕማማት

The Government of the NationalRegional
State of Tigray, Bureau of Health
Health Promotion &Disease Prevention Core Process

Ref No 554/334/03 ቁፅሪ

Date 5/9/2003 ዕለት

ናብ _____

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ዋኒኑ ፣ ኣብ PMTCT ንዝግበር መፅናዕቲ ትሕብብር ይምልከት

University of the Western Cape /ዌስትርን ኬፕ ዩኒቨርሲቲ/ ኣብ PMTCT ዝተደረኸ ሰፊሕ መፅናዕቲ ክካይድ ምስ ቢሮ ሓለዋ ጥዕና ብምትእስሳር ኣብ ዝገብሮ ዓውደ መፅናዕቲ ትካለኩም ነዚ መፅናዕቲ ንዘካይዱ ምሉእ ናይ ሰራሕ ድጋፍ ክገብረሎም እና ገለፅና ንዝግበረሎም ምትሕብባር ኣቐዲምና ነመስግን።

ምስ ሰላምታ!

ዮሃንስ ተወልደ
ኣመራ ዝደዲ ሰራሕ ምስሙር
ጥዕናን ምክልኻል ሕማማትን

ቅዳሕ
- ንኣይተ ወንደወሰን ተረፈ
መቐለ

ሣ 7 | ☎ 251-034-440-02-22 | ፋክስ 251-034-440-88-30 | ኢ-መይል tigrayhealth@ethionet.et | መቐለ ትግራይ ኢትዮጵያ Mekelle, Tigray, Ethiopia

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10 May 2011

To Whom It May Concern

I hereby certify that the Senate Research Committee of the University of the Western Cape has approved the methodology and ethics of the following research project by:
Mr WT Lerebo (School of Public Health)

Research Project:	A hierarchical modeling approach to identify factors associated with the uptake of HIV counseling and testing and prevention of mother to child HIV transmission programme among post-partum women in Ethiopia
Registration no:	11/4/5

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa

Tel: +27 21-959-9307, Fax: 27 21-959-2872

E-mail: wlerebo@uwc.ac.za, djackson@uwc.ac.za

"A hierarchical modelling approach to identify factors associated with the uptake of HIV counselling and testing and prevention of mother to child HIV transmission among post-partum women in Ethiopia"

You are invited to participate in a research study that will start in May 2011. This research will be conducted at this clinic by Wondwossen Lerebo a PhD Student at UWC. The research is being conducted to help us understand, factors associated on the accessing of ANC, HCT and PMTCT from a post-partum women perspective.

Participation in this research is both voluntary and free. If you choose to participate, I would like to interview you for about 30-45 minutes at a place that is comfortable for you. This will be a private and confidential interview which will be conducted only by me.

I would like you to show me verbally a consent which shows that you allow me to interview. The completed interview will be kept safely by the researcher in a locked cabinet at the School of Public health and will only be seen by me and my supervisors Professor Debra Jackson and Dr. Steven Callens.

If you choose to volunteer your identification such as your name and your address will not be disclosed to anyone and the data collected will be used for the research study only. These interviews will not affect your medical treatment, counselling and support from the clinic and your community health workers as I do not work for the Clinic or the Community health work organisations.

Thank you for taking the time. If you would like more information about the research please contact the following people:

Wondwossen Lerebo: Prof. Debra Jackson:

091 101 7591 0027 83 327 7331

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01-ቃለ-መጠይቅ ዝቀርበሉ ዕለት_____
02-ተራ/ቁዕሪ ቃለ-መጠይቕ_____
03-ሽም ጥዕና ትካል_____

መእተዊ

ሽመይ----------ይበሃል ሕጂ ኣብዚ መዒኣ ዘለኹ ካብ ወስተርን ከፕ ዩኒቨርስቲ ሕብረተሰብ ጥዕና ክፍሊ ዝካይዳ መፅናዕቲ ሓበፌታ ንምእካብ እዩ ።

ኣዚ መፅናዕቲ ደቅን ከኽትባ ዝመፃ እዴታት ኣብ ምኽሪ ግልጋሎትን ምርመራ ኤች.ኣይ.ቪ.ን ቅድመ ወሊድ ግልጋሎትን ምክልኻልን ኤች ኣይ ቪ ካብ ጥንስ ዘለወን እዴታት ናብቲ ዕሽል ከይሃልፍ ንክካላኽላ ዝሕግዝ ዕንቅፊታት ዝኮኑ እንታ እዩ። ካብዚ መረዳዕታ ብምብጋስ ዝተፈላለዩ ፕሮግራማት ንምሕንፃፅ ዝሕግዙ መረዳእታታት ምርካብ ይከኣል እዚ ንምርካብ ድማ ቅኑዕ ምላሽ ክትህብኒ/ባኒ እናተላበኩ ኣብዚ መፅናዕቲ ምስታፍ ዓብዩ ኣሰተዋፅኦ ከም ዘለዎ ክገልፅ ይፈቱ።

ምስጢርን ፍቐደኝነትን ዝምልከት
ኣብ እነቕርቦ ሕቶ ናይ ዉልቀ ፂወትን ዝጥምቱ ዝተፈላለዩ ሕቶታት ክህሉዉና እዮም። ዝዋህቡ ምላሻት ኩለም ሚስጢር ናይ ዉልቀሰብ ብምኽኑ ንማንም ሰብ ክምዘይንገሩ ክትፈልጣ ንደሊ። ብተወሳኺ ኣብዚ መረዳእታ እዚ ዅሉም ሰነዳት ሚስጥር እዮም። ኣብ ዝኮነ እዋን ድማ ሽምክን ኣይታሕዝን መን ዝመለሶ እዩ ተባሂሉ ሽምክን ኣይትሕተታን ።

እቲ እትህብኒ /ባኒ ምላሽ ግን ኣገዳሲ ስለዝኾነ ብትኽክል ክቑርብ ብጣዕሚ ወሳኒ እዩ።ኣብ ሞንጎ ሕቶና ክትምልሶኦ ዘይድለ ነገር እንተህልዩ ምግዳፍ ይካኣል እዩ።
ዘይድለይ መሲሉ ተተሰሚውክን/ክን ሙሉእ ብሙሉእ ምላሽ ዘይግባእ ወይ ድማ ብክፉል ዘይምምላስ ትኽእሊ /ላ ኢ.ኽ/ኽን።

