COLLEGE OF MEDICINE AND HEALTH SCIENCE
DEPARTMENT OF PUBLIC HEALTH

TREND AND ASSOCIATED FACTORS OF HIGH FERTILITY RATE IN ETHIOPIA. USING DEMOGRAPHIC HEALTH SURVEY DATA FROM 2000-2019: MULTILEVEL ANALYSIS MODEL

BY: MESFIN BEYENE (BSc)

JANUARY 2024

HAWASSA, ETHIOPIA

TREND AND ASSOCIATED FACTORS OF HIGH FERTILITY RATE IN ETHIOPIA. USING DEMOGRAPHIC HEALTH SURVEY DATA FROM 2000-2019:

MULTILEVEL ANALYSIS MODEL

BY: MESFIN BEYENE (BSc)

A THESIS REPORT TO BE SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, COLLEGE OF MEDICINE AND HEALTH SCIENCES, HAWASSA UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN EPIDEMIOLOGY- PUBLIC HEALTH.

ADVISORS:

1. FANUEL BELAYNEH BEKELE (ASSISTANT PROFESSOR, MPH, HAWASSA UNIVERSITY)
2. MESKEREM JISO (LECTURE, MPH, HAWASSA UNIVERSITY)

EXAMINERS:

1. Dr. MENGISTU MESKELE (ASSOCIATE PROFESSOR, PHD, WOLAITA SODO UNIVERSITY)
2. Dr. BIRHANU JIKAMO (ASSISTANT PROFESSOR, PHD, HAWASSA UNIVERSITY)
3. Mr. DERESSE LEGESSE (LECTURE, MPH, HAWASSA UNIVERSITY)

JANUARY 2024

HAWASSA, ETHIOPIA

HAWASSA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

EXAMINERS APPROVAL SHEET

We, the undersigned, members of the Board of Examiners of the final open defense by Mesfin Beyene have read and evaluated his thesis entitled "Trend and Associated Factors of High Fertility Rate in Ethiopia. Using Demographic Health Survey Data from 2000-2019: Multilevel Analysis Model" and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree of Master of Public Health in Epidemiology.

_____	_____	_____
Name of Major Advisor	Signature	Date
_____	_____	_____
Name of Chairperson	Signature	Date
_____	_____	_____
Name of Internal Examiner	Signature	Date
_____	_____	_____
Name of External Examiner	Signature	Date
_____	_____	_____
SGS Approval	Signature	Date

Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the School of Graduate Studies (SGS) through the Department/School Graduate Committee (DGC/SGC) of the candidate`s department.

Stamp of SGS Date: _____

APPROVAL SHEET

By my signatures below, I endorse that this thesis document is submitted in partial fulfillment of the requirement for the degree of Masters in Public Health (MPH) with speculations in Epidemiology in the graduate program of Hawassa University, department/school of public health and has been caried out by Mesfin Beyene (ID No: GPPHEpW/0010/13) under my supervision.

Therefore, I recommend the student fulfill the requirements and hence, hereby can submit the thesis to the department.

Submitted by:

_____	_____	_____
Name of student	Signature	Date

Approved by:

1. _____	_____	_____
Name of Major Advisor	Signature	Date
2. _____	_____	_____
Name of Co-advisor	Signature	Date
3. _____	_____	_____
Thesis reviewer	Signature	Date
4. _____	_____	_____
Post-graduate, HU-CMHS	Signature	Date

I. Acknowledgement

First and foremost, I am indebted to the Almighty God because of whose full mercy and grace I started and completed my thesis project in his time.

I would like to express my deep gratitude to my research prime and co-advisors, Mr. Fanuel Belayneh and Meskerem Jiso for their continuous advice and professional guidance during development towards realization of this work.

My exceptional gratitude goes to our course instructors Dr. Tarekegn Solomon, Dr. Taye Gari, Mr. Akalewold Alemayehu, Mr. Yusuf Haji, Mr. Dawit Jembere, Mr. Alemu Tamiso and Dr. Wondwosen T/Silasie for their unreserved great effort for shared their expertise knowledge and equipped us with enough concepts and knowledge on Statistics and Research Methodology in general.

I would like to thank the MEASURE DHS Program and ICF International for providing me the permission to use the EDHS data.

I would like to extend my grateful in advance to the Hawassa University, College of Medicine and Health Sciences for the hope of receiving ethical clearance for this study in the future.

Finally, I would like to extend my heartful gratitude to my teammate at PSI-Ethiopia- AYSRH Program, Dr. Tamirat Tesfaye (PHD – Reproductive Health), for his unconditional expertise support through the whole processes of this project work.

Table of Contents

LIST OF FIGURES:

Pages

LIST OF TABLES:

Pages

ANNEXES:

Pages

II. ACRONYMS

AIC: Akaike Information Criterion
AOR: Adjusted Odds Ratio
ASFR: Age-Specific Fertility Rates
AYSRH: Adolescent and Youth Sexual and Reproductive Health
BIC: Bayesian Information Criterion
CEB: Children Ever Born
CI: Confidence interval
CSA: Central Statistics Agency
DESA: Department of Economic and Social Affairs
DHS: Demographic and Health Survey
EDHS: Ethiopian Demographic and Health Survey
EA: Enumeration Area
EPHI: Ethiopia Public Health Institute
FDRE-MOH: Federal Democratic Republic of Ethiopia- Ministry of Health
FP: Family Planning
HFR: High Fertility Rate
HIV/AIDS: Human Immuno-Virus/Acquired Immuno-Deficiency Syndrome
ICC: Intra-cluster Correlation
ICF: International Classification of Functioning, Disability and Health
IRB: Institutional Review Board
MAC: Middle- African Countries
MCH/MNCH: Maternal and Child Health/ Maternal, Newborn and Child Health
MDGs: Millennium Development Goals
MMR: Maternal Mortality Ratio
MOR: Median Odds Ratio
NMR: Neonatal Mortality Rate
NFFS : National Family and Fertility Survey

OR: Odds Ratio
PCV: Proportional change in variance
PD: Population Division
PNC: Post-partum Care
SDG Sustainable Development Goals
SNNPR: Southern Nations, Nationalities, and Peoples' Region
SRS: Simple Random Sampling
SSA: Sub-Saharan Africa
STATA: South Texas Art Therapy Association (Statistical Software)
SPSS: Statistical Packages for the Social Sciences
RMNCH: Reproductive, Maternal, Newborn and Child Health
TFR: Total Fertility Rate
TX: Texas
UN-DESA: United Nations Department of Economic and Social Affairs
UN: United Nations
UNICEF: United Nations Children's Fund
VIF: Variance Inflation Factor
WHO: World Health Organization

III. ABSTRACT

Background: High fertility rate remains one of the most important determinants playing a key role in changing the size and structure of the population of a given nation over time. Even if there were a declining trend in last few years, like many African countries, the fertility rate of Ethiopia is still high, make the nation as the second most populous nation in Africa, after Nigeria. Therefore, this study was aimed to analyze the magnitude, trend and determinants of high fertility (number of children ever born alive ≥ 5) among reproductive-age women in Ethiopia using the Demographic Health Surveys conducted from 2000 to 2019.

Method: The trend with cross-sectional study design operated using data from the Ethiopian demographic health survey from 2000 to 2019. A total weighted sample of 44,596 women of reproductive ages were included in the analysis from the latest 2016 EDHS data to compute the magnitude and identify the determinants of high fertility. Multilevel logistic regression analysis assessed the relationship between high fertility and its determinants using STATA software (version 16; StataCorp, College Station, TX). Trend analysis of high fertility assessed using the extended Mantel- Haenszel Chi-square test for linear trend using the OpenEpi (V.3.01) response program and the adjusted odds ratio (AOR) with the 95% confidence interval was computed, and a significant association was declared at p value ≤ 0.05.

Results: The magnitude of high fertility was 64.6 % (95 % CI, 64.10 - 65.01). The multilevel logistic regression model reviled that high fertility were significantly associated with residing in rural area [AOR = 3.90, 95% CI: 2.85-5.34], lack of formal education [AOR=2.21; 95%CI:1.93-2.53], never used any contraceptive [AOR=1.38; 95% CI:1.24-1.53], early marriage [AOR=2.42;

95% CI: 2.11-2.78], childbearing at early age [AOR=2.70; 95% CI: 2.44-3.00], polygamous marriage [AOR=1.47; 95% CI:1.30-1.65], short birth intervals of ≤36 months [AOR=2.36; 95% CI:2.17-2.56] and husband low education status [AOR=3.64; 95%CI:2.12-4.27]. But women with a met contraceptive need [AOR = 0:28, 95% CI: 0.08, 0.93] were less likely to have high fertility.

Conclusions: The finding of this study implies that sixty-five out of hundred women in this survey reported having high fertility, and the magnitude and trend did also show significant change during the last two decades. Key determinants of high fertility were early marriage and childbearing at early ages, lack of formal education, low rate of family planning use, polygamous marriage status, short birth intervals of ≤36 months, and unmet needs for family planning that needs public health attention. It is recommended to stakeholders develop new approaches to deal with the primary causes of high fertility factors. Special attention should also be done on improving the Adolescents and Youth Sexual and Reproductive Health (AYSRH) services focused on rural settings.

Key words: High fertility, Trend, factors, Multilevel analysis, Ethiopia.

1. INTRODUCTION

1.1. Background

Demographers define fertility as the product or result of reproduction, not only the capability to produce offspring[(1)]. This is meant to imply that it is the actual reproductive performance of a couple. Together with mortality and migration, fertility is an important element of population growth, reflecting both the causes and effects of economic and social developments[(1)].

The total fertility rate (TFR) and its component age-specific fertility rates (ASFRs) are the most widely used contemporary indicators to measure fertility. The TFR is a projection of the average number of births a woman would have at the end of her reproductive years if she had children at the prevailing age-specific fertility rates throughout her childbearing years (age 15-49). Whereas the ASFRs are defined in terms of the number of live births among women in a particular age group divided by the number of woman-years in that age group during the specific period. Hence the total fertility rate is calculated by totaling the age-specific fertility rates as defined over five-year intervals. Assuming no net migration and unchanged mortality, a total fertility rate of 2.1 children per woman ensures a broadly stable population. Whereas, High Fertility Rate (HFR), a situation when a woman has five or more alive children over the course of her reproductive years[(2)].

In this regard, nations of the world may well be categorized in three levels based on the TFR: as Low, intermediate, and HFR countries. The former represents those countries where women have fewer than 2.1 children on average, whilst an “intermediate- fertility” countries could include those where women have on average between 2.1 and 5 children. Likewise, in “high

fertility" countries the average woman has five or more children over her lifetime[2]. Today, 46 per cent of the world's population lives in countries with low levels of fertility, which include all of Europe and Northern America, as well as many countries in Asia and Latin America and the Caribbean. Another 46 per cent of the world's population lives in "intermediate - fertility" countries that have already experienced substantial fertility declines and the remaining 8 per cent of the world's population lives in "high-fertility" countries that have experienced only limited fertility decline to date. Most of these countries are in Sub-Saharan Africa (SSAs)[3, 4].

Global patterns of fertility have undergone major shift during the last few decades. Despite historically declining trend of fertility, there are still wide variations in the patterns of childbearing among nations and regions. Even if there is a significant decline in FR in the future, the large number of young people who are currently living on the Africa and who will become adults in the next few years and have children of their own ensures that the region will play a crucial role in determining the size and distribution of the global population over the coming decades[4, 5].

Referring to the United Nations Department of Economic and Social Affairs (DESA) assumptions, the 2030 Agenda for Sustainable Development cannot be realized without an understanding of global population patterns and an understanding of future demographic shifts. Numerous Sustainable Development Goals (SDGs) have made significant headway in recent years, according to population trends recorded during the last few decades. Examples include decreased mortality, particularly in children, as well as improved gender equality, better access to sexual and reproductive health care, and the freedom and responsibility of women to choose the number, spacing, and timing of their children[4, 5].

Recent and continuing demographic patterns are signs of the difficulties that sustainable development may face in the future. For instance, nations with high population growth—the majority of which are in SSAs— expected to put pressure on already strained resources, so that they must ensure that existing high number of children and youth have access to education and work opportunities as well as to health care and education. Furthermore, countries where population growth has slowed or ceased need to get ready for a growing older population and, in some situations, a smaller overall population. Anticipating future demographic patterns and

using that information into policy and planning can help to handle these and other difficulties[4, 5].

Ethiopia, being the second most populated nation in Africa after Nigeria, has been suffering from both direct and indirect population challenges[6]. Unrestrained fertility has had a negative impact on the nation's socioeconomic, demographic, and environmental growth. High population has been made worse by poverty, famine, and conflict, which are all linked to poor health, infrastructure, and agricultural and industrial production[7].

The increase in Ethiopian population has significant demographic implications for Africa. The nation is one of the biggest and poorest to have kept strong fertility rates despite the crisis[8]. From 11.8 million at the beginning of the 20th century to over 80 million in 2007, its population has nearly multiplied seven times. The predicted annual growth rate was 2.7%, and the estimated time till doubling was 26 years.

