THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF PUBLIC HEALTH

DETERMINANTS AND PATTERNS OF FERTILITY IN ZAMBIA

By

Mumbi J. Chola

Supervisor

Dr Charles C. Michelo (UNZA)

Dissertation submitted in partial fulfilment of a Master of Science in Epidemiology Degree

TABLE OF CONTENTS

DECLARATION

This dissertation is the original work of **MUMBI CHOLA**

It has been produced in accordance with the guidelines for MSc. Epidemiology dissertation for the University of Zambia. It has not been submitted elsewhere for a degree at this or another University.

Signature……

Date…….

CERTIFICATE OF COMPLETION OF DESERTATION

I……

Hereby certify that this dissertation is the product of my own work and, in submitting it for the Degree of Master of Science in Epidemiology programme, further attest that it has not been submitted to another University in part or whole for the award of any programme.

Signature……

Date…….

I, DR……

Having supervised and read this dissertation is satisfied that this is the original work of the author under whose name it is being presented.

I confirm that the work has been completed satisfactorily and is ready for presentation to the examiners.

Signature/Supervisor……..

Date……

Head of Department……

Date……

Department……

CERTIFICATE OF APPROVAL

The University of Zambia approves this dissertation of Mumbi Chola in partial fulfilment of the requirements for the award of the degree in Master of Science in Epidemiology.

Examiner's signature	Date
……..	……..
……..	……
……..	……..

DEDICATION

This dissertation is dedicated to my lovely daughter Ntanda Joy Chongo Chola, my motivation and source of inspiration. To my family, Brian, Lumbwe, Mubanga, Tabbie, Annette, Sebastian “Ba Mwine”, Jojo, Lister, Joe, Ba Mayo, Grandma, Ba Yama, Uncle Gesh, my nieces and nephews Chilambwe, Taonga, Nduwa, Katepa, Wana, Ireen, and all I have not mentioned, I thank you all immensely for the love, support, encouragement. I hope you take as much pride in this work as I do.

To my darling Musakanya, words cannot express the gratitude I have for all the support, encouragement and patience during my studies. You are a constant pillar of strength that I can always rely on. I can only thank God for giving me you.

ACKNOWLEDGEMENTS

I would like to acknowledge the contributions of the following persons without whom this work could not have been possible.

Many thanks to my supervisor Dr. Charles Michelo for his invaluable advice and confidence in my capabilities; Richard Banda and Chola Nakazwe for advice and technical support; the staff at the department of Public Health, School of Medicine for their support through their constructive criticism; my course mates for their support and encouragement.

I would like to thank NOMA for the financial support given towards my education.

My friends, David Chibanja Lungu, Brian Chileshe, Musenge Chipwende, Chileshe Chileshe, amongst many, for all the assistance and encouragement they lent to me during the course of my studies. I will be eternally grateful.

Finally, I wish to thank my family for their love, support and encouragement.

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ART ……Anti-retroviral Therapy

AIDS ……Acquired Immune Deficiency Syndrome

CDC ……Centre for Disease Control and Prevention

CPH ……Census of Population and Housing

CSO ……Central Statistical Office

DBS ……Dried Blood Spot

DHS ……Demographic and Health Survey

HIV ……Human Immuno-deficiency Virus

IUD ……Intra Uterine Device

MoH ……Ministry of Health

PLWHA……People Living with HIV/AIDS

PMTCT……Prevention of Mother-to-child Transmission

TDRC ……Tropical Diseases Research Centre

TF ……Total Fecundity Rate

TFR ……Total Fertility Rate

TM ……Total Marital Rate

TN ……Total Natural Marital Fertility Rate

UNZABREC……University of Zambia Biomedical Research Ethics Committee

USAID ……United States Agency for International Development

VCT ……Voluntary Counselling and Testing

WHO ……World Health Organisation

ZDHS ……Zambia Demographic and Health Survey

ABSTRACT

Introduction

Zambia has continuously reported high fertility rates. While influence of both underlying and proximate determinants is well documented in various studies worldwide, there's a lack of information on their influence on fertility in Zambia. Therefore, this study was aimed at examining the determinants of fertility in Zambia.

Methodology

The analyses were based on 2007 Zambia Demographic and Health Survey (ZDHS) data. The ZDHS data is nationally representative data, comprised of information from face-to-face interviews and syphilis and HIV testing results. The survey sampled 8000 households across the country, collecting information on males aged 15-59 years and females aged 15-49 years. This thesis focused on the females only. Analysis was based on the Bongaarts Fertility Differentials and the Fertility Determinants Models. The Fertility Determinants model involved the use of bivariate and multivariate logistic regression analyses to examine the possible determinants for fertility.

Results

Of the 7,146 females sampled in the survey, 44% resided in urban areas while 56% resided in the rural areas. About 22% of the respondents were aged below 20 years while 20% and 19% were aged between 20-24 and 25-29 years respectively. Pooled results show that majority of the respondents (44%) were aged between 25-39 years with 42% of the population aged between 15-24 years. Married women were almost 5 times more likely to experience child birth compared to those that had never been married. Women in urban areas were almost 7 times more likely to have a child than rural women.

The Bongaarts Fertility Determinants Model revealed that 40% of fertility reduction from its biological maximum (18.83 children/mother) is due to the inhibiting effect of marriage with contraceptive use and duration of postpartum infecundability accounting for 8% and 33% respectively, to attain TFR of 6.2.

The Fertility Determinants Model showed that the main predictors of fertility for women in Zambia were their age, their current marital status, whether they are currently abstaining or not, what they perceive as their ideal family size and their current contraceptive use. HIV status, however, was not a predictor of fertility.

Conclusion

It was determined that the major predictors of fertility for women in Zambia are age, current marital status, sexual activity, ideal family size and current contraceptive use. It has also been shown that the determinants which contribute towards fertility reduction from its biological minimum were marriage, postpartum infecundity and contraception. The combined effect of these drivers and inhibitors of fertility will thus determine the fertility rates and the population growth rate. . Any measures aimed at maintaining fertility levels should take into consideration these drivers and inhibitors.

1. BACKGROUND

Fertility, along with mortality and migration, plays a significant role in driving population growth. Fertility is defined as the actual production of live offspring. Stillbirths, foetal deaths, and abortions are not included in the measurement of fertility in a population (Porta, 2008). Measurement of fertility is mainly done using various fertility rates. The total fertility rate is generally used as a measure of fertility as opposed to number of births since it is an average of the number of births per woman. Total Fertility Rate (TFR) in a specific year is the average number of children that would be born per woman if all women lived to the end of their childbearing years and bore children according to a given set of age-specific fertility rates (Porta, 2008). The Total Fertility Rate (TFR) is derived from the age-specific fertility rates defined over five year intervals of women aged between 15 and 49 years. The computations of these rates are based on the number of live births in each age group. As such, the fertility rates are determined chiefly by the number of live births (Central Statistical Office (CSO), 2009).

Fertility determinants

Generally, it is understood that changes in fertility are mainly a result of changes in the total fertility rates. However, there are various factors that have a bearing or influence on birth rates, and in turn, fertility rates. These factors are termed underlying and proximate determinants (Boermaa and Weir, 2005, Bongaarts and Potter, 1983, Davis and Blake, 1956). The interaction of these factors and births result in either an increase or decrease in births and ultimately fertility rates and this has been shown in various studies (Tey et al., 2012, Moses and Kayizzi, 2007, Van Rossem and Meekers, 2007). Underlying determinants include factors that do not directly have an influence on fertility but still have a bearing on fertility outcomes. These include socio-economic, cultural and environmental factors such as education, wealth, residence, age and religion. Proximate determinants, on the other hand, include all those factors that directly influence fertility. Proximate determinants include factors such as marriage, contraception, induced abortion, lactational infecundability and frequency of sexual intercourse among others. The 2007 ZDHS, however, lists proximate determinants as including, among others, marriage, contraception, sexual activity, abstinence, postpartum amenorrhea, abortion and menopause.

Global Fertility Levels and Trends

Evidence has shown that these proximate determinants have a role to play in fertility levels and trends across the world and that they have an influence or contribute significantly to fertility levels. The Bongaarts fertility model has been widely used to show how many determinants contribute to fertility levels and trends by virtue of a numerical value assigned to each factor reflecting its contribution to fertility reduction. In China, it was shown that contraception was the most significant (.367) along with the effect of marital structure (.566). Abortion (.832) and infecundability (.852) had minimal effects on fertility reduction. About 52% of the inhibiting effects on the total fertility rate are due to contraception,

followed by marital structure at 29.8%. With marriage being universal, it is suggested that the compulsory delay in age at marriage contributes to the decline in fertility. Induced abortion reduced fertility by 9.6% and lactational infecundability by 8.4% (Cheng and Rajulton, 1992).

Analysis of factors affecting fertility in Bangladesh revealed that contraception emerged as the highest fertility reducing factor and its effect was greatest in middle and older age groups. Although until the early 1990s postpartum lactational infecundability was the most important and strongest fertility reducing factor in Bangladesh, its fertility inhibiting effect was gradually decreasing due to the declining trend in the lactational infecundability period. The analysis revealed that although the fertility reducing effect of the marriage pattern was increasing, its effect was offset by the declining trend in the lactational infecundability period. A review of these two variables suggested that their effect could not be raised much for prevailing socioeconomic and cultural reasons, and any future reduction in fertility in Bangladesh may be largely dependent on increased use of effective birth control methods (Islam et al. (2004).

An application of Bongaarts' model to vital statistics, population census, and survey data of Peninsular Malaysia revealed that marriage postponement and contraception were the two most important proximate determinants of fertility. According to a recent study in Malaysia, since the mid-1980s, the continued fertility decline even with a contraction in the use of contraceptives prompted the need to understand the underlying reasons such as increase in abortion, sterility, and out-of-wedlock pregnancy. Fertility decline was attributed to rapid socio-economic development, which could only influence fertility through the intermediate or proximate variables (Tey et al. (2012).

From these studies, it can be deduced that proximate determinants play a huge role in fertility levels. In these studies, contraception and marriage have been singled out as having the most inhibiting effect on fertility. Though abortion and lactational infecundability also contribute to fertility reduction, in the studies above these have had a smaller effect compared to marriage and contraception. However, these determinants do play a part in explaining ethnic fertility differentials. The fertility inhibiting effects of these determinants have been seen to also vary by various factors such as socio-economic status, religion, social class among others. In Malaysia, it was observed that the effects of marriage postponement and contraceptive use were not uniform across the ethnic groups. The predicted total fertility rate for Chinese and Malays were 2.9 and 1.6, respectively, compared with the observed level of 3.0 and 1.9. Postpartum infecundability and abortion also played a part in explaining ethnic fertility differentials (Tey et al. (2012).

African Fertility Levels and Trends

In Africa, similar findings have been observed although they are markedly different from those observed worldwide particularly with regards to abortion. Being a deeply religious

continent with a high value for life, abortion is considered an abomination. It is also illegal in most countries in Africa except on medical or socio-economic grounds. However, various studies, also employing the Bongaarts fertility model, pointed to contraception, marriage and postpartum infecundability as the main proximate determinants (Palamuleni, 2010, Moses and Kayizzi, 2007, Alene and Worku, 2009).