ዝሕቶዚ ዝወስደልና ጊዜ ካብ 15 ክሳብ 25 ደቓይቕ ዩ።

ፍቃደኛ ዲኺ/ኽን? እወ ☐ → ቀፅል
ኣይኮንኩን ☐ → ሕቶኣቐም

If you would like more information about the research please contact the following people:

Wondwossen Lerebo:

092 162 8003

Prof. Debra Jackson:

0027 83 327 7331

Information will be collected from Health facility manager			
No	**Questionnaire**	**Answer**	Skip
1.2	The name of this health facility		
1.2.1	Number of health workers in this facility	Doctors…… Health Officers…… Nurses……. Midwifes…… Lab technicians…… Pharmacist……	
1.2.2	Number of health workers trained in ANC		
1.2.3	Number of health workers trained in HCT		
1.2.4	Number of health workers trained in PMTCT		
1.2.5	Type of the facility	1. Hospital 2. Health center 3. Health post	
1.2.6	In this health facility there ever run stock outs of HIV test kits?	1. Yes 2. No 3. Don't know	→ 1.2.10
1.2.7	If answered "Yes" for Q 1.2.6, how often?	1. Once a month 2. Once in six months time 3. Once a year 4. Don't know	
1.2.8	If answered "Yes" for Q 1.2.6, for how long?	1. For less than a day 2. From 1 day to less than a week 3. From 1 week to less than a month 4. For more than a month 5. Don't know	
1.2.9	If answered "Yes" for Q 1.3.6, due to this, was there any one who need to be tested went without testing?	1. Yes 2. No 3. Don't know	
1.2.10	In this health facility have there ever run stock outs of ART used in PMTCT?	1. Yes 2. No 3. Don't know	→ 1.2.14

1.2.11	If answered “Yes” for Q 1.3.10, how often?	1. Once a month 2. Once in six months time 3. Once a year 4. Don’t know	
1.2.12	If answered “Yes” for Q 1.3.10, for long?	1. For less than a day 2. From 1 day to less than a week 3. From 1 week to less than a month 4. For more than a month 5. Don’t know	
1.2.13	If answered “Yes” for Q 1.3.10, due to this, was there any HIV positive mother and her new born baby didn’t get it?	1. Yes 2. No 3. Don’t know	
1.2.14	Do you test for Syphilis during the pregnancy?	1. Yes 2. No 3. Don’t know	

INTERVIEW WITH MOTHER

No	**Questionnaire**	**Answer**	Skip
1.	**General characteristics (of the mother)**		
1.1	Age of MOTHER in YEARS (99 if unknown)		
1.1.1	Age of the FATHER in years (99 if unknown)		
1.2	What is the education level of the MOTHER?	1. No education 2. From grade 1 to grade 4 3. From grade 5 to grade 8 4. From grade 9 to grade 10 5. Preparatory 6. Tertiary	
1.2.1	What is the education level of the FATHER?	1. No education 2. From grade 1 to grade 4 3. From grade 5 to grade 8 4. From grade 9 to grade 10 5. Preparatory 6. Tertiary	
1.3	Marital Status	1. Single – Never married 2. Married – monogamous relationship 3. Married – polygamous relationship 4. Widowed 5. Divorced/separated 6. No response	1.4 →
1.3.1	If answered 2,3,4, or 5 for Q 1.3, which year?		
1.4	Religion of the mother	1. Orthodox 2. Muslim 3. Protestant 4. Catholic 5. Other (specify).....	
1.5	Place of residence	1. Urban 2. Peri-urban 3. Rural	
1.6	What type of toilet do you use at the child's home?	1. Flush toilet 2. Pit latrine ventilated 3. Pit latrine 4. Bush 5. Open space 6. Other (specify).....	
1.7	What is the MAIN fuel used for cooking in the child's house?	1. Gas/paraffin 2. Charcoal 3. Wood from market 4. Wood from bush 5. Other (specify).....	
1.8	What is the MAIN material that the house the child lives in is built with?	1. Brick/cement block 2. Stone + wood + soil 3. Wood + mud + grass 4. Other (specify).....	

1.9	What is the MAIN source of water used for drinking in the child's home?	1. Piped water 2. Bore hole 3. River 4. Other (specify).....	
1.10	Employment status of the MOTHER	1. Employed 2. House wife 3. Un employed 4. Self employed 5. Other (specify).....	
1.11	Employment status of the FATHER	1. Employed 2. Laborer 3. Un employed 4. Self employed 5. Other (specify).....	
1.12	Monthly income (from any source)	1. Less than 500 birr 2. 501-1000 birr 3. 1001-2000 birr 4. Greater than 2001 birr 5. Unknown	
1.13	What is the sex of your child?	1. Male 2. Female	
1.14	How old is the child in months?		
1.15	What is your household size including you?		
1.16	Why did you bring this child to the clinic today? Tick all that apply.	1. Immunization 2. The child is sick 3. Other (specify)……	
1.17	How long (in hrs) does it take to reach the nearest health facility from your home?		
1.18	How far (in km) is the nearest health facility from your home?		
1.19	How do you go usually to the nearest health facility when you need?	1. On foot 2. By animals (horse, mules…) 3. By taxi/bus 4. By bajaj 5. Other (specify)……	

2. PREGNANCY HISTORY

No	**Questionnaire**	**Answer**	Skip
2.1	How many times have you ever been pregnant?		
2.1.1	How old were you at first pregnancy?		
2.2	How many live children have you given birth to?		
2.3	How many of your children are alive today?		
2.4	Was this pregnancy planned?	1. Yes 2. No	