1.2. Problem Statement

High fertility remains one of the most important determinants in altering the rate of population growth, by playing a key role in changing the size and structure of the population of a given nation over time. It also known in impeding the wellbeing of mothers and the survival of their children in developing nations [9, 10]. It has negative effects on maternal and child health, detracts from human capital investment (reduces investment in human capital), decelerates economic progress, and aggravates environmental risks[11]. High fertility is defined as a total fertility rate (TFR) of 5.0 or higher. The TFR denotes the average number of births per woman during her lifetime as inferred by the age-specific fertility rates that prevailed during her reproductive period.

The world population was about 2.5 billion in 1950, then 6.14 billion in 2000, 6.70 billion in 2007, 7.38 billion in 2015 and reached 7.71 billion as of mid-2019, implying that the planet has tripled its population size over the last seven decades and has been adding another billion people every 12 years since 1975, which proved as the result of human fertility trends. Assuming the ‘medium fertility’ projection variant, global population might increase to 9.7 billion by 2050, and rise further to 11.2 billion by 2100. However, if fertility and mortality rates stay at current levels (i.e. assuming the ‘no change’ projection variant), growth rates are projected to be substantially higher, with global population possibly rising to 10.2 billion by 2050 and 19.3 billion by 2100[5].

In the past seven decades since 1950, fertility has significantly decreased among most of the developing nations. Nevertheless, thirty-three nations are characterized by high fertility, which is defined as five or more births per woman over the course of her reproductive years. Twenty-nine of these nations are located in Sub-Saharan Africa. High fertility increases environmental dangers, reduces investment in human capital, puts children and mothers at risk for health problems, and slows economic progress[11]. The effects of declining fertility, such as population aging, and other demographic issues, such as urbanization, have become the focus of demographic concerns in recent years. Although some nations still have high fertility rates, there is solid reason to believe that these nations will eventually see significant fertility declines as well, given the worldwide experience since 1950. However, it is still unclear how quickly this reduction will happen, what policies and initiatives can hasten it, and whether fertility will decline to low levels (i.e., less than 2.5 births per woman) across the board[11].

The pace of progress toward achieving the Millennium Development Goals is one example of how the high-fertility countries lag behind in numerous development indices (MDGs). Additionally, compared to nations further along in their transitions to lower fertility, these nations have received less aid for population and reproductive health development, and the aid they did receive increased only slightly between 1995 and 2007, a time when investments in both health and HIV/AIDS increased significantly[4].

High fertility has a negative impact on a nation's socioeconomic, demographic, and environmental growth[9, 10, 12, 13]. Most elaboratively, higher-order births are known to carry a higher risk of infant and young child mortality. One comparative analysis conducted by Mary Mahy in 2003, of Demographic and Health Survey (DHS) data examines risk of death during four intervals: neonatal (0–4 weeks), infant (0–1 year), early childhood (1- 4 years), and under-five (0 - 5 years). Birth orders 2 and 3 show the lowest rates. By comparison, at orders 7+ neonatal mortality is 43 percent higher and early childhood mortality is 11 percent higher. Moreover, Children from large families attain less schooling. And successively larger birth cohorts—a feature of high fertility societies—detract from the quality of schooling by diluting the expenditure per pupil[14].

Higher pregnancy orders also increase the likelihood of maternal death. The surveillance system data in Matlab thana, Bangladesh, contains some of the best proof. These findings show that

women who have five or more pregnancies are far more likely to pass away from maternal causes. Between pregnancy orders five and six, mortality is almost 50% greater. Even as mortality dropped from high levels in the 1970s to much lower levels in the 2000s, this disparity maintained[15, 16]. Another, less-noticed benefit of avoiding high fertility is that fewer pregnancies reduce the lifetime risk of maternal mortality because pregnancy is a necessary but not sufficient condition for maternal mortality. Fortunately, this will be the reason for the 640 women die from pregnancy- and childbirth-related problems for every 100,000 births in high-fertility African nations[17]. Family planning would be the most effective tool for lowering pregnancy-related mortality, according to a recent modeling exercise for India, for this reason among others[18].

Similarly, more than 570 deaths per 100,000 live births occurred in 2008 among the 1.4 billion women in the developing world who are of reproductive age (15-49), with 70% of these deaths occurring for completely preventable causes[19]. These women reside in nations where they are either very poor or very poor, and as a result, their health is frequently threatened. Studies conducted in several countries show that wherever fertility is high, maternal, and infant and child mortality rates are high. Fetal deaths, low birth weight, and related problems are also associated with unregulated fertility. Fertility rate is highest in sub-Saharan Africa than many parts of the world, mainly due to strong kinship networks and high economic and social values attached to children[3, 4].

In the other aspect, there is a negative relationship between economic growth and fertility. The underlying causal relationship between fertility and economic growth cannot be revealed by this straightforward correlation, though. A theoretical framework for including fertility (or population growth) in models of economic growth is provided by Barro (1991). His neoclassical growth model also uses technology advancement and human capital investment as fundamental justifications. Barro (1991, 1997)[13] tests the model using panel data (1960–1990) from 100 countries and finds that fertility has a negative impact on productive output, reflecting expenditure on child-rearing rather than production of goods (income generation). Barro concludes that an exogenous drop in fertility raises productive output in the long run. Moreover. fertility decline contributes economic growth via favorable changes in the age-structure—the "demographic dividend" of a larger concentration of the population in the working ages, thereby increasing per capita productivity. The "demographic dividend" contributed substantially to economic growth in East Asia and Latin America in the period since 1960[11]. In many nations,

impending freshwater shortages are a direct and immediate outcome of high fertility and the resulting population increase. Population expansion has also contributed to global warming—by as much as one-third—and one of the most practical ways to slow it is by reducing fertility through expanding family planning options[(11)].

Based on the United Nations, Department of Economic and Social Affairs, Population Division (UN-DESA-PD) prediction, Africa is anticipated to contribute more than half of the world's population growth between now and 2050. Among the major regions, Africa's population grew at the greatest rate, 2.55 percent yearly between 2010 and 2015. As a result, 1.3 billion of the 2.4 billion extra individuals expected to join the world's population between 2015 and 2050 would reside in Africa. Asia is projected to be the second largest contributor to future global population growth, adding 0.9 billion people between the mentioned over three decades of future period[(20)].

Based on similar estimation report, most of the increase in world population in the forthcoming three decades till 2050 can be attributed to a short list of nine countries categorized as either in high-fertility countries, mainly in Africa, or in countries with existing large populations. Of these listed nations, Ethiopia is ranked at middle fifth position next to front listed: India, Nigeria, Pakistan, Democratic Republic of the Congo and followed by United Republic of Tanzania, United States of America, Indonesia and Uganda according to the size of their contribution to the total growth[(20)].

Over the past few decades, there have been substantial changes in global patterns of fertility. Despite there are still significant disparities in countries and regions' patterns of childbearing. The 2030 Agenda for Sustainable Development's implementation, as well as policies and planning across all nations, are strongly impacted by the demographic and development implications of these varied fertility rates. Based on recent estimates (by UN-DESA-PD, 2019)[(5)], by the years 2030 and 2050 the global total fertility is projected to decline to 2.4 and 2.2 children per woman respectively. Whilst that of Africa fertility is expected to decline to 3.9 and 3.1 children per woman in the same projection years, and due to this slower rate of expected fertility drop in the continent, there has been significant population and development consequences for than in Asia, Latin America, and the Caribbean at comparable levels of fertility[(20)].

Previous research has revealed that HFR is associated with a wide range of factors. HFR is a severe public health issue globally, especially in developing nations like Ethiopia, whilst the factors causing the huge disparities are typically neglected[21]. On the other hand, research from published literature focusing on developing countries shows that early marriage, polygamous marriage, husband preference, rural living, low literacy, and restricted access to modern contraception are the most common risk factors[22-25].

Among the African countries, Ethiopia ranks second in population following Nigeria. The 2007 national population census cited the Ethiopian population as being 74 million, with a yearly growth rate of 2.6 percent[26] with annual population growth rate of 2.4 percent based on the UN-DESA, 2010-2015 Population Prospect report[20]. Ethiopia has a young population, with 45 percent of its population under the age of 15 years and only 4.8 percent age 60 years or older. Women within the reproductive years of 15-49 constitute 23 percent of the total population. These demographic indicators are mainly the results of past high fertility[26]. However, in the last few years, Ethiopia has been showing a decline in fertility. According to the 1990 National Family and Fertility Survey, the TFR of Ethiopia was 6.6 children per woman. However, this rate declined to 5.5 in 2000, 5.4 in 2005[27] and further to 4.8 in 2011[28]. Although showing a declining trend, like many African countries, the fertility rate of Ethiopia is still high. Therefore, this study aimed to analyze the trends and determinants of high fertility rate among reproductive-age women in Ethiopia.

1.3. Rationale of the study

The fertility level of Ethiopia is unacceptably and comparably high with significant disparities among urban and rural area portions of the nation. The higher the fertility of a woman, the more the risk associated with each childbearing process. In addition to her productive duty, women's reproductive roles placed them in low social and economic standing. Pregnancy and childbirth are 18 times more likely to result in a woman's death in underdeveloped nations like Ethiopia than in affluent nations[29]. It would be easier to develop strategies to successfully implement any program to address uncontrolled fertility and to improve the status of women if we understood the elements that influence the fertility level.

Therefore, this study attempted to visualize the existing fertility status and factors contributing to uncontrolled high fertility across our nation considering these realities and scenarios. It is crucial

to highlight the implications of current government initiatives for achieving the desired fertility status, notably the successful implementation of the costed implementation plan to lower Ethiopian women's overall fertility to 3.0. Additionally, this study will show where and how to concentrate on these pockets of high fertility.

The finding will help in examine the level and pattern of Ethiopia's fertility status and identify factors determining it and for possible and fruitful intervention can be designed. The generated information will support to health programmers, policy makers in designing targeted health and related intervention programs; that lead to improve maternity care utilization.

2. LITRATURE REVIEW

2.1. Overview of Global to Local Fertility Situation

The world's population increased from 2.5 billion in 1950 to around 7.7 billion in 2019, almost tripled the size over the last seven decades and even expected to continue to escalate until 2050/2100 consistent with most UN projection variants. Let's say the 'medium fertility' projection variant undertake across countries, global population might tend to grow about 9.7 billion by 2050 and rise further to 11.2 billion by 2100 and the median projected for Mid-African Countries (MAC) is more than 3.97 billion[12, 30]. However, if fertility and mortality rates stay at current levels (i.e. assuming the 'no change' projection variant), growth rates are projected to be substantially higher, with global population possibly rising to 10.2 billion by 2050 and 19.3 billion by 2100[5].

Likewise, population growth in Asia and especially Africa will account for a major portion of the estimated worldwide population rise. Under "average fertility" estimates, Africa's population is predicted to increase significantly and continuously, from 1.2 billion people now to roughly 4.5

billion by 2100, whereas Asia's population is anticipated to reach its peak by 2050. Besides, the Total Fertility Rate (TFR) was expected to have been high (over six births per woman) in all sub-regions of sub-Saharan Africa between 1950 and 2015, according to estimates. In Eastern and Western Africa, fertility was high until the 1980s, when it started to slowly fall, reaching 4.9 births per woman in Eastern Africa and 5.5 in Western Africa from 2010 to 2015[(4)]. High and slowly decreasing fertility resulted in the remarkable increase in the projected population of the great majority of the sub-Saharan (and hence Mid-African Countries) African countries[(31)]. The fertility decline in this region started nearly 20 years later compared to the rest of the developing countries[(12)] and, once begun, is estimated to have been one-fourth as fast as in Asia and Latin America at the equivalent demographic stage[(25)].

The global TFR was estimated 2.5 children per woman during the period between 2010-2015, but that of Africa's were 4.7 with disparities among its sub-regions (ranging from 5.9 to 2.5 births per woman, comparably higher in the Middle, Western, and Eastern Africa with 5.9, 5.5 and 4.9 in descending order, and slightly lower in Northern and Southern portion of the continent (with respective TFR of 3.4 and 2.5 births per woman)[(4)]. Total fertility levels ranged even more widely among the 20 countries in Eastern Africa, from 1.5 in Mauritius to 6.6 in Somalia. One additional country in Eastern Africa still had a fertility level above six in 2010–2015 (Burundi) and six countries had fertility between five and six births per woman (Malawi, Mozambique, South Sudan, Uganda, Tanzania, and Zambia). Eight countries had fertility levels between four and five births per woman. The lowest levels of fertility were in Djibouti (3.3 births per from 1950 to 2010, the world population increased from 2.5 billion to 6.9 billion, or by 174%. Growth from 1950 to 2010 was rapid—the global population nearly tripled, woman) and in the small island countries of Mauritius, Réunion, and Seychelles (less than three births per woman)[(4)].