Analysis of data from Kenya and Zimbabwe revealed that the fertility-inhibiting effects of contraception are more important than the effects of postpartum infecundability, marriage patterns, or sterility. Furthermore, the contraceptive patterns have their greatest fertility-suppressing effects in the middle and younger age groups. In Kenya, on the other hand, the dominant fertility-inhibiting effect is postpartum infecundability, with contraception coming in second. Another important finding is the fairly marked extent to which observed levels of fertility in Kenya and Zimbabwe can be attributed to concomitant variations in postpartum lactational infecundability, contraception, and nuptiality (Sibanda, 1999).

Moses and Kayizzi (2007) analysed the 1995 and 2001 Uganda demographic and health surveys using the Bongaarts model in an effort to explain fertility decline in urban areas of Uganda. Their findings established that the change in the proportion of women married and postpartum infecundability due to breastfeeding had the greatest inhibiting effect on fertility in urban areas of Uganda while contraception use contributed the least (Moses and Kayizzi, 2007).

Letamo (1996) used the Bongaarts' model to examine the contributions of three proximate determinants (non-marriage, contraceptive use and postpartum infecundability) to fertility change using data from the 1984 and 1988 Botswana Family and Health Surveys. According to the findings, breast-feeding was the most important proximate determinant of fertility, followed by contraceptive use, and finally non-marriage, both in 1984 and 1988. However, contraceptive use increased between 1984 and 1988, leading to fertility decline over this period. Marriage was the least important proximate determinant of fertility, probably due to the high prevalence of premarital childbearing. Other factors such as induced abortion could have played a major role in the fertility decline but their effect could not be estimated due to lack of accurate data (Letamo (1996) .

In a study comparing fertility trends in Botswana, Zimbabwe and Zambia, Letamo and Letamo found that the fertility transition on Southern Africa appeared to be driven mainly by the adoption of modern forms of contraception except in Zambia where the role of traditional methods was still important. In both Botswana and Zimbabwe, the pace of the fertility transition and context appeared to be very similar. For example, in both countries a strong family planning programme fully backed by the government was observed. The use of modern forms of contraception was quite high in the two countries. Zambia however presented a different picture. The pace of fertility decline was rather sluggish. This may have been due to the common use of traditional methods of contraception, the family planning

programme being the responsibility of NGOs and the dominant role of husbands in women's access to contraceptives.

Zambian Fertility Levels and Trends

Fertility rates have been computed for Zambia and reported data show that fertility has been declining since the first national census was conducted in 1969. Zambia Demographic and Health Survey (ZDHS) data show that fertility rates have decreased by one birth over a 27-year period from 7.2 births per woman at the time of the 1980 Census to 6.2 births in the 2007 ZDHS. Fertility rates had been shown to have declined to 5.9 in the 2001/2002 ZDHS but increased to 6.2 in 2007. This increase in the total fertility rate was attributed to an increase in rural fertility from 6.9 in 2001-2002 to 7.5 in 2007 (Central Statistical Office (CSO), 2009).

The majority of studies on Zambia concerning fertility trends patterns and determinants were based on the 1992 ZDHS. These studies focused on the period prior to 1992 and most of them were not published. However, published findings like those by Dekedzeke (1994) which were based on the Bongaarts model show that at that time, postpartum infecundity contributed the most towards reducing fertility followed by contraception and marriage. This was based on the 1992 ZDHS. Since then however, little had been done to try and understand or find out whether this had changed or not in light of the aggressive abstinence and contraceptive use campaigns which were embarked on in the 1990s and 2000s. These social marketing campaigns reached out to many people thus influencing their usage of contraceptives and family planning services. As shown by Van Rossem and Meekers, people who were exposed to radio and television programs about family planning and HIV/AIDS were more likely to have ever used a condom (OR = 1.16 for men and 1.06 for women). As a result, there's potential for a reduction in the number of births and thus fertility due to increased up take of family planning services and less exposure to pregnancy due to condom use (Van Rossem and Meekers (2007).

HIV and Fertility

Another factor that has been under-studied though it may have a significant influence on fertility, particularly through fertility preferences, is HIV. HIV has impacted on every aspect of our society, particularly sexual activity. Resultantly, HIV has not just had an impact on contraception and sexual activity but it has also had an impact on fertility and fertility preferences. This is especially the case among people who are living positively. Studies worldwide have shown that once people discover that they are HIV positive, their fertility preferences usually change (Juhn et al., 2008, Mmbaga et al., 2013, Baylies, 2000). Some opt to delay pregnancy while others put if off completely and various reasons have been cited for these decisions.

However, with increased availability of antiretroviral therapy and the Prevention of Mother-to-Child Transmission (PMTCT), HIV is increasingly being seen as a chronic disease people

live with for many years rather than a death sentence. This might also have had an impact on the preferences of people when it comes to child bearing. A systematic review of twenty-nine studies revealed that among people living with HIV/AIDS, fertility desires were influenced by a myriad of demographic, health, stigma-associated and psychosocial factors. Cultural factors were also found to be important, particularly in Sub-Saharan Africa and Asia (Nattabi et al. (2009).

Globally, various studies have been conducted with regard to HIV and fertility. A study in the United States found that overall, 28-29% of HIV-infected men and women receiving medical care desire children in the future. Among those desiring children, 69% of women and 59% of men actually expect to have one or more children in the future. The proportion of HIV-infected women desiring a child in the future is somewhat lower than the overall proportion of U.S. women who desire a child. The fertility desires of HIV-infected individuals do not always agree with those of their partners: As many as 20% of HIV-positive men who desire children have a partner who does not (Chen et al. (2001). In discordant couples however, a significant proportion with an HIV negative partner had no desire to have children. The study also found that the desire among HIV positive women was higher among the younger women as well as those who had never had children. Those who already had children did not want to have more children(Chen et al., 2001).

In Africa, there is limited data about how or if knowledge of one's HIV status influences fertility preferences or the desire to have children. In Malawi, a study examining how HIV positive and negative test results impact respondents' desires to continue childbearing found that respondents who received a positive test result reduced their childbearing desires (Yeatman, 2009). In a review and analysis of data from individual studies in sub-Saharan Africa, it was concluded that large fertility differentials existed between HIV-infected and uninfected women, with substantial variation by age. Findings from this analysis showed that fertility was lower among HIV-infected women than HIV-uninfected women, with the exception of those aged 15–19 years, in whom the selective pressure of sexual debut on pregnancy and HIV infection led to higher fertility rates among the HIV infected. This fertility differential resulted in a population-attributable decline in total fertility of 0.37% (95% confidence interval 0.30%, 0.44%) for each percentage point of HIV prevalence (Lewis, 2004).

Other studies, however, have shown a positive association between antiretroviral therapy (ART) use and pregnancy. A cohort study by Myer et al found that ART use was associated with significantly higher pregnancy rates among HIV-infected women in sub-Saharan Africa. With a pregnancy incidence of 7.8/100 person years, the rate of new pregnancies was significantly higher among women receiving ART (9.0/100 PY) compared to women not on ART (6.5/100 PY) (adjusted hazard ratio, 1.74; 95% CI. 1.19 – 2.54)(Myer L, 2010). These findings go to show that the desire to have children is higher among HIV-infected persons as compared to those who are not infected. Additional factors independently associated with

increased incident pregnancy included younger age, being married or cohabiting, failure to use non-barrier contraception, lower educational attainment and higher CD4 count.

In Zambia, data on the influence of HIV on fertility is scare. The few studies available point to the fact that the risk of HIV is not always associated with child bearing. Baylies examined how concerns about HIV infection affected fertility preferences. Based on data from 1995, it was found that although there were high levels of anxiety about AIDS, risk from HIV was not always associated with the act of conceiving children, nor did this association necessarily influence actual behaviour or family size preferences. In some cases, however, the threat of contracting HIV had led to a decision to have fewer children. Many also worried about leaving orphans for others to look after and the costs which might be incurred in taking over the care of orphans left by others. A related reason for limiting fertility was the hope that orphaned children would be better cared for if there were fewer of them. One inherent limitation of this study was that it being a qualitative study, it could not be generalised to the wider population (Baylies, 2000).

Although this study found no association at the time, it is still necessary to determine just how much HIV has affected fertility and fertility preferences in Zambia. By using the ZDHS data which uses a nationally representative sample, it becomes possible to draw more representative conclusions concerning associations between HIV and fertility preferences in Zambia. Therefore, this study will seek to determine whether HIV has had an influence on fertility trends in Zambia and if so, the extent to which it has contributed to the existing patterns and trends existing in Zambia.

1.1. EPIDEMIOLOGICAL CONSIDERATIONS

Population change is a result of the interaction of various factors. Although theories of population change primarily focus on fertility, mortality and migration in analysing the causes and determinants of population change, the influence of other disciplines including epidemiology cannot be overlooked. As Kurt Mayer stated, “Any meaningful interpretation of the cause and effects of population changes must … extend beyond formal statistical measurement of the components of change, i.e. fertility, mortality and migration, and draw on the theoretical framework of several other disciplines for assistance”(Mayer., 1962). Therefore, the influence of other disciplines on the population should be considered and a multi-disciplinary approach should be undertaken in addressing issues of population change.

Since epidemiology is primarily concerned with the distribution of disease and death and with their determinants and consequences in population groups, increased population growth has epidemiological consequences. According to Abdel Oman “Inasmuch as patterns of health and disease are integral components of population change, epidemiology's reservoir of knowledge about these patterns and their determinants in population groups serves not only as a basis for prediction of population change but also as a source of hypotheses that can be further tested to correct, refine and build population theory.

Furthermore, many epidemiologic techniques that have heretofore been limited to the examination of health and disease patterns can be profitably applied as well to the exploration of other mass phenomena, such as fertility control" (Omran, 2005).

Therefore, employing a multidisciplinary approach in the analysis of fertility determinants with the aid epidemiological techniques could be useful in understanding the determinants of population change. With this understanding, this study sought to understand the various factors that influence fertility in Zambia. The analysis of both underlying and proximate determinants would provide an understanding of the main factors that influence fertility and population growth in Zambia with a view of managing population growth and in turn contributing to mitigation of epidemiological consequences of population growth.

1.2. RESEARCH GAPS & STATEMENT OF THE PROBLEM

Studies conducted in the early 1990s indicate that proximate determinants do actually play a role in fertility levels and patterns. Over the last 30 years, ZDHS data shows that fertility has been declining steadily from a TFR of 6.5 in 1992 to an all-time low of 5.9 in 2001/2 but increased to 6.2 in 2007. Disparities exist between rural and urban areas with fertility rates being generally higher in rural areas compared to urban areas. Differences in fertility levels have also been recorded between provinces. Fertility is also higher among younger women compared to older women.

With such changes in fertility levels, it is important to have knowledge of the factors influencing fertility. However, there is limited data examining how various factors influence fertility levels. Bearing in mind the massive campaigns on sexual abstinence and contraception use that have been conducted since the early 1990s, it is necessary to determine how these activities may have influenced fertility. The effect of these factors may have changed from what was observed in the early 1990s and thus may provide more recent information on the current effects of proximate determinants on fertility levels in Zambia.

Additionally, the possible influence of HIV cannot be overlooked. As shown from the studies above, HIV does affect birth preferences and therefore fertility levels. Though previous studies show that there has been no association between HIV and childbearing in Zambia, this data is based on research in the mid-1990s and the situation may have changed over time. As such, with HIV being endemic in modern day society, it becomes vital to understand how HIV has affected the existing fertility levels as well as fertility preferences.