		3. Don't know	
2.5	What is the rank of this child?		
2.6	How many months interval are there between the last child and this one? (If this child is not the first born)		
2.7	Do you know any traditional birth attendant around you live?	1. Yes 2. No 3. Don't know	
2.8	Do you know health facility that gives ANC around you live?	1. Yes 2. No 3. Don't know	
2.9	Did you get any encouragement/support from your husband/partner to visit ANC?	1. Yes 2. No 3. Not applicable	
2.10	Did you get any encouragement/support from your family members to visit ANC?	1. Yes 2. No 3. Not applicable	
2.11	Did you get any encouragement/support from your community you live to visit ANC?	1. Yes 2. No 3. Not applicable	
2.12	How many weeks pregnant you were in your first ANC visit during this last pregnancy? (If you don't know put 99)		
2.13	How many ANC visits did you have during this last pregnancy? (If you don't know put 99)		
2.14	How long (in hours) do you wait until you see the health worker at this facility?		
2.15	Do you think it is too long?	1. Yes 2. No 3. Not sure	
2.16	Have you ever left without seeing health worker due to long waiting time at ANC?	1. Yes 2. No 3. Not sure	
2.17	During pregnancy did you ever discuss with anyone at the health facility what the best way for you to feed your baby?	1. Yes 2. No 3. Don't know	
2.18	Where was the child born?	1. Hospital 2. Health center 3. Health post 4. Home 5. Other (specify).....	
2.19	Who attended the birth of the child?	1. Doctor 2. Nurse/mid-wife/other health worker 3. Traditional birth attendant 4. Other (specify).....	
2.20	Did you receive services or support from any of the following during your pregnancy, delivery or postpartum?	1. Community health worker 2. Traditional birth attendant 3. No support received 4. Other (specify).....	
2.21	Generally, pregnant women around you live for the birth attendance on whom is they confident more?	1. Health workers in health facility 2. Traditional birth attendant 3. Other (specify).....	
2.22	How do you grade health workers behaviour at ANC?	1. Very good 2. Good 3. Don't know 4. Bad 5. Very bad	

3. HIV testing

3.1	Do you know about HIV/AIDS?	1. Yes 2. No **3.** Don't know	
3.2	Do you know the ways of getting HIV infection?	1. Yes 2. No **3.** Don't know	
3.3	What are the ways of preventing HIV infection? (One or more response)	1. Abstinence 2. Being faithful 3. Condom use 4. Don't know	
3.4	Do you know the site that gives HCT around where you live?	1. Yes 2. No **3.** Don't know	
3.5	Did you get any encouragement/support from your husband/partner to HCT?	1. Yes 2. No **3.** Not applicable	
3.6	Did you get any encouragement/support from your family members to HCT?	1. Yes (from who)..... 2. No **3.** Not applicable	
3.7	Did you get any encouragement/support from your community members to HCT?	1. Yes (from who)..... 2. No **3.** Not applicable	
3.8	Did you think you were at risk of HIV infection?	1. Yes (why)..... 2. No **3.** Don't know	
3.9	During your last pregnancy, were you tested for HIV infection?	1. Yes → **3.11** 2. No 3. Don't know 4. Choose not to answer	
3.10	If answered "No" for the Q 3.9, why were you not tested for HIV during your last pregnancy?	1. Never offered 2. Did not want to test 3. Didn't get permission from husband 4. No reason offered 5. Other (specify)……	
3.11	Have you ever tested for HIV infection prior to the last pregnancy?	1. Yes 2. No 3. Don't know 4. Choose not to answer → **3.15**	
3.12	Did you get the result of the most recent test?	1. Yes → **3.14** 2. No 3. Choose not to answer	
3.13	If answered "No" for Q 3.12, why did you not get the HIV test result?	1. Not available 2. Did not want the result 3. Other (specify).....	
3.14	If answered "Yes" for Q 3.12, please, what is your HIV status?	1. Positive 2. Negative 3. Don't know 4. Choose not to answer	
3.15	Has the father of your child been tested for HIV?	1. Yes 2. No 3. Don't know	

3.16	Has your child tested for HIV?	1. Yes 2. No 3. Choose not to answer	**3.17**
3.16.1	If answered "Yes" for Q 3.16, please what is your child HIV status?	1. Positive 2. Negative 3. Don't know 4. Choose not to answer	
3.17	Have you told anyone about your HIV status?	1. Yes 2. No 3. Choose not to answer	**3.19**
3.18	If answered "Yes" for Q 3.17, can you tell me who? (Choose one or more answers)	1. Own mother 2. Mother-in-law 3. Father of child 4. Other family member 5. Friend 6. Health staff 7. Neighbour 8. Other (specify).....	
3.19	Have you ever feared? (self-stigma question)	1. Being gossiped about 2. Being verbally insulted, harassed and/or threatened 3. Being physically harassed and/or threatened 4. Being physically assaulted 5. That someone would not want to be sexually intimate to you 6. Other (specify).....	
3.20	What would happen/has happened if others knew/know your status?	1. I feel hurt 2. I regret telling others 3. Others avoid having physical contact with me 4. People stop calling me 5. Others make judgments about my lifestyle 6. Others will worry about being alienated because of their connection with me 7. They won't allow me near their children 8. They distance themselves from me 9. I lose friends 10. They think of me as immoral 11. Other (specify)……	
3.21	Were you ever denied accessing health services due to your HIV status in the in the health facility?	1. Yes 2. No 3. Don't know 4. Choose not to answer	
3.22	Were you ever denied any participation of social activity in the community?	1. Yes 2. No 3. Don't know 4. Choose not to answer	
3.23	Do you think the health worker that knows your HIV	1. Yes 2. No	

	status disclose to anyone without your consent?	3. Don't know 4. Choose not to answer	

4. Knowledge about MTCT

4.1	Can a baby get HIV from the mother if the mother is infected with HIV?	1. Yes 2. No 3. Don't know	
4.2	How? Probe after each answer (i.e. any other way).	1. Breastfeeding 2. During pregnancy 3. During childbirth 4. Other (specify)……. 5. Don't know	
4.3	Have you ever heard of the PMTCT programme?	1. Yes 2. No	

These questions are only for HIV positive post-partum women who come for child immunization