Sub-Saharan African countries particularly have population growth rates that are outpacing their economic growth, with more than five children are born to each woman on average in this sub-region, which is more than twice as many as the global average of 2.5[(32)]. Fertility rates in more developed regions are below replacement levels, whereas those in least developed regions have five or more children per woman[(5)]. The greatest TFR in both Africa and the entire world is found in Niger. There were 7.4 children born to each woman overall. Young marriage exposes girls to the health hazards associated with having children while still adolescents. In Niger, one in seven females between the ages of 15 and 19 gives birth every year, and more than 70% of

women in their early 20s had married before the age of 18 . In South-Central Asia, the infant mortality rate had reached 82 per 1,000 live births, but in sub-Saharan Africa, it was still 148 per 1,000 live births. An estimated 585,000 women perish in underdeveloped nations every year as a result of complications with pregnancy, childbirth, and unsafe abortion. This equates to roughly one death per minute. In underdeveloped nations, pregnancy-related problems account for between 25% and 50% of mortality among women of reproductive age[33].

According to the Ethiopian Demographic and Health Surveys (EDHS) report, the TFR of nation declined from 5.5 children per woman in 2000 to 5.4 in 2005 and further to 4.8 children per woman in 2011[34].The trend shows an overall decline of about 11 percent or a drop of just less than one child per woman during the period between 2000 and 2011[35], but it is considered as high fertility rate when compared to developed countries, despite showing a downward trend like many other African countries[12, 17, 36]. Knowing the factors influencing women's fertility levels at the individual and community levels in the rural context of Ethiopia, where the majority of women reside, would help greatly in preventing deaths related to high fertility and thereby elevating the status of women at large. Maternal deaths related to childbearing are unacceptably high in our country[33]. Maternal mortality and morbidity rates in Ethiopia are among the highest in the world. The health of mothers and children is significantly impacted by unequal access to maternal health services and unplanned pregnancies[23, 37]. According to recent estimates, the nation still has higher rates of infant, maternal, and under-five mortality, with rates of 412 deaths per 100,000 people, 67 deaths per 1,000 live births, and 48 deaths per 1,000 live births, correspondingly[37].

The population of the world is increasing by roughly 80 million people a year. By the middle of the twenty-first century, there will be around 9.2 billion people on the earth if current trends continue. Almost every significant issue facing the globe today is related to the rapid population expansion. It encourages political instability, environmental deterioration, water scarcity, hunger and poverty, and health risks[38]. Planners, programmers, and policy makers are all concerned about the population's growth and decline, which is mostly influenced by fertility. The population growth of high-income nations has significantly lagged behind that of the developing world in recent decades. The poorest nations see the highest concentration of population growth rates, whereas the majority of wealthy nations experience the lowest rates of population growth.

The continent with the greatest fertility rate and fastest population growth is Africa. The majority of people in Africa are quite young[39].

Regarding the magnitude of high fertility rate, findings from community-based studies conducted in different parts of Ethiopia have revealed that HFR has been ranging from 28% to 70.8% which include in Sidama region [40], Gedeo Zone [22], Tigray region, Enderta district [41] and in Butajira district [42]. This figure was also fairly higher than the prevalence reported by other studies conducted abroad ranging from 9.4 % to 27% in Gambian, Tanzania, Cameroon, Nigeria, and India [31, 43), (44), (45), (46]. The fact that later studies were all carried out in health facilities and urban catchment areas could explain these low prevalence rates. The educational backgrounds, socioeconomic, sociodemographic, and cultural settings of these studies are different from the current findings [45].

Ethiopia has a TFR of 4.6 children per woman, ranking it as the 12th most populous nation in the world[47]. Although the fertility rate in Ethiopia has decreased noticeably, the changes have not been distributed uniformly among the various administrative regions of the nation[48]. While others are heading in the opposite direction, some regions have seen a decline in fertility, while the remaining regions have seen no change in the overall fertility rate[49]. This places the nation's overall fertility rate at the 14th highest level in the world[37]. In rural and urban areas, respectively, the TFR among women decreased from 6.0 children in 2000 to 5.2 children in 2016 and from 3.0 children in 2000 to 2.3 children in 2016[37, 50].

2.2. Factors Associated with High Fertility

Many different factors affect human fertility. A general division of them would be into proximate (direct) and distal (indirect) components. The later, distal determinants are socio-cultural factors, which consist of socio-economic and demographic factors, affect fertility indirectly by affecting the bio behavioral factors, whereas the proximal factors are bio-behavioral factors, known to be the intermediate determinants, are the biological, reproductive, and behavioral/attitude factors through which the indirect determinants must devour to affect fertility and affect fertility directly[24, 51, 52].

Studies conducted in many nations have uncovered varied reproductive disparities. Studies conducted in Bangladesh and Cambodia revealed that the use of contraceptives was a major contributor to changes in fertility[53, 54]. From its biological maximum of 19.10, marriage and

postpartum infecundity in Zambia accounted for the strongest inhibitory influence on natural fertility[24]. In the Philippines, fertility varies depending on the ethnic group, location, educational level, employment of women, and age at marriage. The usage of contraceptives and the wealth index were crucial in explaining the variations in fertility[42, 55]. According to research from Ghana, a woman's use of contraception, her marital status, and her postpartum infertility are all significant predictors of reproductive outcomes. Lower fertility rates were consistently linked to urban living and higher education levels[56].

The majority of the drop in fertility in Sub-Saharan Africa (SSA) can be attributed to rising unmarried female population rates and, to a lesser extent, rising contraceptive use rates[3]. A study conducted in SSA revealed the usage of contraceptives, post-partum amenorrhea, and non-marriage as significant contributors in reducing fertility. The study also identified background characteristics as determining determinants of fertility, such as planned number of children, national family planning effort, under-five mortality, degree of education, engagement of women in the workforce, and area of residence[17]. In Asia, induced abortion and marital patterns were significant factors in lowering female fertility[52].

Study conducted in identifying the proximate determinants of fertility [Laelago et al.][23] using the 2011 and 2016 EDHS found that, the total fertility rate in 2016 was calculated to be 4.14 children per woman. The findings of this study also showed variability in TFR across the selected background variables. Accordingly, the highest TFR, 8.1 children per woman, and the lowest TFR, 1.5 children per woman, were observed in Somalia and Addis Ababa regions, respectively in 2016. In this year, the highest TFR of 4.9 children per woman was seen in lowest wealth quintile and the lowest TFR of 1.8 children per woman in the highest wealth quintile. In relation to the participants' education, the highest TFR, 2.6 children per woman, and the lowest TFR, 1.8 children per woman, were observed among participants with primary education and higher education respectively in 2016. The TFR was 2.5 in rural and 1.5 in urban areas in this year. Delay in marriage and nonmarriage had an inhibitory effect on 37.8% of births in 2011, although it only contributed 34.4% to decreased fertility in 2016. In 2011 and 2016, respectively, the influence of contraception on fertility inhibition was 28.5 and 30.7% below its biological limit. Infertility following childbirth reduced overall fertility by 34.7% in 2011 and 34.5% in 2016. In both survey years, the index of fetal wasting had the same impact, inhibiting just 9.2% of all deliveries. According to the study prediction, Ethiopia's total fertility in 2020 will be 3.2.

At final, the study concluded that, the major factors restricting conception in 2011 and 2016, respectively, were the index of marriage and postpartum in-fecundability. While fetal wastage made the smallest contribution in both survey years, the index of contraceptives climbed from 28.5% in 2011 to 30.7% in 2016. Therefore, it is necessary to encourage the study participants to use contraceptives and breastfeed their babies[23].

A proper understanding of these factors are of paramount importance in tackling the problem of uncontrolled fertility, which paves the way for the improvement of the prevailing socioeconomic problems of the country. Particularly, it would have a substantial contribution in the improvement of the health status of women and children. It is plausible that they may be related to each other. To address the issue of uncontrolled fertility, which permits the convenient way for the improvement of the country's ongoing socioeconomic issues, a proper knowledge of these elements is of the utmost importance. It would make a significant improvement on the health status of mothers and children in particular, on which they could possibly be related to one another.

Based on these facts, it is clear that fertility analysis is necessary not only to comprehend the demographic makeup of a particular community but also because it has a significant impact on population well-being and influences public policy and the funding of the education and health systems. Fertility is a concern to policymakers, researchers, and government representatives since it can affect how development is planned in general. Health professionals are also interested in fertility because it has a significant impact on mothers' and children's health. For instance, having children too soon in life or having them too close together can endanger both the moms' and the children's survival. Because they give birth to children when they are physically and emotionally unprepared to be mothers, young women in many developing nations are at risk for complications related to maternal health. There are still nations that are suffering from the effects of early marriage and early childbearing, despite the fact that some countries have been successful in reducing the prevalence of early childbearing by keeping girls in school and changing local norms and national policies about early marriage.

2.3. Conceptual Framework on Determinants of High Fertility Status

The conceptual framework of the study was primarily developed based on peer-reviewed literatures that deals with the determinants of high fertility status as shown in figure1. The selected socio-economic and demographic factors in the model list the proximate as well as indirect determinant variables. These factors can also determine high fertility of reproductive-aged women.

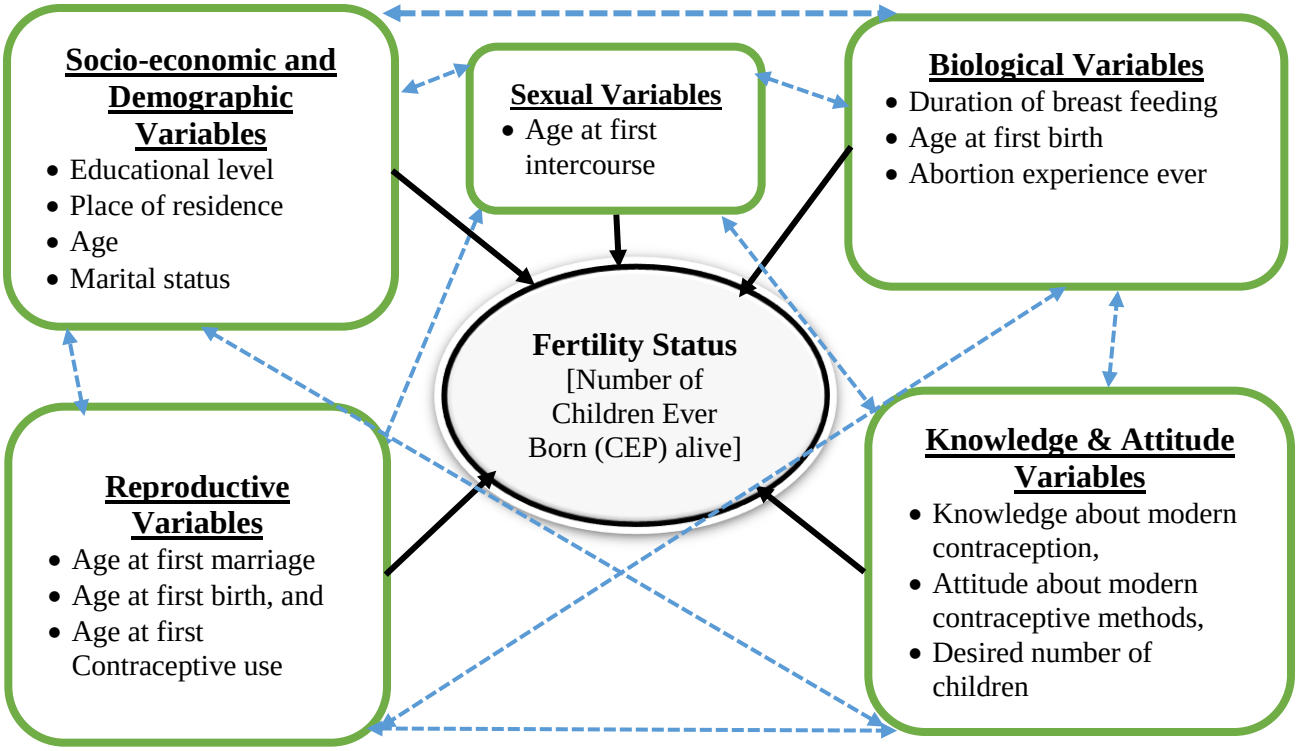


Figure-1: The theoretical conceptual framework showing the direct (proximal) and indirect (distal) factors affecting the fertility status of reproductive aged women adapted from Bongaart's (1982), "Natural Fertility and its Proximal Determinants" [1]

3. OBJECTIVES OF THE STUDY

3.1. General Objective

To examine the trends and explore the associated factors of high fertility rate among reproductive-age women in Ethiopia using data from the five rounds of Demographic and Health Surveys (DHS) carried out during the periods between 2000 to 2019.

3.2. Specific Objectives

- Examine the magnitude/level of high fertility rate among reproductive-age women in Ethiopia using the 2016 DHS.
- To examine the overtime trends of high fertility rate among reproductive-age women in the five consecutive Ethiopian Demographic and Health Survey (DHS) periods, i.e., 2000, 2005, 20ll, 2016 and 2019.
- Identify factors associated with high fertility status among reproductive-age women in Ethiopia.