1.3. RATIONALE

Understanding the main determinants, associated patterns and levels of fertility as well as the influence HIV has had, is very critical in many aspects. Firstly, Zambia's population has been growing rapidly over the years and this has been mainly due to the high fertility rate which has had serious socio-economic repercussions. Preliminary reports from the 2010

Census indicate that the population growth rate has increased to 2.8 % from 2.4% in the 2000 Census (CSO, 2012). Projections made by the Ministry of Finance and National Planning based on assumptions on the future course of fertility indicate that over a 30 year period (2007 – 2037), the population will rise from 12.1 million persons in 2007 to 33 million in 2037, an increase of 21 million persons if the fertility rate remains unchecked(MoFNP, 2010). Therefore, with an understanding of which proximate determinants are dominant in influencing fertility levels in Zambia, this information could provide evidence on the main factors driving fertility.

Such information on how socio-economic determinants influence fertility levels can be useful in developing policies aimed at reducing and managing fertility rates and population growth. With clear knowledge of which determinants are dominant in contributing to fertility levels and patterns, a more targeted approach in fertility reduction could be employed by focusing on the dominant determinants. The understanding of just what role HIV plays in these fertility levels and patterns also ensures that these policies take into account the context with regards to HIV in modern society.

2. RESEARCH OBJECTIVES

2.1. RESEARH QUESTION

What are the major determinants of fertility and how have they influenced levels of fertility in Zambia?

2.2. OBJECTIVES

General Objective

To examine the determinants and patterns of fertility in Zambia using data collected in the 2007 ZDHS.

Specific Objectives

The specific objectives of the study were;

1. To determine the association between socio- demographic (underlying) factors and fertility in 2007
2. To examine the role of marriage and contraception in fertility levels among women in 2007
3. To examine the role of postpartum infecundity in fertility levels among women in 2007
4. To describe the fertility preferences in 2007 in the Zambian population
5. To examine the association between HIV infection and fertility levels and preferences in the Zambian population in 2007

3. CONCEPTUAL FRAMEWORK

3.1. BONGAARTS FERTILITY DIFFERENTIAL MODEL

The Bongaarts and Porter (1983) aggregate model was selected because it quantifies the contribution of each proximate determinant of fertility. The following equations summarize the basic structure of the Bongaarts' model by relating the fertility measures to the proximate determinants.

TFR = Cm x Cc x Ca x Ci x TF (1)

TM = Cc x Ca x Ci x TF (2)

TN = Ci x TF (3)

Where

TFR is the Total Fertility Rate. This is the number of births a woman would have at the end of the reproductive years if she were to bear children at prevailing age-specific fertility rates while living through the entire reproductive period

TM is the Total Marital Fertility Rate. This is the number of births a woman would have at the end of the reproductive years if she were to bear children at prevailing age-specific marital fertility rates and remained married during the entire reproductive period

TN is the Total Natural Marital Fertility Rate. This is equal to the total marital fertility rate in the absence of contraception and induced abortion.

TF is the Total Fecundity Rate. This is the total natural fertility rate in the absence of lactational and postpartum abstinence. In other words it is the biological maximum value(Dzekedzeke and Nyangu, 1994).

Cm, Cc, Ca and Ci are the indices of marriage, contraception, induced abortion, and postpartum infecundability respectively. The indices can only take values between 0 and 1. When there is no fertility-inhibiting effect of a given intermediate fertility variable, the corresponding index equals 1, if the fertility inhibition is complete, the index equals 0. These indices can be estimated from measures of the proximate variables and these estimates are given below.

Estimation of the index of marriage (Cm)

The index of marriage measures the inhibiting effect of marriage on fertility in the population. It has to be noted that the higher the level of marriage in the population the less the inhibiting effect and the reverse is true. The index of marriage is estimated using the formula;

$$Cm = \sum m(a)\, g(a) / \sum g(a)$$

Where

Cm = Index of marriage.

m(a)= Age specific proportions of married females, m(a) is got by dividing the number of married women of a particular age group by the number of women in the same age group.

g(a) = Age specific marital fertility rates, g(a) is got by dividing the births of a particular age group by the number of women in the same age group.

Estimation of the index of contraception (Cc)

The index of contraception in the model measures the inhibiting effect of contraception on fertility in the population. The higher the level of contraception in the population, the higher the inhibiting effect due to contraception and the lower the level of contraception the lower the inhibiting effect. The index of contraception is estimated using the formula;

$$Cc = 1 - 1.08 * u * e$$

Where

u = Proportion using contraception among married women of reproductive age (15-49 years).

e = Average use effectiveness of contraception.

The coefficient 1.08 represents an adjustment for the fact that women do not use contraception if they know that they are sterile.

The indices of use effectiveness proposed for particular contraceptives are; pill = 0.90, IUD =0.95, sterilization = 1.00 and others = 0.70 (Bongaarts, 1983).

Estimation of the index of abortion (Ca)

The index of abortion measures the inhibiting effect of abortion on fertility in the population. In this study the index of abortion was set at 1.0 due to lack of data. Abortion data is not collected independently and this made it difficult to determine the prevalence of abortion in the ZDHS hence an index of 1.0. The index of abortion is estimated using the formula below;

$$Ca = TFR / TFR + b * TA = TFR / TFR + 0.4 * (1 + u) * TA$$

Where

u = Prevalence contraceptive use.

b = Average number of births averted per induced abortion and $b = 0.4 (1 + u)$. b = 0.4 when u = 0 and b = 0.8 when u = 1.0. TA = Total abortion (Average number of induced abortions per woman at the end of the reproductive period if induced abortion rates remains at prevailing levels throughout the reproductive period. a C = 1.0 if the TA is 0. Therefore the Total Abortion rate in this study is 1.0.

Estimation of the index of postpartum infecundability (Ci)

The index of postpartum infecundability measures the inhibiting effect of breastfeeding or abstinence on fertility in the population. The index of postpartum infecundability in the model is estimated using the effect of breastfeeding (lactation amenorrhea) or postpartum abstinence. The ratio of natural fertility in the presence and absence of postpartum infecundability therefore equals the ratio of the average birth interval without and with postpartum infecundability. If no breastfeeding and postpartum abstinence are practiced, the birth interval averages about 20 months, which is the sum of;

i) 1.5 months of minimum postpartum anovulation.
ii) 7.5 months of waiting time to conception.
iii) 2 months of time added by spontaneous intrauterine mortality.
iv) 9 months for a full term pregnancy.

Bongaarts and Potter (1983) state that, in the presence of breastfeeding and postpartum abstinence, the average birth internal equals approximately 18.5 months (7.5 + 2 + 9) plus the duration of postpartum infecundability. The index of postpartum infecundability (Ci) is estimated as;

$$Ci = 20 / 18.5 + i$$

Where

Ci = the index of postpartum infecundability.

i = Average duration of postpartum infecundability caused by breastfeeding or postpartum abstinence.

In this study, the index of postpartum infecundability will be estimated using the mean duration of breastfeeding and this will be obtained from a question, which is aimed at establishing the duration the most recent child was breastfed.

Therefore, these four indices measure how each of the following components reduce fertility from its biological maximum. These components are;

i) The prevalence of marriage
ii) The use of contraception
iii) The amount of postpartum fecundity and,
iv) The use of induced abortion.

The values of each of these indices obtained from the Bongaarts model reflect the relative value or importance of the component in reducing fertility.

3.2. FERTILITY DETERMINANTS MODEL

This model was designed for purposes of this study and was based on the proximate determinants conceptual framework detailed in figure one below. This model was an adaptation of Davis and Blake's analytical framework for the comparative study of the sociology of fertility and Bongaarts' proximate determinants model. As cited by Boermaa & Weir (Boermaa and Weir, 2005), the key to Davis and Blake's framework was a set of "intermediate variables through which any social factors influencing the level of fertility must operate". Three groups of intermediate variables were identified: factors affecting exposure to intercourse, factors affecting exposure to conception, and factors affecting gestation and successful delivery. Each of these biological factors can be influenced by a set of behavioural intermediate variables that are directly linked to the biological factors (Davis and Blake, 1956). This framework was further developed by Bongaarts], who replaced the term "intermediate variables" with "proximate determinants." He developed a simple statistical model in which any variation in the level of fertility, between populations or over time, can be decomposed into variations in the proximate determinants of marriage (exposure to sexual intercourse), postpartum infecundity (associated with lactation and abstinence), induced abortion, and contraceptive use (Bongaarts and Potter, 1983).

The model used in this study, however, included underlying determinants whereas the other models focused only on proximate determinants. The model aimed at examining the underlying and proximate determinants in order to determine their influence on fertility. The model employed regression analysis in order to determine which determinants are predominant in influencing fertility. The schematic presentation below shows how different conditions interact with fertility as the outcome. It shows that fertility is influenced by more than just the number of births. It points out the underlying determinants, proximate determinants as well as biological determinants that influence births and ultimately fertility.

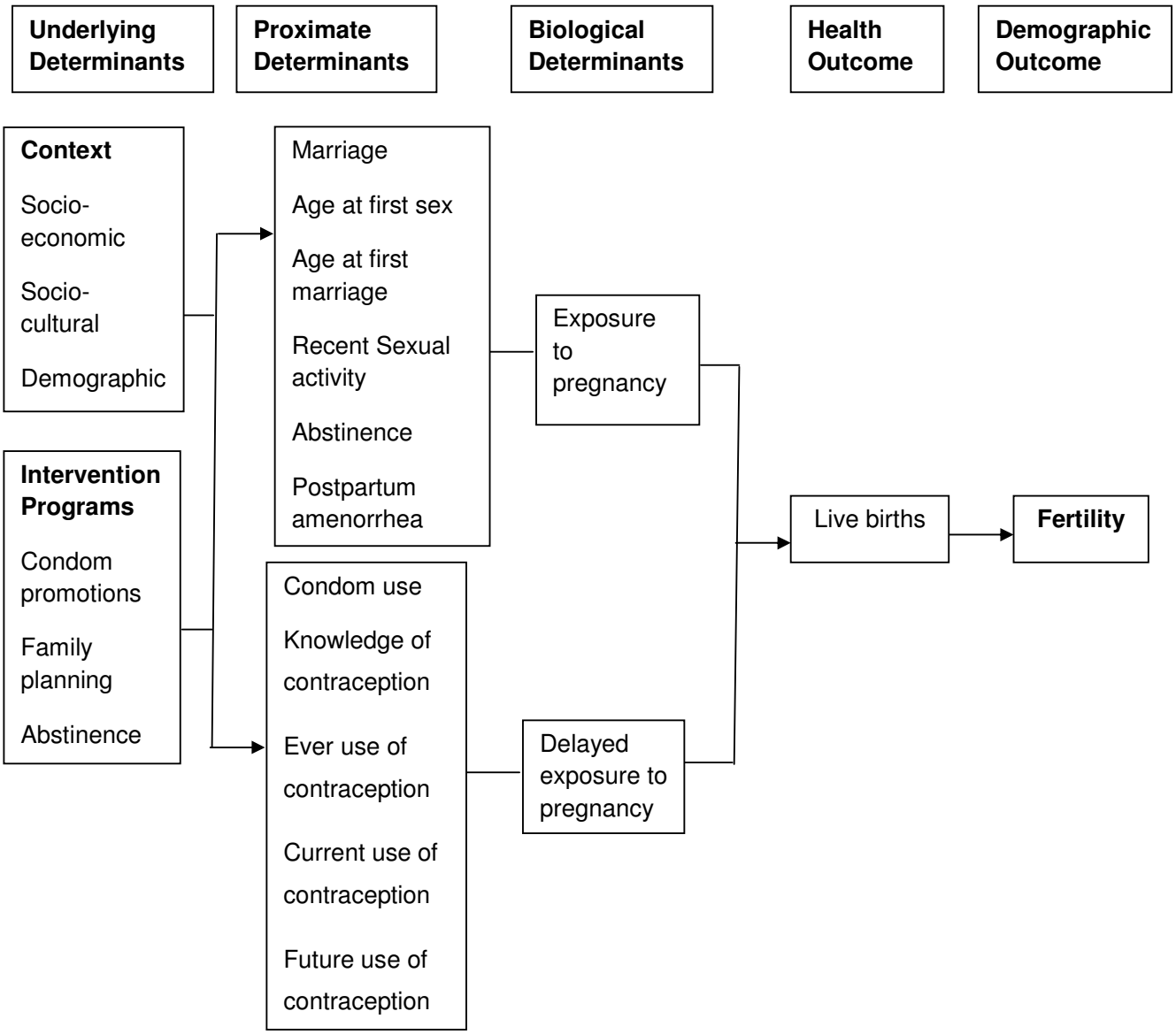

Figure 1: Proximate-determinants conceptual framework for factors affecting fertility