5.PMTCT

No	**Questionnaire**	**Answer**	Skip
5.1	When did you know you were HIV positive?	1. Before being pregnant for this child 2. While I was pregnant for this child — HAART eligible 3. At the time delivery for this child 4. After giving birth for this child — not eligible 5. Choose not to answer	5.2 5.3 5.4 5.4.2
5.2.1	If you answered 1 for the question 4.1, have you got family planning methods before being pregnant for this child?	1. Yes 2. No 3. Don't know 4. Choose not to answer	
5.2.2	If you answered 1 for the question 4.1, were you become pregnant while receiving HAART?	1. Yes 2. No 3. Don't know 4. Choose not to answer	
5.2.3	Did your child get AZT? [Explanation: AZT for the child is a syrup given with a syringe twice a day to prevent mother to child transmission]	1. Yes 2. No 3. Don't know 4. Choose not to answer	
5.2.4	How many days was your child given AZT (write 99 if Don't Know)?		
5.3	If you have answered 2 for question 5.1, and eligible for HAART.		
5.3.1	Did you receive AZT during your pregnancy with this child? [Explanation: AZT = a tablet you take every day on its own during pregnancy, starting from 12 weeks -	1. Yes 2. No 3. Don't know	

	show a picture of AZT]	4. Choose not to answer	
5.3.2	Did your child get AZT? [Explanation: AZT for the child is a syrup given with a syringe twice a day to prevent mother to child transmission]	1. Yes 2. No 3. Don't know 4. Choose not to answer	
5.3.3	How many days was your child given AZT (write 99 if Don't Know)?		
5.4	If you have answered 2 for question 5.1, and not eligible for HAART.		
5.4.1	For how long, in weeks, did you take the AZT before your last child was born?		
5.4.2	Did you take any medicines to prevent transmission of HIV to your infant when you went into labour? (Check the card)	1. Yes 2. No 3. Don't know 4. Choose not to answer	
5.4.3	What medicines did you receive when you were in labour? [Explanation of drugs: see the relevant card with descriptions of each possible]	1. Nevirapine 2. AZT 3. Other (specify)…….. 4. Chooses not to answer 5. Don't know	
5.4.4	Was your last child given Nevirapine after delivery? [Explanation: Nevirapine for the child is a syrup given to the baby within 72 hours of delivery to prevent mother to child transmission]	1. Yes 2. No 3. Don't know 4. Choose not to answer	
5.5	Have you had a blood test for a CD4 count?	1. Yes 2. No 3. Don't know 4. Choose not to answer	
5.6	What was the last CD4 result?		
5.7	Have you been referred to the ART clinic?	1. Yes 2. No 3. Don't know 4. Choose not to answer	
5.8	Have you visited the ART clinic?	1. Yes 2. No 3. Don't know 4. Choose not to answer	

ካብ ጥዕና ትካል ኣማሓዳሪ ዝእከብ ሓበሬታ			
ተ.ቁ	**መሕተት**	**መልሲ**	ይሽዱ
1.2	ሽም ጥዕና ትካል		
1.2.1	በዝሒ ሰራሕተኛተኛታት ሰብ ሞያ ጥዕና	ዶክቶር -------- ጥዕና ሞኮነን --------- ነርስ------ መዋልዳን-------- ላቦራቶሪ ቴክኒሻል--------- ፋርማሲስት ----------	
1.2.2	በዝሒ ዝሰልጠኑ ሰብ ሞያ ጥዕና ክንክን ቅድመ ወልድን		
1.2.3	በዝሒ ዝሰልጠኑ ሰብ ሞያ ኣብ ግልጋሎት ምኽሪን ምርመራን ኤችኣይቪ		
1.2.4	በዝሒ ዝሰልጠኑ ሰብ ሞያ ጥዕና ኣብ ምክልኻል ኤችኣይቪ ካብ ኣዶ ናብ ዕሸል		
1.2.5	ዓይነት ጥዕና ትካል	4. ሆስፒታል 5. ጥዕና ጣቢያ 6. ኬላ ጥዕና	
1.2.6	ናይ ኤችኣይቪ ቴስት ኪት ካብ መኽዝን ኣቋሪፁ ይፈልጥ ዶ?	4. እወ 5. ኣይትቋረፀን 6. ኣይፈልጥን	1.2.10
1.2.7	እንተድኣ ሕቶ ቁፅሪ 1.2.6 “እወ” ኮይኑ መልሲ ክንደይ ግዜ?	5. ሓደ ግዜ ብወርሒ 6. ሓደ ግዜ ኣብ ሽዱሽተ ወርሒ 7. ሓደ ግዜ ብዓመት 8. ኣይፈልጥን	
1.2.8	ኣብ ሕቶ ቁፅሪ 1.2.6 መልሲ “እወ” እንተድኣ ኮይኑ ንክንደይ ዝኣክል ፀኒሑ?	6. ካብ ሓደ መዓልቲ ንታሕቲ 7. ካብ ሓደ መዓልቲ ክሳብ ሰሙን 8. ካብ ሓደ ሰሙን ክሳብ ትሕቲ ሓደ ወርሒ 9. ልዕሊ ሓደ ወርሒ 10. ኣይፈልጥን	
1.2.9	ኣብ ሕቶ ቀፅሪ 1.2.6 መልሲ “እወ” ተኾይኑ ብምኽንያት ምቁራፁ ምርመራ ክንብር ዝደለዩ ዘይተመርመረ ኣሎ ዶ?	1. እወ 2. የለን 3. ኣይፈልጥን	
1.2.10	ኣብዚ ጥዕና ትካል ንግልጋሎት ምክል ኻል ኤችኣይቪ ካብ ኣዶ ናብ ዕሸል ዝውዕም ኤአርቲ /ART/ ካብ መኽዝን ተቋሪፁ ይፈልጥ ዶ?	1. እወ 2. ኣይተቋረፀን 3. ኣይፈልጥን	1.2.14
1.2.11	ኣብ ሕቶ ቁፀሪ 1.2.10 መልሲ“እወ” እንተኾይኑ ንክንደይ ግዜ ዝኣክል?	1. ሓደ ግዜ ብወርሒ 2. ሓደ ግዜ ኣብ ሽዱሽተ ወርሒ 3. ሓደ ግዜ ብዓመት 4. ኣይፈልጥን	
1.2.12	ኣብ ሕቶ ቁፅሪ 1.2.10 መልሶም "እወ" እንተኾኑ ንክንደይ ግዜ ፀኒሑ?	1. ካብ ሓደ መዓልቲ ንታሕቲ 2. ካብ ሓደ መዓልቲ ክሳብ ሰሙን 3. ካብ ሓደ ሰሙን ክሳብ ትሕቲ ሓደ ወርሒ 4. ልዕሊ ሓደ ወርሒ 5. ኣይፈልጥን	
1.2.13	ኣብ ሕቶ ቁፅሪ 1.2.10 መልሲ "እወ" እንተኾይኑ ብምኽንያት ምቁራፅ ኤአርቲ/ART/ ኣብ ደማ ኤችኣይቪ ዘለዋ ዝወለደት ኣዶ መድሓኒት ከይረኽበት ዝኸደት ኣላ ዶ?	1. እወ 2. ዘይወሰደት የላን 3. ኣይፈልጥን	
1.2.14	ኣብ እዋን ክትትልጥንሲ ምርመራ ብፆታዊ ርክብ ዝመሓላለፉ ሕማማት ትገብሩ ዶ?	1. እወ 2. ኣይገብርን 3. ኣይፈልጥን	