4. METHOD AND MATERIALS

4.1. Study Setting and Period

According to the World Bank in 2018, Ethiopia is the second-most populous nation in Africa with about 109 million people and the fastest-growing economy in the region. Ethiopia is located

in the Horn of Africa. Ethiopia borders Eritrea, Somalia, Kenya, South Sudan, and Sudan. Ethiopia is landlocked[19]. Ethiopia is a Federal Democratic Republic composed of 12 National Regional states: namely Tigray, Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, Southern Nations Nationalities and People (SNNP), Gambella, Sidama, Southwest Ethiopia, and Harari; two administrative cities (Addis Ababa city administration and Dire Dawa city council). Addis Ababa is the capital city of Ethiopia and the headquarters of the African Union. Ethiopia covers 1,119,683 square kilometers with more than 79 % living in rural areas [21, 36, 37, 57-59]. Women of reproductive age (15 – 49 years) constituted about 25% of the estimated population. The total fertility rate was 4.2 and is estimated to decrease to 3.5 by 2020. The data for this study was extracted from July-August 2023.

Figure-2: Map of Ethiopia showing the regional states.

4.2. Study Design

Trend with cross sectional study design was conducted using DHS data in high fertility rate and its determinants among childbearing women in Ethiopia quantitatively analyzed by using the data sets of the five consecutive Demographic and Health Survey (DHS), including the 2000 [60], the 2005[61], the 2011[50], the 2016[37] and finally the 2019 (interim survey)[62]. In principle, the Ethiopia Demographic and Health Surveys (EDHS) were community-based, cross-sectional data

and distinctively this study used the retrospective birth history data from five rounds of the EDHS effected in the last two decades from 2000 to 2019.

4.3. Population

4.3.1. Source population

The source population included all women of age 15–49 years who were listed as the usual members and visitors of surveyed Households during last five rounds of DHS conducted on 2000, 2005, 20ll, 2016 and 2019 in Ethiopia.

4.3.2. Study population

The study population were all women of age 15-49 years who were identified as eligible at the DHS surveyed households and who entirely interviewed throughout the five-nation representative DHS of Ethiopia.

4.4. Eligibility Criteria

4.4.1. Inclusion criteria

- All eligible women of age 15-49 years who found at randomly selected and surveyed households and entirely interviewed throughout the study period were included in the study All reproductive-age group women who randomly all selected women childbearing in all regions and cities administrative included in the study.

4.4.2. Exclusion criteria

- Women who are mentally or critically ill and unable to communicate was excluded from an interview.
- Questionnaires of women with incomplete or missing information were excluded from the primary survey and this study as well.

4.5. Sample Size Determination

The preceding four DHS surveys were full-scale which conducted in 2000, 2005, 2011, and 2016. However, the 2019 EDHS were an interim survey. The sampling frame used for the EDHS is the frame of the Population and Housing Census (PHC) conducted in Ethiopia in 1984, 1994, and 2007 for each survey, respectively[21, 63]. The census frame is a complete list of

all census enumeration areas (EA). An EA is a geographic area that covers an average of 181 households.

Based on mentioned facts, a total of selected 645 enumeration areas (EAs) were included for the 2016 DHS, from which 202 EAs were urban and 443 EAs were rural areas [(37)]. The 2011 DHS, a whole of 624 EAs area were selected, out of these 187 EAs were included from urban and 437 EAs were included from rural[(50)]. The 2005 DHS consisted of a total of 540 EAs (145 from urban and 395 from rural were selected)[(61)]. Besides, the former DHS conducted in 2000 whole 539 EAs (401 from rural and 138 from urban)[(60)]. that of the 2019 mini-DHS were selected 303 EAs in total (93 EAs were urban and the rest 212 were rural areas)[(62)] (Table-1).

In this regard, the sampled households in the 2016 national representative survey were 16,650 (5,232 in urban areas and 11,418 in rural areas) were successfully enrolled with a response rate of 98%[(37)]. In 2011 DHS, the included sample size was 16,702 households were interviewed with a response rate of 98%[(50)]. In 2005 DHS, included the total sample size was 13,721 households[(61)]. Finally, in 2000 DHS included a representative sample was 14,072 with a response rate of 96%[(60)]. Furthermore, in 2019 EMDHS the total household were 8,794 with 99% of response rate reached (Table-1).

Thus, the total unweighted sample women enrolled in all the five rounds of EDHS were 193,994 and of these, those high fertility women were 129, 403. When look at the separate quantification of high fertility women were 30,853 in the 2000 DHS, 26,962 in the 2005 DHS, 30, 367 in the 2011 DHS, 26,720 in the 2016 DHS and finally in the 2019 Mini-DHS were 14,501 Table-1) [(37, 50, 60-62)].

Conclusively, the sample size used in this study were determined based on the analysis type. Such that, all women enrolled in all the five rounds of EDHS were used for the trend analysis (to address objective-2 of the study), whilst the total of 44,596 weighted sample of high fertility women who enrolled in the 2016 EDHS were separately used for analysis of the magnitude (objective-1) and associated factors of HFR (objective-3).

4.6. Sample Technique/ Procedure

4.6.1. Sampling Technique/ Procedure for the DHS Study

The EDHS often rely on the nearby Ethiopia Population and Housing Census (PHC) data for using it as a sampling frame and obtained a complete list of enumeration areas (EAs) created specific to each PHC. The census frame is a complete list of all census EAs which is a geographic area covering about 181 households on average. The sampling frame contains information about the EA location, type of residence (urban or rural), and estimated number of residential households.

The EDH surveys were intended to provide key indicators at the national and regional levels gathering up-to-date data from each of the 11 regions and the two administrative cities. Generally, the EDHS outlined two stages stratified random sampling technique. The stratification of each region into urban and rural areas end-up with 21 sampling strata. Samples of EAs were chosen independently in each stratum in two stages. A HH listing operation was carried out in all of the selected EAs prior to data collection.

In the first stage, a total EAs was selected with probability proportional to sample size and with independent selection in each sampling stratum. The selection of households was the second stage. A fixed number of households per cluster were selected with an equal probability proportional allocation to sample size was done.

Table-1: Determined Sample size in the five rounds of EDHS data with respect to application of the standard enrollment techniques, DHS 2000-2019 of Ethiopia

EDHS Period	Study participants per each survey			Total selected EAs			Total HHs reached
	Cases	Controls	Total study units	Urban	Rural	Total EAs	
DHS-2000	30,853	13,321	44,174	138	401	539	14,072
DHS-2005	26,962	12,919	39,881	145	395	540	13,721
DHS-2011	30,367	15,173	45,540	187	437	624	16,702
DHS-2016	26,720	14,672	41,392	202	443	645	16,650
DHS-2019	14,501	8,506	23,007	93	212	305	8,794
Grand Total	**129,403**	**64,591**	**193,994**	**765**	**1,888**	**2,653**	**69,939**

4.7. Data Collection Methods

4.7.1. Instruments and Data Source

The Demographic and Health Surveys (DHS) has endowed with a comprehensive overview of population, maternal, and child health issues as well as deliver sufficient estimates of key demographic and health indicators accordingly. In the last two decades, Ethiopia has so far had five DHSs conducted in 2000, 2005, 2011, 2016 and 2012, without ignoring to a one National Family and Fertility Survey (NFFS) which was done earlier in 1990.

The EDHS often used five questionnaires: the Household, the Woman's, the Man's, the Biomarker, and the Health Facility (only for EDHS 2016) questionnaires facility questionnaires[37, 50, 60-62]. It has standard questionnaires, to which adapted to reflect the population and health issues relevant to Ethiopia, primarily managed by the CSA of Ethiopia.

Thus, this study used the data collected from the women's questionnaires of the five surveys accordingly. These tools were prepared in English, they were translated into varies local languages.

This data was retrieved from the DHS program's official database website (http://dhsprogram.com/data/dataset_admin/login_main.cfm) through authorized access request from the concerned data owner. The DHS is well-known to be a nationally representative household survey that collects information about population, health and other important indicators, so that permit the estimation of the levels and trends of key demographic and health issues as well.

4.7.2. Training of the Research Assistants for EDHS

- Qualified and trained health professionals were recruited as data collectors and supervisors.
- Trainings were also provided for all data collectors, supervisors and quality controls teams of all levels [37, 50, 60-62].

4.7.3. Pre-test of the EDHS Study Instruments

- Qualified and trained health professionals were recruited as data collectors and supervisors.
- Trainings were also provided for all data collectors, supervisors and quality controls teams of all levels.

4.7.4. Field Work of the EDHS

- Demographic health survey data collection period for:
  - The first DHS from February to May 2000,
  - The second DHS from April to August 2005,
  - The third DHS from December 2010 to June 2011,
  - The fourth DHS from January to June 2016 and
  - The fifth Mini-DHS from February 27 to March 19, 2019, respectively
- The field workers for the DHS study consisted of supervisors, field editors, female and male data collectors and biomarkers, and a driver.
- The overall data collection was also supervised by staff from the minister of health (MoH) and Ethiopia public health institute (EPHI) and staff of the DHS program. This study data will be extracted from January 1 to June 30, 2023.

4.8. Operational definitions

- **High fertility status:** when the number of children ever born (CEB) from a woman is ≥5 at the time of the interview.
- **Children Ever Born (CEB)**: represents the number of all children ever born alive to a particular woman in her lifetime fertility experience by the time of the survey.

4.9. Data Management and Analysis

4.9.1. Outcome Variables for the DHS Study

The main outcome variables for the DHS study were high fertility rate women. These include all women who given above five children at the time of the interview. The percentage of high fertility women was calculated by dividing the number of women who had childbirth by the total number of childbirths given in the last five-year surveys.

4.9.2. Independent Variables for the DHS Study

The independent variables were categorized into two-level factors: individual-level and community-level factors.

- The individual-level factors include:
  - Age of study subjects,
  - Education level (categorized under no formal education, and have formal education)
  - Occupation,
  - Marital status,
  - Sex of household head,
  - Contraceptive utilization, unmet need of contraceptive, religion, place of previous birth, and space of birth.
  - Wealth index: (contained five groups: Poorest Poorer, Middle, Richer and Richest). A wealth index based on common items was constructed for the DHS data using a principal component analysis. The indicators used to create the wealth index (proxies of wealth indicators) were household facilities and assets such as whether the household owns a radio, a television, electricity, type of flooring of the household, toilet facility, drinking water facility, number of members per room in the household, and ownership of pack animals, cattle, sheep and goats.
- Community-level factors include:
  - Place of residence (urban and rural)
  - Geographical region including all eleven regional states: Tigray, Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, Southern Nations Nationalities and People (SNNP), Gambella, Sidama, Southwest Ethiopia, and Harari; two administrative states (Addis Ababa city administration and Dire Dawa city council) and,
  - Religion (Orthodox. Catholic, Protestant, Muslim and Others)

4.9.3. Analysis Methods

Completed DHS questionnaires were carefully coded, entered, and edited before analysis. The data analysis used the weighted samples to ensure the survey results will be representative of the national and regional level findings. Data analysis was conducted using STATA software (version 14; StataCorp, College Station, TX) and Statistical Packages for the Social Sciences (Version 22; IBM SPSS). Descriptive statistics like frequencies and percentages were used. The demographic characteristics of respondents and outcome variables had been compared across the five ordered surveys. The trends analysis of high fertility was assessed using the Extended Mantel-Haenszel Chi-square test for linear trend using the OpenEpi (version 3.01)- Response program. A P-value of less than 0.05 was used to declare a 95% significant probability of the existence of a trend. A P-value of less than 0.05 used to declare 95% significant factors. Multi-level logistic regression analysis techniques identified the determinants with high fertility. The final findings were measured using an adjusted odds ratio (AOR). Within the multilevel logistical regression analysis, four models were fitted for the result variable. The primary model (null or empty model) was fitted without explanatory variables. The second model (individual model), third model (community model), and fourth model (final model) variables were fitted for individual level, community-level, and each individual- and community-level variable respectively. The final model was used to check for the independent effect of the individual and community level variables on high fertility. To show cluster correlation within a model, the Intra-Cluster Correlation (ICC) was calculated. The Proportional Change in Variance (PCV) was also calculated to determine the predictive power of the variables included in each model. To identify the factors associated with high fertility, the model with the highest PCV value was used.

The model fitness was assessed using Akaike Information Criterion (AIC), the Bayesian information criterion (BIC), and the Likelihood Ratio (LR) test. The values for each model of AIC and BIC were compared, the lowest one assumed to be a better explanatory model[(64)]. Multicollinearity between the individual- and community-level variables was checked using the Variance Inflation Factor (VIF). The mean value of VIF < 10 was the cut-off point[(65)]. It was considered statistically significant if the P-values were less than 0.05 with the 95% confidence intervals.