4. METHODOLOGY

4.1. STUDY POPULATION

The study was set to look at fertility data on Zambia. As of 2010, the population of the country stood at 13,092,666 of which 49.3 percent (6,454,647) were males and 50.7 percent (6,638,019) were females. This represented an increase of 32.4 percent from the population of 9,885,591 captured during the 2000 Census (CSO, 2012).

The 2007 ZDHS, however, was based on 2000 Census population figures. Total fertility rates (TFR) estimated from the 1969 and 1980 censuses were 7.4 and 7.2 births per woman, respectively. The fertility rate declined to 6.7 births per woman in 1990, to 6.0 in 2000, and to 5.9 in 2002. According to the 2007 ZDHS, the TFR was reported at 6.2, reflecting an increase from 5.9 in 2002. Life expectancy at birth for males was 50 years in 1980 and was estimated to have declined to 46 years by 1990. In 2000, it increased to 48 years. Overall, life expectancy at birth ranged from 44 years in Western province to 56 years in North-Western province. Zambian women lived, on average, 4 years longer than men. The overall infant mortality rate declined from 141 deaths per 1,000 live births in the mid-1960s (based on the 1969 census) to 99 deaths in the late 1980s, after which it increased to 123 in 1990. According to the 2000 Census, infant mortality was estimated at 110 deaths per 1,000 live births. The ZDHS estimates show a decline in infant mortality from 95 deaths per 1,000 live births in 2001-2002 to 70 deaths in 2007 (CSO, 2002).

Since fertility is usually reported using fertility rates calculated based on live births, only women were considered in this study. Therefore, the population that was focused on included all females in the reproductive age groups, that is, between ages 15 and 49 years. Using the methods described below, a representative sample of these women was drawn on whom the results of this study were based.

4.2. STUDY TYPE AND DESIGN

This study was a cross sectional study. The study was aimed at providing an analysis of the influence that proximate determinants have had on fertility levels and patterns in Zambia. The study sought to determine which proximate determinants contribute the most towards existing fertility levels and patterns using 2007 ZDHS data. The study also endeavoured to determine the impact HIV has had on fertility preferences. A similar analysis as that which was done on the proximate determinants was done in analysing the impact of HIV on fertility preferences. Data analysis was based on the 2007 ZDHS because in this survey, HIV data was collected via HIV testing. The study reflected the disparities in fertility preferences in light of the HIV epidemic.

4.2.1. ZDHS DATA SET

The study involved the use of secondary data. Data used in the study was from the 2007 Zambia Demographic and Health Survey which is a nationally representative sample survey of Zambian households. The main objective of the ZDHS is to provide information on levels and trends in fertility, childhood mortality, use of family planning methods, and maternal and child health indicators including HIV/AIDS. This information is necessary for programme managers, policymakers, and implementers to monitor and evaluate the impact of existing programmes and to design new initiatives for health policies in Zambia.

Among the primary objectives of the ZDHS are:

- To collect up-to-date information on fertility, infant and child mortality, and family planning
- To collect information on health-related matters such as breastfeeding, antenatal care, children's immunisations, and childhood diseases
- To assess the nutritional status of mothers and children
- To support dissemination and utilization of the results in planning, managing, and improving family planning and health services in the country
- To enhance the survey capabilities of the institutions involved in order to facilitate the implementation of surveys of this type in future.
- To document current epidemics of STIs and HIV/AIDS through use of specialized modules.

The HIV/AIDS and Syphilis testing component was included in the 2007 ZDHS. This was undertaken to provide information to address the monitoring and evaluation needs of government and non-governmental organization programmes addressing HIV/AIDS and syphilis, and to provide programme managers and policy makers with the information that they need to effectively plan and implement future interventions. The overall objective of the survey was to collect high-quality and representative data on knowledge, attitudes, and behaviours regarding HIV/AIDS and other STIs, and on the prevalence of HIV and syphilis infection among women and men.

The sample for the 2007 ZDHS is designed to provide estimates of population and health indicators at the national and provincial levels. The sample design allows for specific indicators, such as contraceptive use, to be calculated for each of the nine provinces (Central, Copperbelt, Eastern, Lusaka, Luapula, Northern, North-Western, Southern, and Western). The sampling frame used for the ZDHS is adopted from the Census of Population and Housing of the Republic of Zambia (CPH) provided by the Central Statistical Office (CSO). A representative sample of 8,000 households has been drawn for all the ZDHS surveys. The sample is a stratified sample selected in two stages from the CPH frame. Stratification is achieved by separating every province into urban and rural areas. Therefore, the nine provinces are stratified into 18 sampling strata. Samples are selected independently in every stratum by a two-stage selection. Implicit stratifications and proportional allocation is

achieved at each of the lower geographical/administrative levels by sorting the sampling frame according to the geographical/administrative order and by using a probability proportional to size selection at the first stage sampling.

In the first stage, 320 SEAs were selected with probability proportional to the SEA size. The household listing operation was conducted in all selected SEAs, with the resulting lists of households serving as the sampling frame for the selection of households in the second stage. Selected SEAs with more than 300 households were segmented, with only one segment selected for the survey with probability proportional to the segment size. Household listing was conducted only in the selected segment. Therefore, a ZDHS 2007 cluster is either an SEA or a segment of an SEA. In the second-stage selection, an average number of 25 households were selected in every cluster, by equal probability systematic sampling. A complete listing of households and a mapping exercise was carried out for each cluster in August 2006. All private households were listed. The listing excluded people living in institutional households (army barracks, hospitals, police camps, boarding schools, etc.). CSO listing enumerators were trained to use Global Positioning System (GPS) receivers to record the geographic coordinates of the 2007 ZDHS sample clusters.

All women age 15-49 and all men age 15-59 that were either permanent residents of the households in the sample or visitors present in the household on the night before the survey were eligible to be interviewed. HIV testing was performed in each household among eligible women and men who consented to the test. In a sub-sample of one in every three households, syphilis testing was performed among eligible women and men who consented to the test. In addition, a subsample of one eligible woman in each household was randomly selected to be asked additional questions about domestic violence.

Three questionnaires were used for the 2007 ZDHS. These were the Household Questionnaire, the Women's Questionnaire, and the Men's Questionnaire. These questionnaires were based on questionnaires developed for the MEASURE DHS programme and were adapted to reflect the population and health issues relevant to Zambia at a series of meetings with various stakeholders from government ministries and agencies, non-governmental organizations, and international donors. In addition to English, the questionnaires were translated into seven major local languages, Nyanja, Bemba, Kaonde, Lunda, Lozi, Tonga, and Luvale.

The Women's Questionnaire was used to collect information from all women age 15-49. These women were asked questions on the following main topics:

- Background characteristics (education, residential history, media exposure, etc.)
- Birth history and childhood mortality
- Knowledge and use of family planning methods Fertility preferences
- Antenatal and delivery care

- Breastfeeding and infant feeding practices Vaccinations and childhood illnesses
- Marriage and sexual activity
- Women's work and husband's background characteristics Women's and children's nutritional status
- Malaria prevention and treatment Domestic violence
- Awareness and behaviour regarding HIV and other STIs Adult mortality including maternal mortality

In the 2001/2 and 2007 ZDH Surveys, dried blood spot (DBS) samples were collected for HIV testing from all voluntary, consenting, eligible women and men, in all selected survey households. In addition, in every third household selected for the survey, venous blood specimens were collected from all eligible women and men who voluntarily consent to having the syphilis test. The protocol for the blood specimen collection and testing for syphilis and HIV was reviewed and approved by the TDRC Ethical Review Committee, the Institutional Review Board of Macro International, and CDC Atlanta.

The protocol for the blood specimen collection and analysis for the 2007 ZDHS was based on the anonymous linked protocol developed for MEASURE DHS. The protocol allows for the merging of the HIV results to the socio-demographic data collected in the individual questionnaires, provided that information that could potentially identify an individual is destroyed before the linking takes place. Eligible women and men who consented to HIV testing were asked to voluntarily provide five drops of blood from a finger prick for anonymous HIV testing. Interviewers explained the procedure, the confidentiality of the data, and the fact that the test results would not be made available to the respondent. They also explained the option of dried blood spot (DBS) storage for use in additional testing. If a respondent consented to the HIV testing, five blood spots from the finger prick were collected on a filter paper card, which a bar code label unique to the respondent was affixed. If the respondent did not consent to additional testing using their sample, the words "no further testing" were indicated on the filter paper card. Each household, whether individuals consented to HIV testing or not, was given an information brochure on HIV/ AIDS and a list of fixed sites providing voluntary counselling and testing (VCT) services grouped by province.

The ZDHS looked at a number of fertility indicators including levels, patterns, and trends in both current and cumulative fertility, the length of birth intervals, and the age at which women begin childbearing. The data on childbearing patterns was collected in the 2007 ZDHS in several ways. First, each woman was asked a series of questions on the number of sons and daughters currently living with her, the number living elsewhere, and the number who were born alive and later died. Next, a complete history of all of the woman's births was obtained, including the name, sex, month and year of birth, age, and survival status for each of the births. For living children, a question was asked about whether the child was living in the household or away. For dead children, the age at death was recorded. Finally,

information was collected on whether female respondents were pregnant at the time of the survey. (Central Statistical Office (CSO), 2009)

4.2.2. FERTILITY DETERMINANTS DESIGN

This study was nested in the ZDHS study. The study was based on fertility data collected in the ZDHS and was focused was on the women because the measurement of fertility was based on births as reported in the ZDHS. The study included all women who answered the question on whether they had a child in the year preceding the study. These women were aged between 15-49 years and were either permanent residents of the households in the sample or visitors present in the household on the night before the survey that were interviewed. Women who consented to HIV testing were also included in the survey in the analysis on HIV and fertility preferences. The data was derived from the women's questionnaire in the ZDHS. Questions considered in answering the objectives of the study were those that focused on the determinants under study. These included background characteristics (education, residential history, media exposure, etc.), birth history, knowledge and use of family planning methods, fertility preferences, marriage and sexual activity as well as HIV status. Therefore, in understanding the existing levels and patterns of fertility in Zambia over, these were the factors that were examined in order to determine just how they have influenced fertility patterns and trends

VARIABLES

Variables that were investigated in this study are shown in the table below.