ቃል መሕተት ምስ ኣዶ

ተ.ቁ	**መሕተት**	**መልሲ**	ይሽዱ
1.	ኩነታት ኣዶ		
1.1	ዕድመ ኣዶ ብዓመት / 99 ዘይፍለጥ ተኾይኑ/		
1.1.1	ዕድመ ኣቦ ብዓመት / 99 ዘይፍለጥ ተ ኾይኑ/		
1.2	ብርኪ ትምህርቲ ኣዶ	1. ኣየተምሃረትን 2. ካብ ክፍሊ 1 ክሳብ 4ይ ክፍሊ 3. ካብ 5ይ ክፍሊ - 8ይ ክፍሊ	

		4. ካብ 9ይ ክፍሊ-10ይ ክፍሊ 5. መሰናድኦ 6. ላዕለዋይ ብርኪ	
1.2.1	ብርኪ ት/ቲ ኣቦ	1. ኣየተምሃረትን 2. ካብ ክፍሊ 1 ክሳብ 4ይ ክፍሊ 3. ካብ 5ይ ክፍሊ - 8ይ ክፍሊ 4. ካብ 9ይ ክፍሊ-10ይ ክፍሊ 5. መሰናድኦ 6. ላዕለዋይ ብርኪ	
1.3	ኩነታት ሓዳር	7. ዘይተመርዓወት ⟶ 8. ዝተመርዓወት ምስ ሓንቲ ሓደ ጥራሕ 9. ዝተመርዓወት ምስ በዙሓት ኣንስቲ ዘለወኦ 10. ብሞት ዝተፈላለዩ 11. ዝተፈትሐት 12. መልሲ ዘይሃባ	1.4
1.3.1	ኣብ ሕቶ ቁፅሪ 1.3 መልሶም 2&3&4 ወይ 5 እንተኾኑ ንክንደይ ዓመት?		
1.4	ሃይማኖት ናይታ ኣዶ?	1. ኦርቶዶክስ 2. ሙስሊም 3. ፕሮተስታንት 4. ካቶሊክ 5. ካሊእ (ይግለፁ)----------	
1.5	መንበሪ ቦታ	1. ከተማ 2. ከተማ መሰል 3. ገጠር	
1.6	እንታይ ዓይነት ሽንቲ ቤት ይጥቀሙ	1. ብማይ ዝሰርሕ ሽንቲ ቤት 2. ደረቕ ሽንቲ ቤት መተንፈሲ ዘለዎ 3. ደረቕ ሽንቲ ቤት 4. ጫካ 5. ሜዳ 6. ካሊእ (ይግለፁ)----------	
1.7	ኣበ ገዛ መብሰሊ እንታይ ይጥቀሙ	1. ጋዝ 2. ፍሓም 3. ዕንፀይቲ ካብ ዕደጋ 4. ዕንፀይቲ 5. ካሊእ(ይግለፁ)----------	
1.8	ንገዛ መስርሒ ዝጥቀሙሉ ብበሓ እንታይ እዩ	1. ሲሚንቶ 2. እምኒ ዕንፀይቲ ሓመድ 3. ዕንፀይቲ +ጭቃ ሳዕሪ 4. ካሊእ(ይግለፁ)----------	

1.9	ንመስተ ዝጥቀሙሉ ማይ ምንጪ ካበይ እዩ?	1. ማይ ቡንባ 2. ካብ ጉድጓድ 3. ካብ ሩባ 4. ካሊእ(ይግለፁ)----------	
1.10	ኩነታት ቁፃር ኣዶ	1. ሰራሕተኛ መንግስቲ/ቁፃር/ 2. ገዛ ዘላዕላ 3. ስራሕ ዘይብላ 4. ናይ ውልቀን ዝሰርሓ 5. ካሊእ(ይግለፁ)----------	
1.11	ኩነታት ቁፃር ኣቦ/ ሰብኣየን/	1. ሰራሕተኛ መንግስቲ/ቁፃር/ 2. መዓልታዊ ሰራሕተኛ 3. ስራሕ ዘይብሎም 4. ናይ ውልቆም ስራሕ 5. ካሊእ(ይግለፁ)----------	
1.12	ወርሓዊ እቶት	6. ትሕቲ 500 ብር 7. 501-1000 ብር 8. 1001-2000 ብር 9. ካብ 2001 ንላዕሊ 10. ኣይፍለጥን	
1.13	ዖታ ናይቲ ህፃን	3. ተባ	

		4. ኣን	
1.14	ዕድሚኡ ክንደይ እዩ		
1.15	በዝሒ ስድራ ምስ ኣዶ ሓዊሱ ክንደይ እዮም		
1.16	እቲ ህፃን ንምንታይ እዩ ናብ ጥዕና ትካል ኣምፀኢኽንኣ ኣብ ታሕቲ ካብ ዝተዘርዘሩ መልሲ ኣብ ዝህባሉ ዝተጠቀሰ ምልክት ይግበሩ	1. ንክትባት 2. እቲ ህፃን ስለ ዝሓመመ 3. ካሊእ ምኽንያት	
1.17	ካብ /ገዛኽን/ዘለኽንኣ ናብ ቀረባኽን ጥዕና ትካል ንምብፃሕ ክንደይ ሰዓት ይወስድ?		
1.18	ካብ ገዛኽን/ዘለኽንኣ/ ናብ ጥዕና ትካል ዘሎ ራሕቂ ብኪ/ሜትር ክንደይ እዩ?		
1.19	ናብ ጥዕና ትካል ብምንታይ ትኸዳ?	1. ብእግሪ 2. ብፈረስ በቅሊ 3. ብታክሲ ብባስ 4. ብባጃጅ 5. ካሊእ(ይግለፁ)----------	