4.10. Ethical Considerations

- Secondary data permission was obtained from DHS program (Institute Review Board of ICF International and the CDC) with Auth Letter_172594 (Annex-1).
- Ethical clearance letter was also obtained from Hawassa University College of Medicine and Health Sciences, Institutional Review Board (IRB Letter Ref. number: IRB/359/15 on Date: 09/07/2023) (Annex-2).

Data was collected after taking informed consent and all information will be kept confidential [37, 50]. For this specific research, permission obtained from the demographic and health survey program to access EDHS data after review of the submitted brief description of the study to the DHS program. The datasets were treated with the greatest confidentiality.

4.11. Plan of Dissemination

Finding will be presented at the academic meeting of Hawassa university, and the University College of medicine and health sciences. Results will be disseminated to the Ethiopia Minister of Health. Correspondingly, the findings will be presented during various national and international scientific conferences, seminars, and workshops. Finally, the finding of this study will be published in a reputable peer-reviewed journal.

5. RESULTS

5.1. Sociodemographic characteristics of study participants

In this study, a total weighted sample of 44,596 women was included in the analysis from the latest EDHS data (2016). The mean age (±SD) of the women was 35.3±7.5 years, with slightly over three-fourth (77%) of women were 30 and above years of age (aged greater than or equal to 30 years). Over four-fifth (88%)of women lived in a rural setting, with (81%) of them were illiterate (cannot read at all) and three-fourth (75%) of women have no formal education. Close to three-fifth (63%) of women were living under middle-to-low level of socio-economic status. Large proportion of the women were married (90.8%), with majority (79%) of them have number of unions for once (Table-2).

Table 2: Sociodemographic characteristics of study participants, based on data from 2016 Ethiopia demographic health and survey.

Individual and community	Categories	Weighted (No)	Weight (%)
Age of women (in years)	15-34	19,839	44.5
	35-49	24,757	55.5
	Mean ±SD	35.34±7.5	
Place of residence	Urban	5,174	11.6
	Rural	39,421	88.4
Regions	Tigray	2,971	6.66
	Afar	388	0.87
	Amhara	9,735	21.83
	Oromia	18,172	40.75
	Somali	1,706	3.82
	Benishangul	489	1.1
	SNNPR	9,890	22.18
	Gambela	100	0.22
	Harari	89	0.2
	Addis Ababa	868	1.95
	Dire Dawa	189	0.42
Educational level	No formal education	33,431	0.75
	Have formal education	11,165	0.25
Literacy status	Literate	8,644	19.38
	Illiterate	35,952	80.62
Wealth index	Poorest	9,566	21.45
	Poorer	9,241	20.72

	Middle	9,335	20.93
	Richer	9,374	21.02
	Richest	7,079	15.87
Religion	Orthodox	17,139	38.43
	Protestant	10,274	23.04
	Muslim	16,426	36.83
	Others	757	1.7
Current marital status	Other marital statuses	4,098	9.19
	Currently married	40,497	90.81
Polygamy/ number of other wives	No	34,472	85.12
	Yes	6,025	14.88
Number of unions for women	Once	35,298	79.4
	More than once	9,158	20.6
Current working status	No	30,494	68.38
	Yes	14,101	31.62
Women occupation status (by type)	Did not work	23,144	51.9
	Professionals/ employed	6,690	15
	Merchant	3,111	6.98
	Agriculture/Farmer	11650	26.12
Husband/Partner's educational level	Lack of formal education	21,748	53.7
	Primary education	14,528	35.87
	Secondary and above	4,221	10.42
Husband/Partner's occupation status (by type)	Did not work	3,536	8.73
	Professionals/ employed	4,039	9.97
	Merchant	4,434	10.95
	Agriculture/Farmer	27,176	67.11
	Others	1,313	3.24
Sex of household head	Male	36,429	81.69
	Female	8,166	18.31
Women supported by husband	No	28,001	69.14
	Yes	12,496	30.86
Community media exposure (combined)	No	30,087	67.47
	Yes	14,508	32.53

In this study, seven regional states and two city administrations were covered. A significant percentage of participants came from the Oromia region, accounting for around 18,172 (40%) and SNNPR region, accounting for approximately 9,890 (22%). Regarding the religion, near to three-fifth (61.5%) of them are Christians (both including the Orthodox, Protestants and Catholic) and 36.8% from the remaining were Muslims (Table-2).

5.2. Sexual and reproductive health characteristics

The mean age (±standard deviation) of women at first childbearing was 18.10 ± 3.36 years and at first coital exposure was 16±2.9 years. The women's mean number of living children was 5.02 with a ±2.23 standard deviation. About two-thirds (67.3%) of women had short birth intervals within or less than 36 months with mean interval was 34.12 ± 20.17 months. Among participants, a considerable proportion of women (47.6%) never utilized modern contraceptives. Nearly, one-out of ten women had experienced child death (11.7%) and/or have experienced abortion (11.8%) in the survey. Slightly more than three-fourths (73%) of women gave birth at home (Table 3).

Table 3: Fertility, sexual and reproductive health characteristics of study participants in Ethiopia, data from 2016 Ethiopia demographic health and survey.

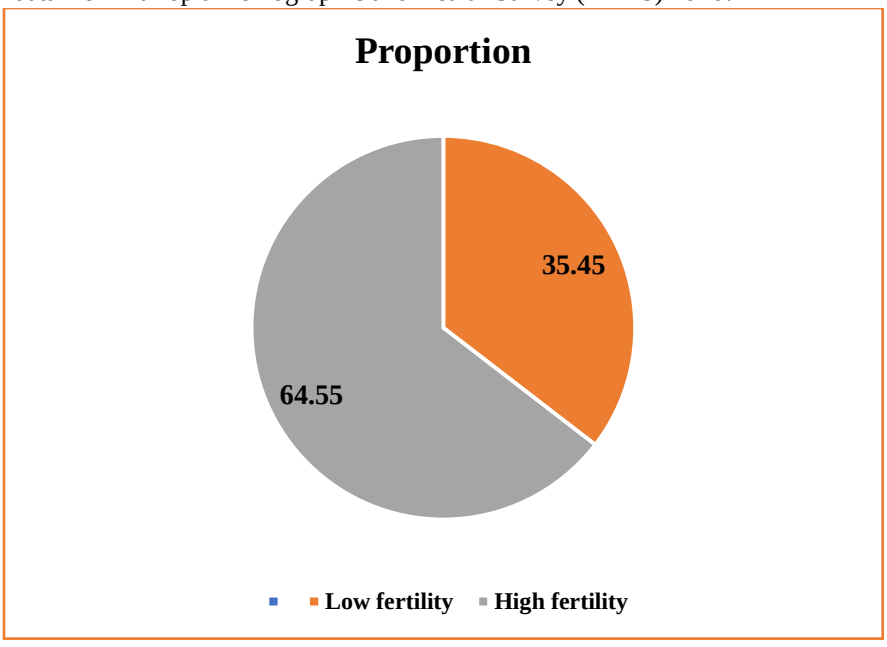
Individual-level variables	Categories	Weighted (No)	Weight (%)
Age of women at first birth	Less than18 years	26,780	61.59
	18 years and above	16,702	38.41
	Mean ±SD	18.10±3.36	
Age at first cohabitation	Age less than 20years	37,499	84.35
	Age 20 years or more	6,957	15.65
	Mean ±SD	16.33±3.67	
Age at first sex	Less than or equal to 18 years	36,688	84.38
	Greater than 18 years	6,794	15.62
	Mean ±SD	15.97± 2.91	
Number of living children	Mean ±SD	5.02 ±2.23	
Preceding birth interval (months)	Less than or equal to 36 months	22,863	67.3
	Greater than 36 months	11,088	32.7
	Mean ±SD	34.12 ± 20.17	
Marriage to first birth interval (months)	Before and 12 months later	14,908	33.53
	Between 13-24 months	13,578	30.54
	After 24 months)	15,970	35.92
	Mean ±SD	104.7 ± 264.9	
History/Pattern of contraceptive use	Ever used	23,388	52.44
	Never used	21,208	47.56
Unmet need of contraceptive	Unmet of contraceptive	10,716	0.24
	Met of contraceptive	26,507	0.60
	Infecund/Menopausal/Others	7,269	0.16

The desire for more children	Wants no more children	25,239	0.57
	Undecided	2,648	0.06
	Wants more children	16,709	0.37
Husband desire more child	Husband wants fewer	3,108	0.08
	Husband wants more	11,614	0.29
	Unsure/Undecided	14,361	0.36
	Both want more	11,126	0.28
Child is alive	No	5,217	11.7
	Yes	39,378	88.3
Ever experienced abortion	No	39,327	88.19
	Yes	5,269	11.81
Place of delivery	Home	7,997	0.73
	Health facilities	3,026	0.27

5.3. The magnitude of high fertility women

Based on the 2016 EHDS data, the grand prevalence of high fertility with the weighted sample was 64.6 % (95 % CI, 64.10 - 65.01), in the 5 years preceding the survey in Ethiopia (Fig.-3).

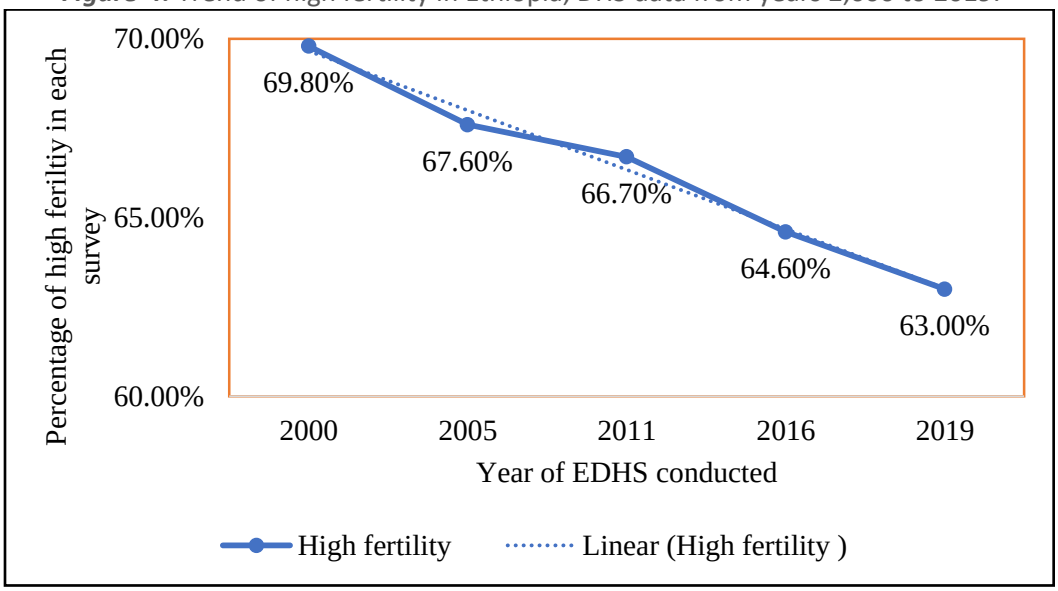
Figure-3: The magnitude of high fertility women in Ethiopia, data from Ethiopia Demographic and Health Survey (EDHS) 2016.



5.4. The trend of high fertility in Ethiopia

The proportion of high fertility in Ethiopia decreased from 69.80% in 2000 to 63.00% in the 2019 DHS. A considerable change in the high fertility trend from five surveys over a period of 18 years was observed (Extended Mantel -Haenszel chi-square for leaner trend= 430.84 and p-values <0.0000001). Likewise, analyzing the percent change in high fertility percentage change was observed between 2000 and 2019 EDHS in the Ethiopia (Fig 4).

Figure-4: Trend of high fertility in Ethiopia, DHS data from years 2,000 to 2019.



5.5. Bivariate variables' association with high fertility women

The bivariate analysis was applied to test for statistical association of individual and community variable with high fertility women in Ethiopia using the 2016 EDHS data. Regard to the residence, the rural dwellers (70.9%) was significantly advanced in high fertility women than in low fertility (38.7%), (P<0.001). Likewise, significantly high proportion of women with high fertility observed to those with lack of formal education (74.3%) than in the lower fertility (45.7%), (P<0.001). Uppermost proportion of high fertility women were both the poorest (73.9%) and richer (72.0%) status groups compared to others based on the wealth index (P<0.001).

Based on the pattern of contraceptive use, those who never used as well as who currently using short-acting family planning methods were significantly greater in proportion of high fertility women (74.3% and 57.8% respectively) than in low to intermediate fertility (P<0.001).

Amongst women with advanced fertility status, those in polygamous marriages (82.9%), were significantly higher compared with lower fertility, (p<0.001). The study result on level of desire for more children among both the women and their partner's, found an opposingly significant difference in between women who had no desire and husbands with high desire than the rest domains of interest (P<0.001). Likewise, significant association of high fertility were found with both the age of women at first sex, cohabitation, and birth, with short birth intervals, religion, husband education level, and with women who had been supported by husband (p<0.001).