Table 1: List of variables

Type of Variable	**Variable**	**Indicator**	**Measurement Scale**
Dependant	Fertility	Live births in the last one year	Nominal
Independent (underlying)	Age	Age in years	
	Marital Status	Marital Status	Nominal
	Residence	Area in which they reside i.e. rural or urban	Nominal
	Educational attainment	Highest level of education attained	Nominal
	Wealth	Wealth Index	Ordinal
	Religion	Religious denomination or affiliation	Nominal
	Marriage Age at first		Nominal

Independent (proximate)		marriage		
		Median age at first marriage		Nominal
	Contraception	Knowledge of contraception		Nominal
		Ever use of contraception		Nominal
		Current use of contraception		Nominal
		Number of children at first use of contraception		Ordinal
	Infecundity	Women who had a birth in the last 5 years, were not currently pregnant, last had a menstrual period 6 months of more ago, not currently using any contraceptive methods, not currently breastfeeding, not currently amenorrheic, not currently abstaining and currently married.		Nominal
	Sexual activity	Age at first sex		Nominal
		Recent sexual activity		Nominal
	Abstinence	Lack of sexual activity		Nominal
	Fertility preference	Desire for more children		Nominal
		Desire to limit childbearing		Nominal
		Ideal family size		Nominal
	HIV		HIV status	Nominal

4.2.2.1. SAMPLING

Considering that this study was nested in the ZDHS, the sampling method was based on that of the ZDHS. The ZDHS sampling method has been described in previous sections (4.2.1). However, the respondents who were included in the analysis were those who met the criteria described in section 4.2.2 above. The data collected from these respondents was analysed in line with the description in the following section.

4.2.2.2. DATA ANALYSIS

Data was analysed using Stata® Version 12 (Stata Corporation, College Station, Texas) (StataCorp, 2013). Firstly, the data was imported into the software programme which was used to clean the data before analysis. Data cleaning ensured that all incomplete and inconsistent entries were accounted for and excluded from the analysis.

Bongaarts fertility differential model

The indices in the Bongaarts Fertility Model were computed using a Microsoft Excel spread sheet containing the necessary formulas needed to compute the indices. The spread sheet illustrates the proximate determinants of fertility using the framework developed by John Bongaarts. The spread sheet requires information on the major proximate determinants:

- Proportion married
- Duration of postpartum infecundability
- Total abortion rate
- Sterility Contraceptive prevalence
- TFR
- It also requires information on the current method mix.

Based on this information, the spread sheet calculated the total fecundity. The effects of each of the proximate determinants in reducing fertility from the total fecundity rate to the actual TFR are displayed graphically. A second calculation allows for changing any of the proximate determinants, calculate the new total fertility rate and compare the results with the base case.

Fertility Determinants Model

In analysing the fertility determinants, the analysis was done in 3 phases using regression models. These 3 phases were the underlying determinants, proximate determinants and predictors of fertility which involved the use of backward regression to determine the main predictors of fertility.

Descriptive statistics were performed on the underlying factors in order to show the nature and distribution of the data. These included demographic data and socio-economic data. Univariate analyses were done to obtain these descriptive statistics.

Bivariate analyses were performed in order to understand the relationships between the dependent variable (births in the year preceding the survey) and the underlying, as well as proximate determinants. The underlying and proximate determinants as shown in the conceptual frame work were tested against the dependent variable.

Multivariate analysis was also done, in order to determine the most efficient model in the reduction of fertility rates over the time period of interest. Regression models were used to test the protective effect of the determinants of fertility (both underlying and proximate) on fertility in this case measured by births in the year preceding the survey. The underlying factors and proximate factors were assessed independently after which they were included in a final model. Multivariate analysis comprised of 3 models as follows: model 1, with underlying factors; model 2, with proximate factors; and model 3 with both underlying and proximate factors to determine the predictors of fertility. The regression models were used to investigate the determinants of fertility, including those that were considered in the Bongaarts fertility model. The known significant factors from literature and variables significant at $p<0.05$ using logistic regression were retained in multivariate analysis using multiple logistic regression in order to obtain the adjusted odds ratios and p-values. The coefficients and odds ratio were used to explain how these determinants influence fertility. This also helped in controlling for confounders and possible interaction. Logistic regression was appropriate in this case because the outcome variables were dichotomous and the occurrence of the events in question occurred within a specified period of time (Wassertheil-Smoller, 2003).

The variable HIV was cross tabulated with fertility preferences in order to determine the association between the two. The 2007 ZDHS was based on the anonymous linked protocol developed for MEASURE DHS and allowed for the merging of the HIV results to the socio-demographic data collected in the individual questionnaires, provided that information that could potentially identify an individual was destroyed before the linking took place. Therefore, HIV data was merged with socio-demographic data and data on fertility preferences in order to perform regression analysis. Analysis was done by cross tabulating HIV status with variables of interest by using bivariate and multivariate analysis in determining the association between HIV and the variables of interest particularly fertility preference.

4.3. ETHICAL CONSIDERATIONS

The protocol for the blood specimen collection and testing for syphilis and HIV was reviewed and approved by the TDRC Ethical Review Committee, the Institutional Review Board of Macro International, and CDC Atlanta.

Ethical clearance for the fertility determinants protocol was sought from and granted by the University Of Zambia Biomedical Research Ethics Committee (UNZABREC) in order to conduct secondary data analysis. The ZDHS dataset was obtained from CSO and Measure DHS as the datasets are provided free of charge.

5. RESULTS

5.1. POPULATION DESCRIPTION

The study focused on fertility data. This was data collected on females in the reproductive age group, 15-49 years. The total population of females sampled in the survey was 7,146. Of these, 44% resided in urban areas while 56% resided in the rural areas. Majority of the respondents were aged below 20 years. About 22% of the respondents were aged below 20 years while 20% and 19% were aged between 20-24 and 25-29 years respectively. The smallest group, those aged between 45-49 years, comprised of about 7% of the population. The population in each age group was decreasing as the age increased. Pooled results show that majority of the respondents (44%) were aged between 25-39 years with 42% of the population aged between 15-24 years. The rest of the population, 14%, was aged between 40 and 49 years. The mean age was 27 years with the median age being 26 years. This is synonymous with a young population.

About 60% of the population was recorded as married. A further break down showed that 27% of the population had never been married with less than one per cent living together. About 4% were widowed while 6% were divorced with 2% not living together. Most of the respondents, 53%, had attended primary school with about 31% attending secondary school. Five per cent had attended higher education. Approximately 10% had never attended school. The poorest people accounted for 15.8% of the population with the richest accounting for 23%. Pooled data showed that the rich constituted approximately 67% while the poor constituted 33%. During the year preceding the survey, 21% of the sample recorded having had at least one child birth. The description of the population is summarized in table 2 below.

Table 2: Description of background characteristics

Characteristic	Number (%) of Respondents	n=7146 %
Births		20.5 79.6
Age (Grouped)	15-19	22.4
	20-24	19.7
	25-29	19.2
	30-34	14.6
	35-39	10.2
	40-44	7.5
	45-49	6.5
Mean age		**27.9**
Median age		**26.0**
Current Marital Status (Grouped)	Never Married	27.2
	Married	59.7
	Living Together	0.7
	Widowed	4.4
	Divorced	5.9
	Not Living Together	2.2
Current Marital Status (binary)	Single	40.3
	Married	59.7
Residence	Urban	44.5
	Rural	55.5
Education level	No education	10.4
	Primary	53.6
	Secondary	31.4
	Higher	5.0
Education (In years)	0	10.6
	1	1.9
	2	3.6
	3	4.1
	4	7.7
	5	7.8
	6	9.3
	7	19.5
	8	6.5
	9	12.6
	10	3.4
	11	1.9
	12+	11.0
	N/R[α]	10.4
	Mean	6.5
	Median	7.0

Wealth Index	Poorest	15.8
	Poorer	17.4
	Middle	19.7
	Richer	24.3
	Richest	22.8
Wealth status [§]	Poor	33.3
	Rich	66.8
Religion	Catholic	19.1
	Protestant	79.1
	Muslim	0.4
	Other	1.3

[α] - denoted No response

[§] - a combination of the wealth index with Poorest, Poorer and Middle forming Poor and Richer and Richest forming Rich.

Fertility patterns

Fertility, represented in this study by number of births in the year preceding the study, was highest among the young population. Among those aged 25-29 years, 28% had recorded a birth in the year preceding the survey. This was the highest followed by the age groups 20-24 years (28%) and 30-34 years (25%). The distribution of births is represented in figure 1 below.

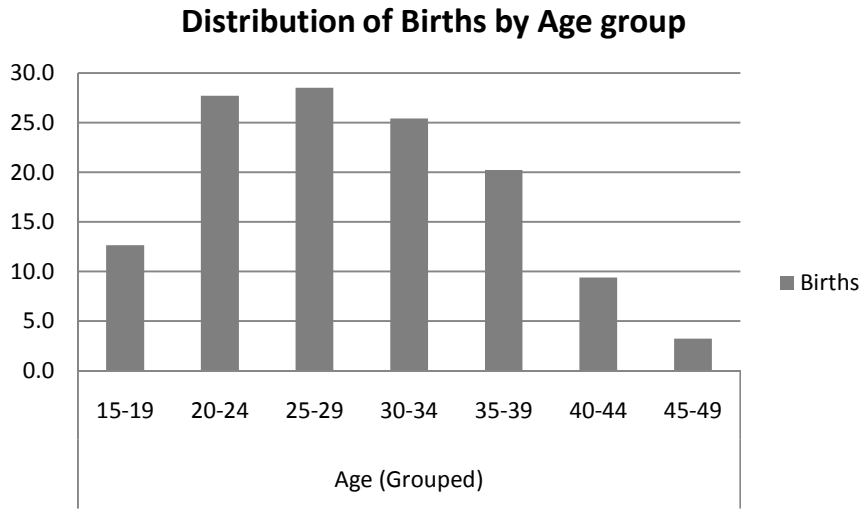

Figure 2: Percentage distribution of births across 5 year age groups.

The married women recorded the highest number of births with 27.9% having recorded a birth in the year preceding the study. About 19% of those living together recorded a birth with those not living together recording 20%. The divorced and widowed recorded 11.4% and 6.7% respectively. There were more births recorded in rural areas compared to the

urban areas. 24.8% of those residing in rural areas recorded a birth with 15.1% recorded in the urban areas.

Fertility was highest among those with no education and decreased as education level increased. Twenty-seven per cent was recorded among those with no education while those with primary education recorded 23%. Those with secondary education recorded 16% while those with higher education recorded 10%. Interestingly, a different picture was depicted when number of years in school was considered. This is represented in figure 2 below.