2. ኩነታት ጥንሲ

ተ.ቁ	መሕተት	መልሲ	ይኸዱ
2.1	ክንደይ ግዜ ጠኒስኪ/ምንፃል ምማትን ሓዊሱ?		
2.1.1	ኣብ ፈለማ ጥንስኺ ክንደይ ዓመት ነይርኪ?		
2.2	በዝሒ ብህይውት ዝተወለዱ ቆልዑ?		
2.3	ሕዚ ብህይወት ዘለው ቆልዑ ክንደይ እዮም?		
2.4	ብትልሚ ዝተጠነሱ ድዩም?	1. እወ 2. ኣይኮነን 3. ኣይፈልጥን	
2.5	መበል ክንደይ ቆልዓ እዩ?		
2.6	ናይ መጨረሻን ቅድሚኡን ዘሎ ኣፈላላይ ዕድመ ክንደይ እዩ?		
2.7	ኣብ ከባቢኺን ብልምዲ ዘዋልዳ ትፈልጢ ዶ?	1. እወ 2. የለዋን 3. ኣይፈልጥን	
2.8	ኣብ ከባቢኽን ናይ ጥንሲ ምርመራ ዝህብ ትካል ትፈልጢ ዶ?	1. እወ 2. የለን 3. ኣይፈልጥን	
2.9	ካብ በዓል ገዛኺ ክትትል ጥንሲ ክትገብሪ የተባብዐኪ ይሕግዘኪ ዶ?	1. እወ 2. ኣይ 3. ኣይተለመደን	
2.10	ካብ ቤተሰብኪ ቅድመ ወሊድ ክትትል ክትገብሪ የተባብዑኺ ወይ ይሕጉዙኺ ዶ?	1. እወ 2. ኣይ 3. ኣይተለመደን	
2.11	ካብ ከባቢ እትነብርሉ ማሕበረሰብ ቅድመ ወሊድ ክትትል ክትገብሪ የተባብዑኺ /ይሕጉዙኺ ዶ?	1. እወ 2. ኣይ 3. ኣይተለመደን	
2.12	ጥንሲ ክትትል ኣብ ክንደይ ወርሒ ጀሚሮም /እንድሕር ዘይፈልጥ 99 የቀምጡ/?		
2.13	ንክንደይ ግዜ ጥንሲ ክትትል ጌርኪ /እንድሕር ዘይፍለጥ 99 የቅምጡ/?		
2.14	ቅድመ ወሊድ ክትትል ኣብ ጥዕና ትካል ኣብ ትኸድሉ ንክንደይ ግዜ ዝኣክል ፀኒሐን?		
2.15	ነዊሕ እዩ እልኪ ዶ? ትኣምኒ	1. እወ 2. ኣይኮነን 3. ርግፀኛ ኣይኮነኩን	
2.16	ነዊሕ ግዜ ብምፅባይ ከይተርኣኺ/ ክትትል ከይተገበረልኪ ተመልስኪ ትፈልጢ ዶ?	1. እወ 2. ኣይኮነን 3. ርግፀኛ ኣይኮነኩን	
2.17	ብጥንስቲኺ ምስ ዝኾነ በዓል ሞያ ስለ ዕሸል ኣመጋግባ ተመያይጥኪ ትፈልጢ ዶ?	1. እወ 2. ኣይተመያየጥኩን 3. ኣይፈልጥን	
2.18	እቲ ህፃን ኣበይ ተወልዱ?	1. ሆስፒታል 2. ጥዕና ጣቢያ 3. ኬላ ጥዕና 4. ኣብ ገዛ	
2.19	ብመን ተዋልድኪ?	1. ዶክተር 2. ነርስ መዋልዳን ካልኦት ሰብ ሞያ ጥዕና 3. ባህላዊ መዋልዳን 4. ካሊእ(ይግለፁ)----------	
2.20	ድሕሪ ምውላድኪ ግልጋሎት ሓገዝ ዝሃቡኺ ካብዞም ዝተዘርዘሩ ግለፂ?	1. ኣብ ማሕበረሰብ ዝሰርሑ ሰብ ሞያ ጥዕና 2. ካብ ባህላዊ ብተለምዶ መዋለድቲ	

		3. ዝኾነ ሓገዝ ኣይረኽብኩን 4. ካሊእ(ይግለፁ)----------	
2.21	ኣብ ከባቢኺ ዘለዋ ጥኡሳት ኣደታት ኣብ መን እምነት የሕድራ?	1. ኣብ ጥዕና ትካል ዝሰሑ ሰብ ሞያ 2. ባህላዊ መዋላድቲ 3. ካሊእ(ይግለፁ)----------	
2.22	ብሰብ ሞያ ጥዕና ዝወሃብ ቅድመ ወሊድ ግልጋሎት ከመይ ትገልፅዮ?	1. ብጣዕሚ ፅቡቅ 2. ፅቡቅ 3. ኣይፈልጥን 4. ሕማቕ 5. ብጣዕሚ ሕማቕ	