However, no significant differences were observed between high and low fertility women concerning occupational status of women, place of delivery, current marital status and with number of unions more than once, (P> 0.05), (Table 4).

Table 4: Bivariate variables association of individual and community variable with fertility status of women in Ethiopia, data from EDHS 2016.

Individual and community Variables	Categories	Low Fertility Status No (%)	High Fertility Status No (%)	P-value
Age of women (in years)	Mean ±SD	29.67 ±6.97	38.11 ±6.01	P<0.001
Place of residence	Urban	3,173 (61.3)	2,002 (38.7)	P<0.001
	Rural	11,483 (29.1)	27,939 (70.9)	
Regions	Tigray	1,086 (36.5)	1,885 (63.5)	P=0.012
	Amhara	3,707 (38.1)	6,029 (61.9)	
	Oromia	5,552 (30.6)	12,620 (69.4)	
	SNNPR	2,761 (27.9)	7,129 (72.1)	
	Addis Ababa	712 (82.0)	156 (18.0)	
	Other Regions	839 (28.3)	2,122 (71.7)	
Educational status	Have formal education	8,595 (25.7)	24,836 (74.3)	P<0.001
	No formal education	6,060 (54.3)	5,105 (45.7)	
Religion	Orthodox	6,639 (38.7)	10,501 (61.3)	P<0.001
	Protestant	3,163 (30.8)	7,111 (69.2)	
	Muslim	4,582 (27.9)	11,844 (72.1)	
	Others	272 (35.9)	485 (64.1)	
Wealth index	Poorest	2,499 (26.1)	7,067 (73.9)	P<0.001

	Poorer	3,003 (32.5)	6,238 (67.5)	
	Middle	2,849 (30.5)	6,486 (69.5)	
	Richer	2,627 (28.0)	6,746 (72.0)	
	Richest	3,677 (51.9)	3,402 (48.1)	
Age at first sex (in years)	Mean ±SD	16.69± 3.36	15.64± 2.63	P<0.001
Current marital status	Never in union	119 (84.9)	21 (15.1)	P=0.061
	Married	12,794 (31.6)	27,704 (68.4)	
	Widowed	528 (27.8)	1,369 (72.2)	
	Divorced or separated	1,215 (58.9)	846 (41.1)	
Age at first cohabitation (in years)	Mean ±SD	17.19±4.09	15.92±3.40	P<0.001
Marriage to first birth interval (months)	Mean ±SD	89.1 ± 245.9	112.7 ± 271.9	P=0.0263
Current working status	No	9,531 (31.3)	20,964 (68.7)	P= 0.003
	Yes	5,125 (36.3)	8,976 (63.7)	
Polygamy/ number of other wives	No	11,717 (34.0)	22,755 (66.0)	P<0.001
	Yes	994 (17.1)	4,805 (82.9)	
Number of unions for women	Once	11,497 (32.6)	23,801 (67.4)	P = 0.739
	More than once	3,040 (33.2)	6,118 (66.8)	
History of abortion	No	13,197 (33.6)	26,130 (66.4)	P= 0.007
	Yes	1,459 (27.7)	3,810 (72.3)	
Women occupation status (by type)	Did not work	7,277 (31.4)	15,867 (68.6)	P=0.395
	Professionals/ employed	2,728 (40.8)	3,962 (59.2)	
	Merchant	1,287 (41.4)	1,824 (58.6)	
	Agriculture/Farmer	3,363 (28.9)	8,287 (71.1)	
Husband/Partner's educational level	Lack of formal education	5,684 (26.1)	16,064 (73.9)	P<0.001
	Primary education	4,733 (32.6)	9,795 (67.4)	
	Secondary and above	2,274 (58.0)	1,647 (42.0)	
Husband/Partner's occupation status (by type)	Did not work	1,001 (28.3)	2.535 (71.7)	P=0.023
	Professionals/ employed	1,687 (41.8)	2,352 (58.2)	
	Merchant	1,761 (39.7)	2,673 (60.3)	
	Agriculture/Farmer	7,781 (28.6)	19,395 (71.4)	
	Others	564 (42.9)	749 (57.1)	
Sex of household head	Male	3,117 (38.2)	5,049 (61.8)	P=0.001
	Female	11,539 (31.7)	24,891 (68.3)	
Age of women at first birth	Mean ±SD	19.12±3.80	17.60±3.01	P<0.001
Preceding birth interval (months)	Mean ±SD	41.29 ±26.68	31.76 ±17.11	P<0.001
Current contraceptive use (by method)	Not using any methods	8,961 (28.7)	22,262 (71.3)	P<0.001
	Short-acting methods	3,921 (42.2)	5,376 (57.8)	
	Long-acting methods	1,774 (43.5)	2,303 (56.5)	

History/Pattern of contraceptive use	Never used Ever used	5,652 (26.6) 9,004 (38.5)	15,556 (73.4) 14,384 (61.5)	P<0.001
Unmet need of contraceptive	Unmet need Met need Infecund/Menopausal/Others	2,543 (22.9) 9,820 (40.7) 2,293 (24.4)	8,538 (77.1) 14,317 (59.3) 7,085 (75.6)	P=0.007
Women desire for more children	Wants no more children Undecided Wants more children	5,097 (20.2) 8,806 (52.7) 753 (28.4)	20,142 (79.8) 7,902 (47.3) 1,896 (71.6)	P<0.001
Husband/Partner's desire more child	Husband wants fewer Husband wants more Unsure/Undecided Both want more	979 (31.5) 3,026 (26.1) 5,532 (38.5) 3,233 (29.1)	2,129 (68.5) 8,588 (73.9) 8,829 (61.5) 7,893 (70.9)	P<0.001
Women supported by husband	No Yes	7,367 (26.3) 5,426 (43.4)	20,634 (73.7) 7,070 (56.6)	P<0.001
Community media exposure	No Yes	8,878 (29.5) 5,777 (39.8)	21,209 (70.5) 8,731 (60.2)	P=0.009
Place of delivery	Home Health facilities	3,980 (49.8) 2,290 (75.7)	4,017 (50.2) 735 (24.3)	P=0.075

5.6. Factors Associated with High Fertility Status of Study Participants

This study executed a two-level mixed effect multivariable logistic regression (MLR) using the data obtained from 2016 EDHS that is aimed at detecting individual and community-level determining factors of high fertility women or women having five or more number of children ever born. The four models of MLR were primarily developed to investigate factors with controlling the effects of possible confounders consequently. According to random-effect analysis; Model-I (null model) had no individual- and community-level variables, and it observed only the random and intercept variables. In the Model-I, the ICC value was 35%. This indicates that the variation on the rate of high fertility occurred at the community level (between-cluster variability) and is contribute to the community-level factors. The ICC in the null model greater than zero designates that it directed the researcher to use multilevel modeling than the standard single-level regression model. Also, results in subsequent models, between cluster variability were found to be 35.8% in Model II (individual-level factors), 18.4% in Model III (communities level factors), and 30.0% in Model IV (combined individual and community level factors). In another way, the proportional change in variance (PCV) results indicated that the

predictor variables to the null model better explained the factors associated with high fertility. The PCV finding for Model-II was (19.6%), for Model-III was (5.4%) and Model-IV was (23.4%). The final Model (combined individual and community level factors) indicated that 23% of the community-level variation on high fertility rates was explained by the combined factors at both the individual and community levels. Therefore, the result in this study was reported based on Model IV (combined individual and community level factors were fitted simultaneously).

Thus, after controlling for the effects of possible confounders, maternal current age category, place of residence, age at first birth as well as at first cohabitation and coital start, preceding birth interval, mother's education, polygamous marriages, desire for more children, religion, both husband's educational and occupational statuses history of contraception, unmet need of contraceptives, sex of household head, history of abortion and poorer status of wealth index were significantly associated with advanced fertility status according to Model IV findings (Table 5). As it is literally expected, women in the older age group were more likely to have more children compared to younger women [AOR=24; 95 % CI: 21.52 - 26.93].

The odds of high fertility compared to low fertility were 3.90 times [AOR=3.90; 95 % CI: 2.85 - 5.34] higher among women who were the rural dwellers than urban. Comparatively, nearly over double odds of advanced fertility were found with women of age less than or equal to 18 years at first birth [AOR=2.70; 95 % CI: 2.44 - 3.00] and on those women of age less than 20 years at first cohabitation [AOR=2.42; 95 % CI: 2.11 - 2.78] respectively.

The odds of advanced fertility were 2 times [AOR=2.21; 95 % CI: 1.93 - 2.53] higher among women who were uneducated compared with women who were educated. Women with preceding birth interval of less than or equal to 36months had 2.36 times higher odds of high fertility than those with more than 3years of interval in prior birth [AOR=2.36; 95% CI: 2.17 - 2.56]. The odds of high fertility compared to those with low fertility status women who never used any contraceptive method in their lifetime were 1.38 times higher compared to those women ever used family planning [AOR=1.38; 95% CI: 1.24 - 1.53].

The odd of high fertility was one and a half (1.47) times higher for those who were in polygamous marriages compared to those in monogamy [AOR=1.47; 95% CI: 1.30 - 1.65]. In addition, the likelihood of high fertility was 72% less likely to have met contraceptive compared to those women who have unmet contraceptive [AOR=0.28; 95% CI: 0.09 - 0.93].

Women whose husbands who with no formal education and with primary education had 1.89 [AOR=1.89; 95% CI: 1.61 - 2.22] and 1.76 [AOR=1.76; 95% CI: 1.51 - 2.05] times higher odds of having high fertility respectively compared to those who attended secondary schools and above (Table 5).

Table 5: Multilevel logistic regression model of individual and community-level factors associated with high fertility women in Ethiopia using data from the 2016 EDHS.

Individual- and community-level variables	Model 1	Model 2	Model 3	Model 4
	Empty (Null) model	Individual-level variables AOR (95% CI)	Community-level variables AOR (95% CI)	Individual- and community-variables AOR (95% CI)
Maternal age in year				
15-34		Ref.		Ref.
35-49		23.36(20.89 - 26.12)***		24.07(21.52 - 26.93)***
Educational level				
Have formal education.		Ref.		Ref.
Lack of formal education		2.26(1.97 - 2.58)***		2.21(1.93 - 2.53)***
Wealth index combined.				
Poorest		1.74(1.43 - 2.13)***		1.09(0.88 - 1.35)
Poorer		1.04(0.85 - 1.26)		0.68(0.55 - 0.83)***
Middle		1.29(1.07 - 1.56)**		0.86(0.70 - 1.05)
Richer		1.48(1.23 - 1.77)***		1.02(0.84 - 1.24)
Richest		Ref.		Ref.
Literacy status				
Literate		Ref.		Ref.
Illiterate		1.37(1.18 - 1.59)***		1.28(1.10 - 1.49)**
Age at first sex				
Less than or equal to 18 years		1.347(1.17 - 1.53)***		1.33(1.16 - 1.53)***
Greater than 18 years		Ref.		Ref.
Marriage to first birth interval				
Prior to marriage to 12 months later		1.51(1.36 - 1.67)***		1.52(1.37 - 1.69)***
Between 13-24 months		1.06(0.96 - 1.17)		1.06(0.96 - 1.17)
After 24 months		Ref.		Ref.
Age (in years) at first cohabitation				
< 20		2.46(2.15 - 2.83)***		2.42(2.11 - 2.78)***
20 or more		Ref.		Ref.
Working status				
Not working		Ref.		Ref.
Woking		1.02(0.93 - 1.13)		1.04(0.95 - 1.14)

Polygamy/ number of other wives				
No		Ref.		Ref.
Yes		1.52(1.35 - 1.72)***		1.47(1.30 - 1.65)***
Husband education level				
Lack of formal education		2.05(1.75 - 2.40)***		1.89(1.61 - 2.22)***
Primary education		1.93(1.66 - 2.25)***		1.76(1.51 - 2.05)***
Secondary education and above		Ref.		Ref.
Husband occupation status				
Did not work		1.40(1.18 - 1.66)***		1.31(1.10 - 1.56)**
Professionals		1.51(1.28 - 1.77)***		1.37(1.17 - 1.62)***
Merchant		Ref.		Ref.
Agriculture/Farmer		1.42(1.24 - 1.63)***		1.29(1.13 - 1.49)***
Others		0.88(0.72 - 1.09)		0.83(0.67 - 1.02)
Sex of household head				
Female		Ref.		Ref.
Male		1.30(1.16 - 1.46)***		1.30(1.16 - 1.46)***
Age of women at first birth				
Less than or equal 18 years		2.73(2.46 - 3.02)***		2.70(2.44 - 3.00)***
Greater than18 years		Ref.		Ref.
Preceding birth interval (months)				
Greater than 36 months		Ref.		Ref.
Less than or equal to 36 months		2.42(2.22 - 2.63)***		2.36(2.17 - 2.56)***
Pattern of contraceptives used				
Ever used		Ref.		Ref.
Never used		1.45(1.31 - 1.61)***		1.38(1.24 - 1.53)***
Unmet need of contraceptive				
Unmet		Ref.		Ref.
Met		0.29(0.09 - 0.93)***		0.28(0.08 - 0.93))***
Infecund/Menopausal		0.37(0.32 - 0.43)***		0.38(0.32 - 0.43)***
Women desire more child				
Wants no more children		3.40(3.09 - 3.75)***		3.48(3.15 - 3.84)***
Undecided		1.95(1.63 - 2.35)***		1.96(1.63 - 2.36)***
Wants more children		Ref.		Ref.
Husband desire more child				
Husband wants fewer		1.20(1.01 - 1.42)*		1.20(1.01 - 1.42)*