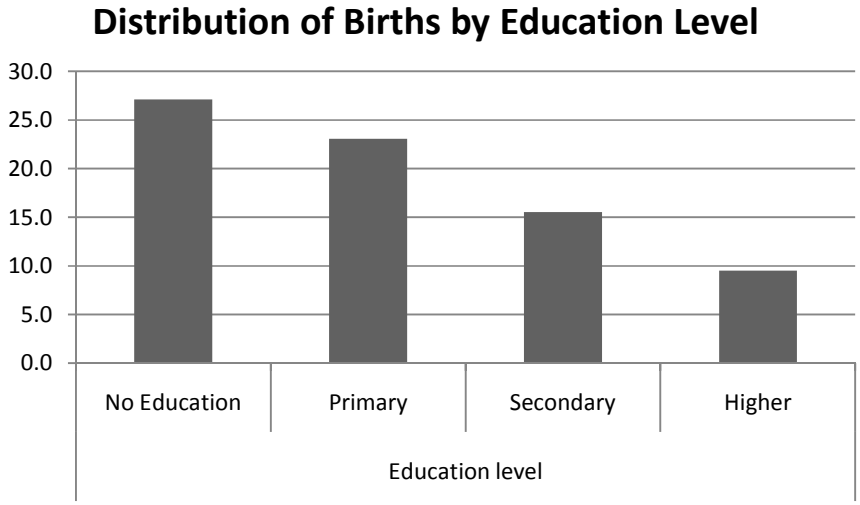

Figure 3: Distribution of births by level of education

Wealth was inversely related to fertility. The births recorded reduced as wealth status increased. The poorest recorded the most births with 28% and the richest recordng12%. The poorer, middle and richer recorded 24%, 18% and 12% respectively. However, the poor (a combination of the poorest, poor and middle) had more births (27%) that the rich (consisting of the richer and richest) (17%).

Among the various religious denominations, the Protestants recorded 21% while there was little difference between the Catholics and Muslims with 20% and 19% respectively. Other religions recorded 25% with 30% missing. The differences between the various religious denominations however were not significant (P>0.63). These findings are represented in table 3 below.

Table 3: Cross tabulation of births and all background characteristics

Characteristic		Number (%) of Respondents n=7146	%	P-Value [1]χ^2
Births (*year preceding the Survey*)		Births	No births	
Age (Grouped)	15-19	12.6	87.4	0.00
	20-24	27.7	72.3	
	25-29	28.5	71.5	
	30-34	25.4	74.6	
	35-39	20.2	79.8	
	40-44	9.4	90.6	
	45-49	3.3	96.8	
Age	15-24	19.7	80.3	0.00
	25-39	25.6	74.4	
	40-49	6.5	93.5	
Current Marital Status (Grouped)	Never Married	8.2	91.8	0.00
	Married	27.9	72.1	
	Living Together	19.2	80.8	
	Widowed	6.7	93.3	
	Divorced	11.4	88.6	
	Not Living Together	20.0	80.0	
Current Marital Status (binary)	Not Married	9.4	90.6	0.00
	Married	27.9	72.1	
Residence	Urban	15.1	84.9	0.00
	Rural	24.8	75.3	
Education level	No Education	27.1	72.9	0.00
	Primary	23.1	76.9	
	Secondary	15.5	84.5	
	Higher	9.5	90.5	
Education (In years)	0	17.4	82.6	0.02
	1	16.1	83.9	
	2	18.1	81.9	
	3	20.1	79.9	
	4	23.4	76.6	
	5	20.0	80.0	
	6	19.0	81.0	
	7 +	21.2	78.8	
	N/R [2]			

Wealth Index	Poorest	27.7	72.3	0.00
	Poorer	25.6	74.4	
	Middle	23.6	76.4	
	Richer	17.8	82.2	
	Richest	11.6	88.5	
Wealth status [3]	Poor	26.6	73.4	0.00
	Rich	17.4	82.6	
Religion	Catholic	19.7	80.3	0.63
	Protestant	20.5	79.5	
	Muslim	19.2	80.8	
	Other	25.6	74.4	
	Missing	30.0	70.0	

[1] - Pearson's Chi[2] [2] - denoted No response [3] - a combination of the wealth index with Poorest, Poorer and Middle forming Poor and Richer and Richest forming Rich

5.2. FERTILITY ANALYSIS

Analysis of the fertility data was done in two parts. The first part constituted of analysis primarily based on the Bongaarts Fertility model whereas the second part constituted of regression analysis of all the fertility determinants considered under this study. The following sections describe the results based on these analyses.

5.2.1. THE BONGAARTS FERTILITY MODEL

The percentage of those that are married (59.7%) was used as Proportion married. Duration of postpartum infecundability as reported in the ZDHS report was 13 months. (Central Statistical Office (CSO), 2009). This was what was used in the computations. Regarding abortion data, 12.5% indicated having had a pregnancy terminated. However, this includes miscarriages and still births. As such, determining the actual abortion figures proved problematic. Therefore, in the spread sheet, abortion index was indicated as 1 because there's no abortion data. Sterility contraceptive prevalence was 1.3% while total fertility rate was 6.2. Based on this information, the spread sheet calculated the total fecundity. The effects of each of the proximate determinants in reducing fertility from the total fecundity rate to the actual TFR are displayed graphically below.

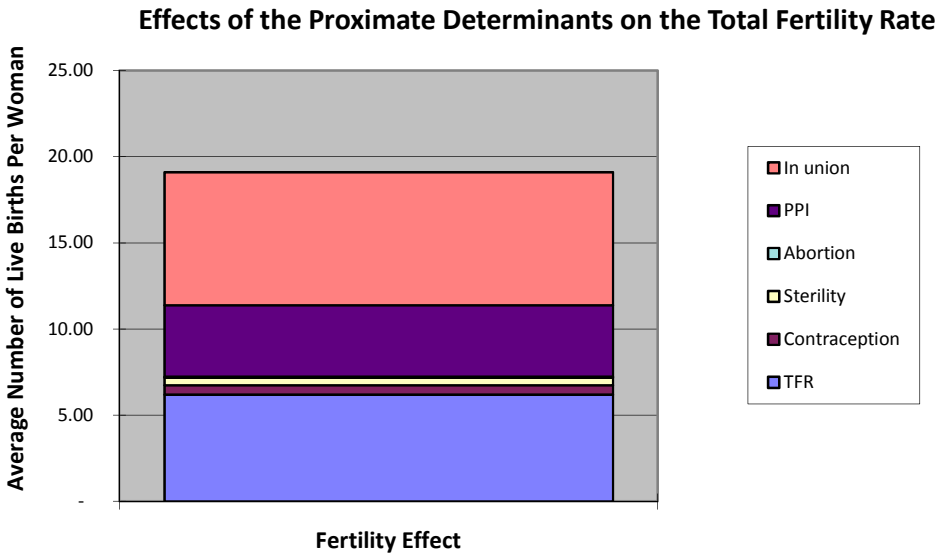

Figure 4: Percentage contribution to fertility failure.

In this study, the indices were also computed and accordingly the index of marriage (Cm) was 0.60, while index of contraceptive use (Cc) and index of postpartum infecundability (Ci) were found to be 0.92 and 0.63, respectively. As earlier indicated, the index of induced abortion was taken as one due problems determining the abortion rate since the data collected included miscarriages and still births. Regarding the fifth index, index of sterility, sterility contraceptive prevalence was used. Thus based on the five indices the TFR can be calculated indirectly using Bongaarts formula:

TFR= Cm x Cc x Ca x Ci x Cs x TF

TFR = 0.60 x 0.92 x 0.92 x 0.63 x 1.03 x 18.83 Children/woman

TFR = 6.2 children/woman

According to this, 40% of fertility reduction from its biological maximum (18.83 children/mother) is attained due to the inhibiting effect of index of marriage while the remaining two major proximate determinants, index of contraceptive use and index of duration of postpartum infecundability reduce the natural fertility by 8% and 33% from its biological maximum respectively, to attain TFR of 6.2.

5.2.2. FERTILITY DETERMINANTS

The results of these analyses are shown in the sections below.

5.2.2.1. UNDERLYING DETERMINANTS OF FERTILITY

Underlying or indirect determinants under study included age, marital status, residence, education, wealth and religion. Results from the analysis of the relationship between these factors and fertility are shown in the Table 4 below. The table shows that although there was an association between the different age groups, the association recorded was not significant for age groups below 35 years. The women in the age group 20-24 years were 22% more likely to experience child birth compared to those in the 15-19 year age group. This however was not significant at 95% confidence interval. Rural women in the 20-24 year age group have a 38% higher likelihood of experiencing childbirth compared to those aged 15-19 years (1.03-1.85 95% CI). Those aged 25-29 years have a slightly higher chance, 40%, while in age groups beyond this, the chances reduce and are not significant except for women in the age groups 40-44 years and 45-49 years. In the urban women, differences in fertility between the various age groups were insignificant with the 20-24 year age group having a 2% higher chance than the 15-19 years. The likelihood reduced in age groups older than the 20-24 year age group with the 25-29 year having 29% less chance than those aged 15-19 years.

In the case of current marital status, the married women had the highest chance of experiencing childbirth. Married women were almost 5 times likely to experience child birth compared to those that had never been married. Those who were reported as living together were over 3 times more likely to experience childbirth compare to the never married. The divorced and widowed were 65% and 47% more likely to experience childbirth compared to the never married. These patterns were similar even when residence was considered. Married women in rural areas were almost 4 times more likely to experience childbirth than those who had never married whereas those living together were over 3 times more likely. The differences between those living together and the never married were however not significant at 95% confidence interval (0.87-13.89, 95% CI). Married women in the urban were almost 7 times more likely to experience child birth than those who were never married while those who were living together were almost 4 times likely. This shows that the married women and those living together in the urban areas had a higher likelihood of having children compared to those in rural areas. This was also the case among those not living together with those in urban areas being almost 6 times more likely to have children compared to the never married in contrast to the rural areas where they were only twice as likely.