3. ምርመራ ኤችኣይቪ ዝምልከት

3.1	ኤችኣይቪ እንታይ ምኽኑ ትፈልጢ ዶ?	**1.** እወ **2.** ኣይፋል **3.** ኣይፈልጥን	
3.2	ኤችኣይቪ ብምንታይ ከምዝመሓላለፍ ትፈልጢ ዶ?	**1.** እወ **2.** ኣይፋል **3.** ኣይፈልጥን	
3.3	ኤቸኣይቪ ብምንታይ ከም እንከላኸሎ ትፈልጢ ዶ?	**1.** ምዕቃብ **2.** ሓደ ብሓደ ምፅናዕ **3.** ኮንዶም ምጥቃም **4.** ኣይፈልጥን	
3.4	ኣብ እትነብረሉ/ርሉ ከባቢ ምርመራ ኤችኣይቪ ዝወሃበለሎም ናቕጣታት ትፈልጢ ዶ?	**1.** እወ **2.** ኣይፋል **3.** ኣይፈልጥን	
3.5	ካብ በዓል ገዛኺ/ዓርኽኺ ክትምርመሪ ዝሕግዝ ሓሳብ ረኪብኪ ትፈልጢ ዶ?	**1.** እወ **2.** ኣይፋል **3.** ተግባራዊ ኣይግበርን	
3.6	ካብ ቤተሰብኪ ክትምርመሪ ዝሕግዝ ሓሳበ ረኺብኪ ትፈልጢ ዶ?	**1.** እወ(ካብ መን)---------- **2.** ኣይፋል **3.** ተግባራዊ ኣይግበርን	
3.7	ካብ ሕ/ሰብ ንክትምርመሪ ዝሕግዝሓሳብ ረኺብኪ ትፈልጢ ዶ?	**1.** እወ(ካብ መን)---------- **2.** ኣይፋል **3.** ተግባራዊ ኣይግበርን	
3.8	ንኤችኣይቪ ተጋላፂት እየ ኢልኪ ሓስቢኪ ዶ?	**1.** እወ (ንምንታይ?)---------- **2.** ኣይፋል **3.** ኣይፈልጥን	
3.9	ኣብ ዝሓለፈ ጥንሲኺ ምርመራ ኤችኣይቪ ኣካይድኪ ነይርኪ ዶ?	**1.** እወ → **3.11** 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	**3.11**
3.10	ንኣብ ላዕሊ ዘሎ ሕቶ መልስኺ ‘‘ኣይፋል’’ እንተኾኑ ንምንታይ ዘይተመርመርኪ?	1. ዝምርምረኒ ኣይረኽብኩን 2. ክምርመር ኣይደለኹን 3. ካብ በዓል ገዛይ ፍቓድ ኣይረኽብኩን 4. ንክምርመር ምኽንያት የብለይን 5. ካሊእ(ይግለፁ)----------	
3.11	ቅድሚ ሓለፈ ጥንሲ መረመራ ኤችኣይቪ ገይርኪ	**1.** እወ	

	ትፈልጢ ዶ?	2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	**3.15**
3.12	ኣብ ቐረባ ግዜ ዝገበርክዮ ምርመረራ ኤችኣይቪ ውፅኢት ፈለሊጥኪ?	**1.** እወ 2. ኣይፋል 3. መልሲ ምሃብ ኣይደለኹን	**3.14**
3.13	ንኣብ ላዕሊ ዘሎ ሕቶ መልስ ኺ ኣይፋል እንተኾይኑ ንምንታይ መልሲ ዘይረኽብኪ?	1. ውፅኢት ኣይተነገረን 2. ውፅኢት ምስማዕ ኣይደለኹን 3. ካሊእ(ይግለፁ)----------	
3.14	ንኣብ ላዕሊ ዘሎ ሐቶ መልስኺ ‘‘እወ’’ እንተ ኾይኑ ውፅኢት ምርመራ ኺ እንታይ እዩ?	1. ኤችኣይቪ ቫይረስ ኣብ ደመይ ኣሎ 2. ነፃ 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣደለኹን	
3.15	በዓለ ገዛኺ/ንህፃንኪ ኣቡኡ /ምርመራ ኤችኣይቪ ገይሩ ይፈልጥ ዶ?	**1.** እወ 2. ኣይፋል 3. ኣይፈልጥን	
3.16	ህፃንኪ ምርመራ ኤችኣይቪ ተገይሩ ዶ?	**1.** እወ 2. ኣይፋል 3. ኣይፈልጥን	**3.17**

3.16.1	ንኣብ ላዕሊ ዘሎ ሕቶ መልስ ኺ ‘‘እወ’’ እንተ ኾየኑ ውፅኢት ምርመራ ህፃንኪ እንታይ እዩ?	1. ኤችኣይቪ ቫይረስ ኣብ ደመይ ኣሎ 2. ነፃ 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣደለኹን	
3.17	ውፅኢት ምርመራኺ ንሰብ ተናኒርኪ ትፈልጢ ዶ?	**1.** እወ 2. ኣይፋል 3. መልሲ ምሃብ ኣይደለኹን	**3.19**
3.18	ንላዕሊ ዘሎ ሕቶ መልስ ኺ ‘‘እወ’’ እንተኾይኑ ንመን?	1. ንኣደይ 2. ንእንምበተይተይ 3. በዓል ገዛይ/ሰብኣየይ 4. ካሊእ ናይ ቤተሰብ ኣባል 5. መሓዛይ 6. ንጎረበተይ 7. ንጥዕና በዓል ሞያ 8. ካሊእ(ይግለፁ)----------	
3.19	ኤችኣይቪ ኣብ ደምኪ እንተሃልዩ ፍርሒ ይስመዐኪ ዶ?	**1.** እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
3.19.1	መልስኺ እወ ተኾይኑ ንምንታይ?	1. ሰብ ይድህለኒ 2. ናይ ቃል ወቐሳ ይበፅሐኒ 3. ናይ ኣካል ማህሰይቲ ይበፅሐኒ 4. 5. ካሊእ ንግብረስጋ ርክብ ኣይቐረበንን 6. ካሊእ(ይግለፁ)----------	
3.20	ውፅኢት ምርመራኺ ካልእ ሰብ ተስሚዕዎ እንታይ ይፍጠር?	1. ሕማቕ ስምዒት ይስመዐኒ 2. ንካልኦት ምንጋር የቋርፅ 3. ካልኦት ሰባት ምሳይ ነይሮም ርክብ የቋርፅ	

		4. ሰባት ስልኪ ምድዋል ጠጠው የብሉ 5. ካልኦት ሰባት ንዓይ ዘለዎም ግምት ይትሕት 6. ካልኦት ሰባት ብጣዕሚ ይጭነቑ 7. ሰባት ናብ ደቆም ክቐርብ ኣይፈቕድን 8. ሰባት ካባይ ይርሕቑ 9. ኣዕርኽተይ ይስእን 10. ካልኦት ሰባት ከም ነውራም ገይሮም ይሪኡኒ 11. ካሊእ(ይግለፀ)----------	
3.21	ኤችኣይ ኣብ ደምኪ ብምህላው ጥዕና ትካል ካብ ምጥቃም ከልኪሉኪ ይፈልጥ ዶ?	**1.** እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
3.22	ኤችኣይቪ ኣብ ደምኪ ብምህላው ሕ/ሰብ ካብ ማህበራዊ ጉዳያት ካብ ምስተታፍ ተዓቒብኪ ትፈልጢ ዶ?	**1.** እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
3.23	ውፅኢት ምርመራኺ ዝፈልጥ በዓል ሞያ ጥዕና ውፅኢትኪ ንካልእ ሰብ ብዘይ ናትኪ ፍቓድ ክነግረለይ እዩ ኢልኪ ሓስብኪ ትፈልጢ ዶ?	**1.** እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	