Husband wants more		1.24(1.12 - 1.38)***		1.24(1.12 - 1.37)***
Unsure/Undecided		1.16(1.04 - 1.28)**		1.15(1.03 - 1.27)**
Both want more		Ref.		Ref.
Women supported by husband				
No		1.04(0.95 - 1.14)		1.042(0.951,1.142)
Yes		Ref.		Ref.
Community media exposure (combined)				
No		1.04(0.94 - 1.16)		1.02(0.92 - 1.13)
Yes		Ref.		Ref.
Regions				
Tigray			Ref.	Ref.
Amhara			0.69(0.50 - 0.93)*	0.28(0.18 - 0.44)***
Oromia			0.84(0.62 -1.15)	0.48(0.30 - 0.76)**
SNNPR			1.13(0.82 - 1.55)	0.88(0.55 - 1.41)
Addis Ababa			0.25(0.17 - 0.37)***	0.16(0.09 - 0.30)***
Other Regions			0.75(0.58 - 0.97)*	0.54(0.37 - 0.80)**
Place of Residence				
Urban			Ref.	Ref.
Rural			4.69(3.90 - 5.63)***	3.90(2.85 - 5.34)***
Random effect				
Community-level variance (SE)	1.84***(0.19)	1.48***(0.13)	1.74***(0.14)	1.41***(0.12)
ICC (%)	35.1%	35.8%	18.4%	30.0%
MOR	3.64	3.10	2.27	3.53
PCV	Reference	19.57%	5.43%	23.37%
Model fit statistics				
Log-likelihood	-23807	-9768	-23550	-9645
AIC	47618	19610	47123	19381
BIC	47635	19915	47218	19760

Note: *significant at *P < 0.05; ** P < 0.01; *** P < 0.001; AOR =Adjusted Odds Ratio, CI =Confidence Interval, AIC =Akaike information criterion, BIC =Bayesian information. criterion, Model 1-Empty (null) model; Model 2- Only individual-level explanatory variables included in the model; Model 3-Only community-level explanatory variables included in the model; Model 4-Combined model; PCV= Proportional Change in Variance, MOR= Median Odds Ratio and Ref.=reference.

6. DISCUSSION

Six-to-seven out of ten of Ethiopian women in reproductive-age group designated as high fertility having had more than or equal to five children ever-born. The findings of this study suggest that several factors are contributing to high fertility in Ethiopia. These factors include individual and community factors. Of these factors, current maternal age, literacy status of women, age of women at first birth and at first marriage, residence, pattern of modern contraception utilization, preceding birth interval, religion, polygamy, husband education level, and unmet need for contraceptives were significantly associated with women having high fertility.

Throughout the analysis, the ICC value in the combined Model was found to be 30.0%. This indicates that 30.0% of the chances of high fertility women were explained through cluster differences of the 2016 EDHS. The value of the ICC in the null model greater than "zero" indicates that it directed the investigator to use multilevel modeling than the standard single-level regression model [(64), (40), (66)]. Similarly, the study indicates that the proportion change in variance (PCV) of the final model was accountable for about 23.4% of the log odds of high fertility in the communities. Furthermore, the results of the median odds ratio, a measure of unexplained cluster heterogeneity of in models 1, 2, 3, and 4 are 3.64, 3.10, 2.27, and 3.53, respectively. Hence, the results of the median odds ratio showed that there is unexplained variation between the clusters of the community.

In this study, the magnitude of high fertility was 64.6% (95 % CI, 64.1 - 65.0). This figure is significantly almost similar compared to other findings from community-based studies conducted in different parts of Ethiopia, which include in Sidama region 70.8% [(40)], and Gedeo Zone 69% [(22)]. Nevertheless, it is higher compared to other findings from nation-wide studies including a study from Tigray region, Enderta district (51%) [(41)] and Butajira district (28%) [(42)]. This figure was also fairly higher than the prevalence reported by other studies conducted abroad ranging from 9.4 % to 27% in Gambian, Cameroon, Nigeria, Tanzania, and India [(43), (44), (45), (46)]. The fact that later studies were all carried out in health facilities and urban catchment areas could explain these low prevalence rates. The educational backgrounds, socioeconomic, sociodemographic, and cultural settings of these studies are different from the current findings [(45)].

The overall trends of high fertility over the study periods showed significant declining change in proportion. This finding was consistent with a previous study done in Tanzania [45]. This significant drop in reproductive health outcomes may have been attributed to factors such as women's access to higher education, heightened public knowledge of the health risks of giving birth at an advanced maternal age, the advantages of family planning, and empowerment of women in reproductive health decision-making[45].

Different sociodemographic and reproductive characteristics have been indicated to be associated with high fertility in these studies. Among which are early marriage, first birth at early age, and the perceived ideal number of children [22]. The prevalence of high fertility has comparatively increased in the current study although evidences showed significantly declined trend in developed countries ranging from 3 to 4 % [45], and this could be described by lack of formal education (75.0%) and a high number of early marriages (84.4%) which is consistent with findings from other studies [17],[24],[55],[56].

In the present study, the higher proportion of the women were rural dwellers (88.4%) and high fertility also showed a strong association to rural residency. It is logically believed that women dwelling in the urban area engage early and stay longer in school, thereby delaying the time for marital engagement [22]. In this context, due to the high resource demanding routine life in agrarian resides and compared to the persistent belief of the rural community which considers the family with a large number of children as a blessed family may result in ambition among rural couples to have an increased number of children. This is consistent with previous studies done in the case of Butajira [42], Ghana [22], and Nepal [46].

One of the main sociodemographic characteristics of a woman's exposure to teenage pregnancy is her age of childbearing. Regarding the current study, early marriage is found to be a common phenomenon as also suggested by the result showing that over four-fifth (84.4%) of the women that participated in this study had their first birth before 18 years of age. Women who gave their first birth at the age of 18 year and above were more likely to have fewer children than those who gave their first birth at an earlier age (67.6% of the total women with high fertility). So that, anyone can realize that in the study community where women start birth before 18 years, the period of fertility is longer, and they have high number of children ever born. This phenomenon is particularly serious in rural set-up of the nation where a large number of the women have poor

knowledge of contraceptive methods with low utilization rates. This finding is similar with previous studies done in Gedeo [22], Kersa district [67], Enderta district [40], Nigeria [68], Namibia [69], and Ghana [22]. However, the issue of early childbearing is considerably alarming in the current study area than the findings from those areas.

Furthermore, this study also revealed that high fertility is significantly associated with polygamous marriage compared with monogamous marriage, on which the finding is similar to other studies conducted in Nigeria[68]. The variation could be due to competition amongst wives to have many children and to build large family sizes.

The likelihood of high fertility was less likely to literate women compared to those illiterates and this finding is in line with previous studies conducted in Nigeria [68], Kenya[70], Nepal[71], and the Tigray [41] and Sidama regions in Ethiopia[40]. On the other hand, researchers found that education is an important factor for high fertility, with several causal relationships from a theoretical perspective [29]. To sum up, education generally results in an improvement in the status of individuals in society in the form of a better understanding of health issues, and employment status [29]. The low social class found among the high fertility women is usually associated with illiteracy and low socioeconomic status, which may be an encouraging factor to produce more children[17],[24].

Women of the reproductive age group having a short birth interval (less than or equal to 36 months) were at higher risk of having high fertility as compared to those with a birth interval more than or equal to 36 months. This finding is also consistent with a study conducted in Wonago District, Gedeo Zone[22]and in Sidama region [40], Ethiopia. Correspondingly, women not using modern family planning appropriately and timely for spacing and limiting the number of births have high fertility. The earlier research conducted in the Sidama region [40] and Gedeo Zone, Ethiopia [22] , Nigeria [68], Nepal [71], and Pakistan (72) is comparable to this one. However, compared to earlier findings, the issue of early age at first birth is noticeably more concerning in the current research area. More generally, the majority of the determinants in this study are either directly or indirectly linked to the poor usage of contraceptives, suggesting that this is the main reason behind the high fertility rate in the research environment. Furthermore, in a particular study, the women did not take contraceptives since their husbands did not give them the freedom to make contraception decisions [54].

7. CONCLUSSIONS

The finding of this study implies that sixty-five out of hundred women in this survey reported having had high fertility, and the magnitude and trend did also show significant change during the last two decades. High fertility was associated with early marriage and early ages of childbearing, lack of formal education, low use of family planning, polygamous marriage status, short birth intervals, and unmet family planning needs that needs public health attention.

8. RECOMMENDATIONS

Based on the major findings, this study has a few implications for policy makers, stakeholders and health service practitioners across all levels:

- ✓ The FMOH needs to continue its efforts to promote family planning (FP) and reduce fertility. This can be done by increasing access to contraception, providing information about FP, and empowering women to make decisions about their own fertility.
- ✓ The government needs to invest in education and healthcare. Education and healthcare are essential for reducing fertility and improving the lives of women and children.
- ✓ The government needs to address the economic needs of families. This can be done by creating jobs and providing social assistance to poor families.
- ✓ Special attention should also be given at all levels on improving the Adolescents and Youth Sexual and Reproductive Health (AYSRH) services focused on rural settings
- ✓ Intersectoral collaboration on preventing early marriage prevalence among the vulnerable communities.

9. Strengths and Limitations of this study

One of the study's strengths was its analysis of the most recent nationally representative data sets, which helped to paint a comprehensive picture of the high fertility in the study setting and identified important variables that predicted the number of children born to women in the reproductive age range. Furthermore, using a mixed modeling technique, clustering effects were taken into consideration in order to prevent misleading conclusions and, consequently, proper interpretation of the data. The study may have had recall bias despite the aforementioned

strengths because participants were asked about incidents that happened five years or more prior to the survey. In addition, the researcher employed secondary datasets; nonetheless, his capacity to choose exposure factors for statistical analysis was constrained.

10. Reference

1. Bongaarts J. Natural fertility and its proximate determinants. Fertility, Biology and Behavior. 1982:21-51.
2. Frank O. The demography of fertility and infertility (2023).
3. Madhavan S. An analysis of the proximate determinants of fertility in sub-Saharan Africa with a focus on induced abortion: Johns Hopkins University; 2014.
4. Gerland P, Biddlecom A, Kantorová V. Patterns of fertility decline and the impact of alternative scenarios of future fertility change in sub-Saharan Africa. Population and Development Review. 2017;43:21-38.
5. United Nations DoeasaU-D. United Nations, Department of economic and social affairs, population division. World population prospects 2019: highlights. Accessed 22/11/2019). Retrieved from: https://population. un. org/wpp …; 2019.
6. Adugna A. Ethiopian Demography and Health: A Brief Introduction. 2014.
7. Ezra M. Demographic responses to environmental stress in the drought-and famine-prone areas of northern Ethiopia. International Journal of Population Geography. 2001;7(4):259-79.
8. Short SE, Kiros G-E. Husbands, wives, sons, and daughters: Fertility preferences and the demand for contraception in Ethiopia. Population Research and Policy Review. 2002;21(5):377-402.
9. Dana DD. Binary logistic regression analysis of identifying demographic, socioeconomic, and cultural factors that affect fertility among women of child bearing age in Ethiopia. Science Journal of Applied Mathematics and Statistics. 2018;6(3):65.
10. Jara D, Dejene T, Taha M. Determinants of high fertility status among married women in Gilgel Gibe Field Research Center of Jimma University, Oromia, Ethiopia: a case control study. Public health research. 2013;3(2):9-17.
11. Chowdhury S. Determinants and consequences of high fertility: a synopsis of the evidence: World Bank; 2010.
12. Economic UNDo, Division SAP. World fertility patterns 2015–data booklet (ST/ESA/SER. A/370). United Nations New York; 2015.
13. Barro RJ. Determinants of economic growth: A cross-country empirical study. National Bureau of Economic Research Cambridge, Mass., USA; 1996.
14. Mahy M. Childhood mortality in the developing world: DHS comparative reports. 2003.
15. Chen LC, Gesche MC, Ahmed S, Chowdhury A, Mosley WH. Maternal mortality in rural Bangladesh. Studies in family planning. 1974;5(11):334-41.
16. DaVanzo J, Razzaque A, Rahman M, Hale L, Ahmed K, Khan MA, et al. The effects of birth spacing on infant and child mortality, pregnancy outcomes, and maternal morbidity and mortality in Matlab, Bangladesh. Technical Consultation and Review of the Scientific Evidence for Birth Spacing. 2004;4(7).
17. Johnson K, Abderrahim N, Rutstein SO. Changes in the direct and indirect determinants of fertility in sub-Saharan Africa: ICF Macro; 2011.
18. Goldie SJ, Sweet S, Carvalho N, Natchu UCM, Hu D. Alternative strategies to reduce maternal mortality in India: a cost-effectiveness analysis. PLoS medicine. 2010;7(4):e1000264.
19. World Bank. The World Bank In Ethiopia. 2019.
20. Nations U. World fertility patterns 2015: Data booklet (ST/ESA/SER. A/370). Population Division, Department of Economic and Social Affairs, United Nations; 2015.