Table 4: Logistic Regression with Adjusted Odds Ratios for all underlying determinants

n=7146		TOTAL	RURAL	URBAN
Characteristic	**Births (%)**	**aOR (95% CI)**	**aOR (95% CI)**	**aOR (95% CI)**
Age				
15-19	12.6	1.00	1.00	1.00
20-24	27.7	1.22 (0.97-1.53)	1.38 (1.03-1.85)	1.02 (0.71-1.46)
25-29	28.5	1.09 (0.86-1.38)	1.40 (1.04-1.89)	0.71 (0.48-1.04)
30-34	25.4	0.86 (0.67-1.11	1.10 (0.80-1.51)	0.55 (0.36-0.84)
35-39	20.2	0.63 (0.48-0.83)	0.78 (0.55-1.10)	0.43 (0.27-0.69)
40-44	9.4	0.26 (0.18-0.37)	0.38 (0.25-0.58)	0.10 (0.04-0.21)
45-49	3.3	0.08 (0.05-0.14	0.12 (0.07-0.23)	0.02 (0.01-0.11)
Current Marital Status				
Never Married	8.2	1.00	1.00	1.00
Married	27.9	4.72 (3.77-5.91)	3.66 (2.71-4.95)	6.98 (4.93-9.88)
Living together	19.2	3.43 (1.66-7.09)	3.48 (0.87-13.89)	3.93 (1.64-9.40)
Widowed	6.7	1.47 (0.88-2.43)	1.37 (0.69-2.71)	1.84 (0.85-3.98)
Divorced	11.4	1.65 (1.13-2.40)	1.47 (0.93-2.34)	1.73 (0.87-3.43)
Not living together	20.0	3.08 (1.95-4.87)	2.06 (1.12-3.80)	5.62 (2.80-11.30)
Residence				
Urban	15.1	1.00		
Rural	24.8	1.04 (0.85-1.26)		
Education Level				
No education	27.1	1.00	1.00	1.00
Primary	23.1	0.83 (0.69-1.01)	0.82 (0.67-1.01)	1.02 (0.61-1.72)
Secondary	15.5	0.77 (0.61-0.96)	0.78 (0.59-1.04)	0.87 (0.51-1.48)
Higher	9.5	0.59 (0.37-0.91)	0.28 (0.06-1.28)	0.78 (0.40-1.49)
Wealth				
Poor	27.7	1.00	1.00	1.00
Poorer	25.6	0.92 (0.76-1.12)	0.92 (0.76-1.12)	2.30 (0.92-5.76)
Middle	23.6	0.82 (0.68-1.00)	0.81 (0.66-0.99)	1.66 (1.17-2.37)
Richer	17.8	0.67 (0.52-0.85)	0.74 (0.55-0.99)	1.17 (0.92-1.49)
Richest$^{\alpha}$	11.6	0.52(0.38-0.70)	0.50 (0.25-0.97)	(omitted)
Religion				
Catholic	19.7	1.00	1.00	1.00
Protestant	20.5	0.94 (0.81-1.10)	0.92 (0.75-1.11)	0.98 (0.76-1.28)
Muslim	19.2	0.98 (0.35-2.77)	2.07 (0.54-7.87)	0.30 (0.04-2.43)
Other	25.6	1.17 (0.69-1.99)	1.22 (0.69-2.16)	0.74 (0.16-3.52)

α - Urban figures omitted in the regression analysis because of collinearity

An inverse relationship was observed between education and fertility. As education level increased, the likelihood of experiencing childbirth reduced. Women with primary school education have a 17% less chance of experiencing child birth compare to women with no education. This reduced further among women with secondary education who have a 23% less chance compared to those with no education. Women with higher education had the least chance among them all with 41% less chance of experiencing childbirth compared to women with no education. These differences were, however, not statistically significant. Similar relationships were observed in both rural and urban areas. The disparities between the different levels of education were more pronounced in the rural areas where women with higher education were 72% less likely to experience childbirth compared to those with no education. Women with higher education in urban areas on the other hand, were only 27% less likely than those with no education to experience childbirth. In both areas, that is, urban and rural areas, these findings were not statistically significant at 95% confidence interval.

Wealth had a similar inverse relationship with fertility as education. As the wealth index increased, fertility declined. Compared to the poor, the richest were 48% less likely to experience childbirth. Comparing rural and urban women, rich women in urban areas were more likely to have children than the poor. The poorer women however, were more than twice as likely to have children as the poor women. Women in both the middle and richer wealth index were more likely to have children than the poor women. Women in the middle index were 66% more likely to experience childbirth while those in the richer index were 17% more likely to experience childbirth compared to those in the poor index.

5.2.2.2. PROXIMATE DETERMINANTS

Table 5 below depicts results from analyses conducted on the proximate determinants of fertility.

Table 5: Description of the proximate determinants of fertility

Characteristic	**n=7146**	
Births (*year preceding the Survey*)		Percent
Contraception		
Knowledge of any method	Knows no method	3.1
	Knows only folkloric	0.1
	Knows only trad. meth	0.1
	Knows modern method	96.8
Ever Used any method	Never used	37.2
	Used only folkloric	0.8
	Used only trad. method	5.6
	Used modern method	56.3
Current Usage (by method type)	Not using	70.1
	Pill	7.6
	IUD	0.1
	Injections	6.7
	Condom	5.5
	Female sterilization	1.3
	Male sterilization	0.0
	Periodic abstinence	0.9
	Withdrawal	3.0
	Other	1.0
	Norplant	0.3
	Lactational amenorrhea	3.6
	Female condom	0.1
Infecundity	Prevalence	7.6
Sexual Activity		
Age at First Sex	Mean	16.5
	Median	16.0
Recent Sexual Activity*	Never had intercourse	13.0
	Active in last 4 weeks	52.9
	Not active in last 4 weeks - postpartum	11.4
	Not active in last 4 weeks - not postpartum	22.6
Abstinence		
Currently Abstaining	No	87.8
	Yes	12.2
Fertility Preferences		

Desire for more children[β]	Wants within 2 years	11.6
	Wants after 2+ years	33.5
	Wants, unsure timing	14.1
	Undecided	8.5
	Wants no more	29.3
	Sterilized	1.3
	Declared Infecund	1.6
Ideal Family Size (Grouped)	0	0.9
	1	1.2
	2	10.1
	3	13.2
	4	26.2
	5	16.2
	6+	26.1
	Non-Numeric response	6.1
HIV		
HIV status[α]	Negative	83.4
	Positive	16.6

***** *- 0.14% had missing responses.*

α *- For HIV status, n=5,713. This includes only those who tested for HIV. Two had indeterminate results and were excluded.*

β *- 0.17% had missing responses*

With regard to contraception, knowledge of modern contraception was almost universal with 97% of the women knowing of at least one contraception method. Despite this high level of knowledge, 70% of the women were not currently using any contraception. Only about 56% of the women had ever used modern contraception methods while 37% had never used any contraception methods. Although knowledge of traditional methods was almost non-existent (0.07%), almost 6% of the women had used these methods.

Infecundity was also measured and the prevalence was reported as 7.6%. infecundity was measure as a composite variable and included only women who had a birth in the last 5 years, were not currently pregnant, last had a menstrual period 6 months of more ago, not currently using any contraceptive methods, not currently breastfeeding, not currently amenorrheic, not currently abstaining and currently married.

The type of contraception methods that they were currently using was rather varied. Among the most used were the pill (8%), injection (7%), male condom (6%), lactational amenorrhea (4%) and withdrawal method (3%). Surprisingly, 70% of the women were not currently using any contraception method reflecting very low usage of contraception. Slightly over half of the women reported being sexually active. Fifty-two per cent of the women reported having had sex in the four week before the study while 13% reported never having had sex. The mean age at first sex was 16.5 years although it ranged between 7 years and 36 years.

With regard to fertility preferences, about 60% of the women desired to have more children. A third (33%) of the women wanted children after 2 years while about 12% wanted children within 2 years. Fourteen per cent were unsure of the timing whereas almost 30% did not want any more. With regard to ideal family size, majority of the women – about 82% – were inclined to more than 3 children. Thirteen per cent wanted 3 children where as 26.2% and 26.1% wanted 4 and 6 or more children respectively. Less than 1% reported zero as their ideal family size. Out of the 5,713 women who consented to HIV testing, 16.6% tested positive for HIV. These were the women whose results were able to be linked.

The results presented in table 6 show that fertility was highest among women who knew only folkloric methods, 33%, and modern methods 21% of contraception. This was statistically significant at 95% confidence ($P<0.05$) indicating a strong relationship between fertility and knowledge of contraception methods. With regard to "ever used any contraception method", fertility was highest among women who used only traditional methods at 29%. Women who only used folkloric methods recoded 25% fertility while those who used modern methods reported 24%. Fertility was lowest among those who had never used any contraceptive method. Current usage by method type showed that fertility was highest among women who used lactational amenorrhea (75%) as a contraception method. Women currently using withdrawal method reported 36% fertility whereas those using any other method reported 32%. Those women using condoms as a method of contraception reported 23% fertility. Fertility was lowest among women who reported using female sterilisation, 4%, as a contraceptive method.

Sexual activity was also reported for women aged 15-49 years. The mean age at first sex for these women was 16.5 years while the median age at first sex was 16 years. With regard to recent sexual activity, fertility was highest, 71%, among women who were not sexually active and were postpartum abstinent after the birth of last child while women who were active in the last 4 weeks reported 20%. Women who were not active in the last 4 weeks but were not postpartum abstinent after the birth of their last child reported 8% fertility where as women who had never had any intercourse did not record ant births and thus fertility was 0.

Women who were reported as currently abstaining reported 71% fertility while those who were not currently abstaining reported 13%. With regard to fertility preferences, women who wanted more children after 2 or more years reported the highest fertility at 32% while those who wanted no more children reported 22%. Among women with low fertility were those who were declared infecund (0.9%), wanted children within 2 years (6%) and those who wanted more children but were unsure of the timing (7%) who reported being sterilised. In relation to ideal family size, fertility increased with ideal family size. Fertility was highest among women preferred 5 or more children (25%) and lowest among those who preferred none (9%).

A statistically significant relationship, at 95% confidence interval, between HIV status and fertility was also reported. Women who were HIV negative had a higher fertility (21%) than those who were HIV positive (16.6%)

Table 6: Cross tabulation of births and all proximate determinants of fertility

Characteristic	Number (%) of Respondents		n=7146 %	P-Value Chi2*
Births (*year preceding the Survey*)		Births	No births	
Contraception				
Knowledge of any method	Knows no method	9.6	90.5	0.000
	Knows only folkloric	33.3	66.7	
	Knows only trad. Meth	0.0	100.0	
	Knows modern method	20.8	79.2	
Ever Used any method	Never used	14.0	86.0	0.000
	Used only folkloric	25.4	74.6	
	Used only trad. method	28.5	71.5	
	Used modern method	23.9	76.2	
Current Usage (by method type)	Not using	18.1	81.9	0.000
	Pill	15.7	84.4	
	IUD	0.0	100.0	
	Injections	15.9	84.1	
	Condom	22.5	77.5	
	Female sterilization	4.3	95.7	
	Male sterilization	0.0	100.0	
	Periodic abstinence	18.0	82.0	
	Withdrawal	35.7	64.4	
	Other	31.9	68.1	
	Norplant	0.0	100.0	
	Lactational amenorrhea	74.6	25.4	
	Female condom	0.0	100.0	
Sexual Activity				
Age at First Sex	Mean	16.5		
	Median	16.0		
Recent Sexual Activity	Never had intercourse	0.0	100.0	0.000
	Active in last 4 weeks	20.0	80.0	
	Not active in last 4 weeks – postpartum abstinence after the birth of the last child	71.2	28.9	
	Not active in last 4	7.7	92.3	

	weeks - not postpartum abstinence after the birth of the last child			
Abstinence				
Currently Abstaining	Yes	71.0	29.0	0.000
	No	13.4	86.6	
Fertility Preferences				
Desire for more children	Wants within 2 years	6.4	93.6	0.000
	Wants after 2+ years	32.1	67.9	
	Wants, unsure timing	6.9	93.2	
	Undecided	17.7	82.3	
	Wants no more	21.9	78.1	
	Sterilized	4.3	95.7	
	Declared infecund	0.9	99.7	
Ideal Family Size (Grouped)	0	9.1	90.9	0.000
	1	13.8	86.2	
	2	16.1	83.9	
	3	16.5	83.5	
	4	18.0	82.0	
	5	25.0	75.0	
	6+	24.0	76.0	
	Non Numeric Response	22.8	77.2	
HIV				
HIV status*				
	Positive	16.6	83.4	0.001
	Negative	21.2	78.8	

** - For HIV status, n=5,713. This includes only those who tested for HIV. Two had indeterminate results and were excluded.*

Further analysis, as shown in table 6, revealed that even though there were associations in fertility by knowledge of type of contraceptive method, these associations were not statistically significant. Women who only knew folkloric methods of contraception were twice more likely to have higher fertility than women who did not know of any contraception method (OR 2.09; 0.16-27.88 95% CI). On the other hand, women who knew only modern methods of contraception were 17% less fertility than women who did not know of any contraception method (OR 0.83; 0.41-1.67 95% CI). Similarly, disparities by ever used any contraception, the association was also not statistically significant. Disparities between rural and urban were also not statistically significant except in urban areas among women who had ever used traditional methods and women who had never used any contraception method. The former were more than twice more likely to have high fertility than latter (OR 1.52; 1.01-2.29 95% CI).