4. ፍልጠት ምትሕልላፍ ኤችኣይቪ ካብ ኣዶ ናብ ዕሸት

4.1	ኤችኣይቪ ኣብ ደማ ዘለዋ ኣደ ን ወዳ ክትሕልፍ ትኽእል ዶ?	**1.** እወ 2. ኣይፋል 3. ኣይፈልጥን	
4.2	ንኣብ ላዕሊ ዘሎ ሕቶ መልሲ ‘‘እወ’’ እንተኾኑ ብኸመይ?	1. ጡብ ብምጥባብ 2. ኣብ እዋን ጥንሲ 3. ኣብ ዝዋን ወሊድ 4. ካሊእ(ይግለፀ)---------- 5. ኣይፈልጥን	
4.3	ብዛዕባ ምክልኻል ኤችኣይቪ ካብ ኣዶ ናብ ዕሸል ሰሚዕኺ ትፈልጢ?	1. እወ 2. ኣይፋል	

እዚ ስዕቡ ዘሎ ሕቶ ኤችኣይቪ ኣብ ደማ ንዘለዋ ጓል ኣንስተይቲን ንክትባት ዝመፀትን ዝሕተት እዩ

ምክልኻል ኤችኣይቪ ካብ ኣዶ ናብ ዕሸል

ተ.ቁ	መሕተት	መልሲ	ይኸዱ
5.1	ኤችኣይቪ ኣብ ደምኪ ከምዘሎ መዓዝ ፈሊጥኪ?	1. ነዚ ዕሸል እዚ ቅድሚ ምጥናስይ 2. ነዚ ዕሸል እዚ ጠኒሰ እናሃለኩ HAART ዝጀመረት 3. ነዚ ዕሸል ከወልድ ከለኹ 4. ነዚ ዕሸል እዚ ምስ ወለድኩ ዘይጀመረት 5. መልሲ ምሃብ ኣይደለኹን	5.2 5.3 5.4 5.4.2
5.2.1	ንሕቶ ቁፅሪ 5.1 መልስኺ ቁፅሪ 1 እንተኾይኑ ቅድሚ ነዚ ህፃን ምጥናስኪ ምጣነ ስድራ ትጥቕሚ ዶ ነይርኪ?	1. እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
5.2.2	ንሕቶ ቁፅሪ 5.1 መልስኺ 1 እንተኾይኑ ፀረ ኤችኣይቪ መሓኒት እናተጠቐምኪ እናሃለ ኺ ጠኒስኪ ትፈልጢ ዶ?	**1.** እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	

5.2.3	ህፃንኪ መከላኸሊ መሓኒት /ART/ ይውሰድ ዶ?	1. እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
5.2.4	ንከንደይ መዓልቲ መከላኸሊ መድሓኒት ወሲዱ /እንድሕር ዘይትፈልጥዮ 99 ኢልኪ ፀሓፊ/?		
5.3	ንሕቶ ቁፅሪ 5.1 መልስኺ 2 እንተኾይኑ ንፀረ ኤችኣይቪ ኤድስ መሓኒት ብቕዕቲ እንተኾይናን		
5.3.1	ኣብ እዋን ጥንሲ መከላኸሊ መድሓኒት ፀረ ኤችኣይቪ ኤድስ/ፕሮፋላክሲስ/ ወስድኪ ነይርኪ ዶ/ መብራህርሂ ይወሃባ?	1. እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
5.3.2	ህፃንኪ መከላኸሊ መሓኒት / ART / ረኺቡ ዶ?	1. እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
5.3.3	ህፃንኪ መካላኸሊ መድሓኒት ንከንደይ መዓልቲ ወሲዱ /ንከንደይ መዓልቲ ከምዝወሰዶ ዘይትፈልጢ እንተኾይንኪ 99 ኢልኪ ፀሓፊ/?		
5.4	ንሕቶ ቁፅሪ 5.1 መልስ ኺ 2 እንተኮይኑ ንፀረ ኤችኣይቪ መድሓኒት ብቕዕቲ እንተዘይኮይና		
5.4.1	ቅድሚዝሓለፈ ህፃን ምውላድኺንከንደይ መዓልቲ /ብሰሙን/ መከላኸሊ መድሓኒት /ART/ ወስድኪ?		
5.4.2	ኣብ እዋን ሕርሲ ንውላድኪ ንኤችኣይቪ ከይሓልፎ ዝኾነ ዓይነት መድሓኒት ወስድኪ ዶ ነይርኪ?	1. እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
5.4.3		1.	
5.4.4	ህፃንኪ /ውላድኪ ምስ ተወለደ መከላኸሊ መድሓኒት /ኔቨራፒን/ ተዋሂብዎ ዶ?	1. እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
5.5	መጠን ሲዲፎር ንምፍላጥ ምርመራ ደም ገይርኪ ትፈልጢ ዶ?	1. እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
5.6	መጠን ሲዲ ፎርኪ ክንደይ ነይሩ?		
5.7	ናብ ኤኣርቲ ክሊኒክ ተላኢኽኪ ዶ ትፈልጢ?	1. እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	
5.8	ኤኣርቲ ክሊኒክ ከይደኪ ትፈልጢ ዶ?	1. እወ 2. ኣይፋል 3. ኣይፈልጥን 4. መልሲ ምሃብ ኣይደለኹን	

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CONSENT FORM

"A hierarchical modelling approach to identify factors associated with the uptake of HIV counselling and testing and prevention of mother to child HIV transmission among post-partum women in Ethiopia"

The study has been described to me in language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered. I understand that my identity will not be disclosed and that I may withdraw from the study without giving a reason at any time and this will not negatively affect me in any way.

Participant's name……..

Participant's signature…….

Witness…….

Date……

Should you have any questions regarding this study or wish to report any problems you have experienced related to the study, please contact the study coordinator:

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