21. Central Statistical Agency CSA/Ethiopia. Census of Population and Housing. Csa.gov.et. 2017-02-22. Retrieved 2019-11-20. 1984.
22. Reda MG, Bune GT, Shaka MF. Epidemiology of high fertility status among women of reproductive age in Wonago district, Gedeo Zone, Southern Ethiopia: a community-based cross-sectional study. International Journal of Reproductive Medicine. 2020;2020.
23. Laelago T, Habtu Y, Yohannes S. Proximate determinants of fertility in Ethiopia; an application of revised Bongaarts model. Reproductive health. 2019;16(1):1-9.
24. Chola M, Michelo C. Proximate determinants of fertility in Zambia: Analysis of the 2007 Zambia Demographic and Health Survey. International Journal of Population Research. 2016;2016.
25. Bongaarts J, Casterline J. Fertility transition: is sub-Saharan Africa different? Population and development review. 2013;38(Suppl 1):153.
26. CSA (2008) A, Addis, Commission PC. Summary and statistical report of the 2007 population and housing census. population size by age and sex. 2008.
27. Teller C, Hailemariam A. The demographic transition and development in Africa: Springer; 2011.
28. CSA I. Central statistical agency [Ethiopia] and ICF International: Ethiopia demographic and health survey. Addis Ababa (Ethiopia): Central Statistical Agency [Ethiopia] and ICF International. 2011.
29. McCrary J, Royer H. The effect of female education on fertility and infant health: evidence from school entry policies using exact date of birth. American economic review. 2011;101(1):158-95.
30. Gerland P, Raftery AE, Ševčíková H, Li N, Gu D, Spoorenberg T, et al. World population stabilization unlikely this century. Science. 2014;346(6206):234-7.
31. Andreev K, Kantorová V, Bongaarts J. Demographic components of future population growth. Population Division Technical Paper. 2013(2013/3).
32. Bureau PR. The World's Women and Girls 2011 Data Sheet: Population Reference Bureau; 2011.
33. Organization WH. Trends in maternal mortality: 1990-2015: estimates from WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division: World Health Organization; 2015.
34. EDHS-2011. The Ethiopian Demographic and Health survey central statistical agency Addis Ababa. Ethiopia ICF International Calverton, Maryland, USA. 2011:180-6.
35. Gebreselassie T. The Fertility Transition in Sub-Saharan Africa, 1990–2005: How Unique Is Ethiopia? The Demographic Transition and Development in Africa: Springer; 2011. p. 19-44.
36. Central Statistical Agency. The 2007 Population and Housing Census of Ethiopia: Statistical Report for Southern Nations, Nationalities and Peoples' Region; Part I: Population Size and Characteristics. 2010
37. Central Statistical Agency (CSA) [Ethiopia] and ICF. Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF. Rockville, Maryland, USA; 2016.
38. Walker R. Demographic Vulneratility: Where Population Growth Poses the Greatest Challenges: Population Institute; 2015.
39. Bremner J, Frost A, Haub C, Mather M, Ringheim K, Zuehlke E. World population highlights: Key findings from PRB's 2010 world population data sheet. Population Bulletin. 2010;65(2):1-12.
40. Dasa TT, Okunlola MA, Dessie Y. Multilevel analysis of grand multiparity: Trend and its determinants in the Sidama National Regional State of Ethiopia: a cross-sectional study design from demographic and health survey 2000–2016. BMJ Open. 2022;12(8):e061697.

41. Atsbaha G, Hailu D, Berhe H, Slassie A, Yemane D, Terefe W. Determinants of high fertility among ever married women in Enderta district, Tigray region, Northern Ethiopia. J Health Med Informat. 2016;7(5):243-8.
42. Mekonnen W, Worku A. Determinants of low family planning use and high unmet need in Butajira District, South Central Ethiopia. Reproductive health. 2011;8:1-8.
43. Ajong AB, Agbor VN, Simo LP, Noubiap JJ, Njim T. Grand multiparity in rural Cameroon: prevalence and adverse maternal and fetal delivery outcomes. BMC pregnancy and childbirth. 2019;19(1):1-7.
44. Omole-Ohonsi A, Ashimi A. Grand multiparity: obstetric performance in Aminu Kano teaching hospital, Kano, Nigeria. Nigerian journal of clinical practice. 2011;14(1).
45. Idoko P, Nkeng G, Anyawu M. Reasons for current pregnancy amongst grand multiparous Gambian women-a cross sectional survey. BMC pregnancy and childbirth. 2016;16(1):1-6.
46. Muniro Z, Tarimo CS, Mahande MJ, Maro E, Mchome B. Grand multiparity as a predictor of adverse pregnancy outcome among women who delivered at a tertiary hospital in Northern Tanzania. BMC pregnancy and childbirth. 2019;19:1-8.
47. Cleland J, Machiyama K. The challenges posed by demographic change in sub-Saharan Africa: a concise overview. Population and Development Review. 2017;43:264-86.
48. Hailemariam A. Implementation of the population policy of Ethiopia: achievements and challenges. Population Horizons. 2016;13(1):1-4.
49. Teklu H, Sebhatu A, Gebreselassie T. Components of Fertility Change in Ethiopia: Further Analysis of the 2000, 2005, and 2011 Demographic and Health Surveys: ICF International; 2013.
50. Central Statistical Agency [Ethiopia] and ICF International. Ethiopia Demographic and Health Survey 2011. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ICF International. . 2012.
51. Gebremedhin S, Betre M. Level and differentials of fertility in Awassa town, Southern Ethiopia. African journal of reproductive health. 2009;13(1).
52. Majumder N, Ram F. Explaining the role of proximate determinants on fertility decline among poor and non-poor in Asian countries. PloS one. 2015;10(2):e0115441.
53. Islam R, Islam N, Rahman M, Hossain G, Islam R. Fertility situation in Bangladesh: application of revised Bongaarts model. Sci Technol. 2015;5(2):33-8.
54. Samandari G, Speizer IS, O'Connell K. The role of social support and parity on contraceptive use in Cambodia. International perspectives on sexual and reproductive health. 2010:122-31.
55. Lai S-L, Tey N-P. Socio-economic and proximate determinants of fertility in the Philippines. World Appl Sci J. 2014;31(10):1828-36.
56. Rutaremwa G, Galande J, Nviiri HL, Akiror E, Jhamba T. The contribution of contraception, marriage and postpartum insusceptibility to fertility levels in Uganda: an application of the aggregate fertility model. Fertility research and practice. 2015;1(1):1-8.
57. Ethiopia Administrative Regions. Ethiopia Regions, Cities, and Population - EthioVisit.com. 2020.
58. Wikipedia. Southern Nations, Nationalities, and Peoples' Region. 2020.
59. Federal Democratic Republic of Ethiopia Central Statistical Agency. Population Projection of Ethiopia for All Regions At Wereda Level from 2014 – 2017. Retrieved 4 June 2018. 2018.
60. Central Statistical Authority/Ethiopia, ORC Macro. Ethiopia Demographic and Health Survey 2000. Addis Ababa, Ethiopia: Central Statistical Authority/Ethiopia and ORC Macro; 2001.

61. Central Statistical Agency/Ethiopia, ORC Macro. Ethiopia Demographic and Health Survey 2005. Addis Ababa, Ethiopia: Central Statistical Agency/Ethiopia and ORC Macro; 2006.
62. EPHI IJEMD, Indicators HSK. Ethiopian Public Health Institute (EPHI)[Ethiopia] and ICF. 2019.
63. Central Statistical Agency-Ethiopia. The 2007 Population and Housing Census of Ethiopia: Statistical ReportI: Population Size and Characteristics. 2010.
64. Merlo J, Chaix B, Ohlsson H, Beckman A, Johnell K, Hjerpe P, et al. A brief conceptual tutorial of multilevel analysis in social epidemiology: using measures of clustering in multilevel logistic regression to investigate contextual phenomena. Journal of Epidemiology & Community Health. 2006;60(4):290-7.
65. Midi H, Sarkar SK, Rana S. Collinearity diagnostics of binary logistic regression model. Journal of Interdisciplinary Mathematics. 2010;13(3):253-67.
66. Sommet N, Morselli D. Keep calm and learn multilevel logistic modeling: a simplified three-step procedure using Stata, R, mplus, and SPSS. International Review of Social Psychology. 2017;30:203-18.
67. Kassa N, Berhane Y, Worku A. Predictors of unintended pregnancy in Kersa, Eastern Ethiopia, 2010. Reproductive health. 2012;9(1):1-7.
68. Alaba OO, Olubusoye OE, Olaomi J. Spatial patterns and determinants of fertility levels among women of childbearing age in Nigeria. South African Family Practice. 2017;59(4):143-7.
69. Palamuleni ME. Determinants of fertility decline in Namibia: an analysis of the proximate determinants. 2017.
70. Mungai SW. Explaining high fertility in the north eastern region of Kenya: University of Nairobi; 2015.
71. Adhikari R. Demographic, socio-economic, and cultural factors affecting fertility differentials in Nepal. BMC pregnancy and childbirth. 2010;10(1):1-11.
72. Kamal A, Pervaiz MK. Factors Affecting the Family Size in Pakistan: Clog-log Regression Model Analysis. Journal of Statistics. 2011;18(1).

Annexes:

Annexe-1: Copy of approval letter from DHS -ICF to Use DHS 2000-2019 Dataset for the study "Trend and associated factors of high fertility rate in Ethiopia."

Nov 25, 2022

Mesfin Beyene
PSI Ethiopia
Ethiopia
Request Date: 11/24/2022

Dear Mesfin Beyene:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Trend and associated factors of high fertility rate in Ethiopia. Using DHS data from 2000-2019. Multilevel analysis model ":

Ethiopia

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

Annexe-2: Ethical Clearance Letter from HU College of Medicine and Health Sciences

ሀዋሳ ዩኒቨርሲቲ
ህክምናና ጤና ሳይንስ ኮሌጅ
የምርምር ስነ-ምግባር ገምጋሚ ቦርድ

HAWASSA UNIVERSITY
COLLEGE OF MEDICINE AND HEALTH SCIENCES
Institutional Review Board

Ref. No: IRB/359/15
Date: 09/07/2023

Name of Researcher(s): **Mesfin Beyene, Fanuel Belayneh (Asst. Prof.), Meskereme Jiso (MPH)**

Topic of Proposal: ***Trend and associated factors of high fertility rate in Ethiopia. Using demographic health survey data from 2000-2019: Multilevel analysis model***

Dear researcher(s),
The Institutional Review Board (IRB) at the College of Medicine and Health Sciences of Hawassa University has reviewed the aforementioned research protocol with special emphasis on the following points:

1. Are all principles considered?
   - 1.1. Respect for persons: Yes ☑ No ☐
   - 1.2. Beneficence: Yes ☑ No ☐
   - 1.3. Justice: Yes ☑ No ☐
2. Are the objectives of the study ethically achievable? Yes ☑ No ☐
3. Are the proposed research methods ethically sound? Yes ☑ No ☐

Based on the aforementioned ethical assessment, the IRB has:

- **A.** Approved the proposal for implementation ☑ Approval period -**09 July 2023** to **08 July 2024**
- B. Conditionally Approved ☐ Element Approved: **Protocol Version No.** 1
- **C.** Not Approved ☐ Follow up report expected in 6 **months**

Obligation of the PI:

1. Should comply with the standard international and national scientific and ethical guidelines
2. All amendment and changes made in protocol and consent form needs IRB approval
3. The PI should report SAE within 3 days of the event
4. End of study, including manuscript should be reported to the IRB

Yours faithfully,

Dr. Embialle Mengistie (Ph.D. Associate Prof.)
Chairperson, Institutional Review Board

☎: + 046 8209290 Website: Fax: + 046 2208755 ✉ 1560 CMHS, Hawassa-Ethiopia

Annex-III: Declaration

I the undersigned, declare that this thesis my original work, has not been presented for a degree in only other university and that all sources of materials used for the thesis has been duly acknowledged.

Name: ***Mesfin Beyene***

Signature: _____

Place: College of Medicine and Health Sciences, Department of Public Health, Hawassa University

Date of submission: _____

This thesis has been submitted with my approval as university advisor.

Name: ***Fanuel Belayneh***

Signature: _____

Date: _____