With regard to current usage of contraception, statistically significant associations were observed for male condom, withdrawal method and lactational amenorrhoea. Women who currently used male condoms as a contraceptive method were 1.87 times more likely to have higher fertility than women who were not using any contraceptive method (OR 1.87; 1.36-2.59 95% CI). Women who were currently using withdrawal method were over 3 times more likely (2.10-5.10 95% CI) to have higher fertility while those using lactational amenorrhoea were over 10 times more likely (7.03-16.70 95% CI) to have higher fertility than those who were not using any contraceptive method. Similar disparities were observed in both rural and urban areas. However, urban women who used lactational amenorrhoea as a contraceptive method were more likely to have higher fertility than rural women.

With regard to recent sexual activity, a statistically significant association was observed between fertility and women who were not active in last 4 weeks because they were postpartum abstinent after the birth of the last child. This was also the case in both rural and urban areas with these women being 57% less likely to have higher fertility than women who have never had sexual intercourse.

There was also an association between desire for more children and fertility. Statistically significant associations were observed among women who wanted more children after 2 or more years (3.63-7.43 95% CI), women who were undecided on whether they wanted more children (1.34-3.38 95% CI) and women who wanted no more children (2.03-4.25 95% CI). This was the case for both rural and urban women except for urban women who were undecided on the number of children they wanted for who the association was not significant. With regard to ideal family size, there was no significant association with fertility. This was also the case for both urban and rural areas. This is reflected in the following table.

Table 7: Adjusted Odds Ratio of proximate determinants of fertility among women 15-49 in Zambia

n=7146	TOTAL	RURAL	URBAN
Characteristic			
Births (year preceding the Survey)	**aOR (95% CI)**	**aOR (95% CI)**	**aOR (95% CI)**
Contraception			
Knowledge of any method			
Knows no method	1.00		
Knows only folkloric	2.09 (0.16-27.88)	2.64 (0.18-38.26)	1.00
Knows only trad. Meth [α]	1.00	1.00	
Knows modern method	0.83 (0.41-1.67)	1.00 (0.47-2.16)	0.68 (0.11-4.12)
Ever Used any method			
Never used	1.00		
Used only folkloric	0.98 (0.38-2.51)	0.82 (0.29-2.33)	1.83 (0.17-19.38)
Used only trad. meth.	1.06 (0.70-1.61)	0.87 (0.54-1.42)	1.92 (0.81-4.55)
Used modern method	1.09 (0.87-1.38)	1.00 (0.75-1.32)	1.52 (1.01-2.29)
Current Usage			
Not Using	1.00	0.68 (0.41-1.12)	1.51 (0.96-2.38)
Pill	0.98 (0.71-1.35)	1.00	1.00
IUD [α]	1.00	0.77 (0.47-1.25)	1.51 (0.93-2.46)
Injections	1.02 (0.72-1.43)	1.00	1.00
Condom	1.87 (1.36-2.59)	1.96 (1.25-3.10)	1.90 (1.17-3.06)
Female sterilization	1.24 (0.41-3.72)	1.16 (0.24-5.60)	1.29 (0.28-6.08)
Male sterilization [α]	1.00	1.00	1.00
Periodic abstinence	1.52 (0.68-3.39)	1.78 (0.65-4.85)	1.07 (0.24-4.87)
Withdrawal	3.28 (2.10-5.10)	2.57 (1.48-4.47)	5.25 (2.50-11.02)
Other	1.99 (0.95-4.15)	1.99 (0.80-4.93)	2.03 (0.54-7.57)
Norplant [α]	1.00	1.00	1.00
Lactational amenorrhea	10.83 (7.03-16.70)	1.00	20.16 (7.83-51.95)
Female condom [α]	1.00	8.69 (5.29-14.27)	1.00
Sexual Activity			
Age at First Sex	0.88 (0.73-1.07)	1.14 (0.88-1.47)	0.66 (0.50-0.88)
Recent Sexual Activity			
Never had intercourse	1.00		
Active in last 4 weeks	1.42 (0.70-2.87)	1.64 (0.71-3.79)	0.80 (0.19-3.40)
Not active in last 4 weeks - postpartum	0.41 (0.32-0.53)	0.43 (0.31-0.60)	0.43 (0.29-0.65)
Not active in last 4 weeks - not postpartum	0.99 (0.06-15.70)	1.00	7.41 (0.42-131.50)

Abstinence			
Currently Abstaining			
No	1.00		
Yes	8.94 (4.50-17.76)	7.93 (3.52-17.84)	17.43 (4.18-72.66)
Fertility Preferences			
Desire for more children			
Wants within 2 years	1.00		
Wants after 2+ years	5.19 (3.63-7.43)	6.31 (3.98-10.00)	3.48 (1.95-6.19)
Wants, unsure timing	1.35 (0.83-2.18)	1.40 (0.74-2.66)	1.24 (0.60-2.58)
Undecided	2.13 (1.34-3.38)	2.24 (1.21-4.13)	1.75 (0.86-3.59)
Wants no more	2.94 (2.03-4.25)	3.26 (2.02-5.27)	2.21 (1.23-3.98)
Ideal Family Size (Grouped)			
0	1.00		
1	0.99 (0.24-4.00)	1.20 (0.14-10.09)	0.82 (0.11-5.84)
2	1.18 (0.37-3.79)	1.60 (0.31-8.27)	0.86 (0.15-4.92)
3	1.18 (0.37-3.74)	1.59 (0.32-7.94)	0.90 (0.16-5.10)
4	1.05 (0.33-3.30)	1.25 (0.26-6.07)	0.80 (0.14-4.50)
5	1.46 (0.46-4.62)	1.68 (0.35-8.17)	1.06 (0.18-6.05)
6+	1.58 (0.50-4.95)	1.78 (0.37-8.59)	1.09 (0.19-6.19)
Non-Numeric response	1.50 (0.45-4.96)	1.72 (0.34-8.72)	1.02 (0.15-6.95)

α *- Dropped in the regression because it predicts failure perfectly.*

5.2.2.3. INFECUNDITY IN ZAMBIA

Infecundity for purposed of this study was defined as the inability to produce live offspring. Infecundity was computed for women who had a birth in the last 5 years, were not currently pregnant, and last had a menstrual period 6 months or more ago, not currently using any contraceptive methods, not currently breastfeeding, not currently amenorrheic, not currently abstaining and currently married. Findings revealed that the prevalence rate for infecundity stood at 7.6%. Infecundity was highest among women aged 40-44 years (14.3%) and lowest among women aged 15-19 with less than 1% being infecund. Rural-urban distribution showed that infecundity was higher in rural areas (8.6%) compared to urban areas (6.4%). Distribution by region or province showed that infecundity was highest in Luapula and Central provinces which had prevalence rates of 10.1% and 9.7% respectively. Infecundity rates were lowest in Copperbelt and Southern provinces with rates standing at 5.1% and 5.6% respectively.

5.2.2.4. FERTILITY DRIVERS

The results (see Table 9) showed that when all the determinants are taken into consideration, the association between all age groups was significant. This was the case for marital status where there were significant associations between fertility and marital status except for those reported as living together (0.38-2.43 95% CI). The association between

fertility and residence was also not significant implying that disparities in fertility between rural and urban may be due to other factors besides residence itself. Education level had an inverse relationship with fertility although the association between the two was not statistically significant. The same was the case with regard to wealth. The association with religion was also not significant.

The association between fertility and age at first marriage was also not significant as was the association with knowledge of contraception method and ever used any contraception method. The association between fertility and current usage by contraceptive method yielded some significant results. This was the case for male condom (2.21-5.28 95% CI), withdrawal method (2.23-6.12 95% CI), female sterilisation (1.03-17.62 95% CI), lactational amenorrhoea (5.05-14.15 95% CI) and other methods (1.17-7.92 95% CI) beside those listed in the table below. The p-value and wide confidence interval the case of female sterilisation indicate that the association is not strong. Other significant associations that were observed were among the women who were active in the last 4 weeks prior to the study.

Table 8: Regression model fitting all determinants (underlying and proximate) with adjusted odds ratios

Characteristic	aOR (95% CI)
Age (Grouped)	
15-19	1.00
20-24	0.77(0.49-1.22)
25-29	0.56(0.35-0.89)
30-34	0.36(0.22-0.61)
35-39	0.27(0.15-0.48)
40-44	0.11(0.05-0.22)
45-49	0.04(0.01-0.10)
Current Marital Status (Grouped)	
Married	1.00
Not Living Together	1.00
Living Together	0.96(0.38-2.43)
Divorced	0.07(0.03-0.17)
Never Married	0.10(0.05-0.18)
Widowed	0.46(0.23-0.92)
Residence	
Urban	1.00
Rural	1.01(0.72-1.43)
Education level	
No Education	1.00
Primary	1.09(0.75-1.59)
Secondary	0.97(0.62-1.51)
Higher	0.59(0.25-1.38)
Wealth Index	
Poorest	1.00
Poorer	0.95(0.67-1.36)
Middle	1.10(0.77-1.58)
Richer	1.02(0.66-1.59)
Richest	0.89(0.52-1.53)
Religion	
Catholic	1.00
Protestant	0.88(0.66-1.18)
Muslim	1.01(0.22-4.54)
Other	1.45(0.59-3.55)
Missing	0.35(0.00-28.73)

Age at First Marriage	1.00
5-9 [α]	1.00
10-14	0.26(0.00-66.09)
15-19	0.27(0.00-68.09)
20-24	0.40(0.00-103.85)
25-29	0.28(0.00-73.80)
30-34	0.59(0.00-177.54)
35+ [β]	1.00
Knowledge of any Contraceptive method	
Knows no method	1.00
Knows only folkloric	5.17(0.08-347.95)
Knows only trad. Meth [α]	1.00
Knows modern method	1.06(0.35-3.17)
Ever Used any Contraceptive method	
Never used	1.00
Used only folkloric	1.28(0.37-4.43)
Used only trad. meth.	0.75(0.44-1.30)
Used modern method	0.79(0.57-1.09)
Current Contraceptive Usage	
Not Using	1.00
Pill	0.95(0.64-1.40)
IUD [α]	1.00
Injections	1.26(0.85-1.85)
Male Condom	3.42(2.21-5.28)
Female sterilization	4.25(1.03-17.62)
Male sterilization [α]	1.00
Periodic abstinence	2.09(0.79-5.51)
Withdrawal	3.69(2.23-6.12)
Other	3.05(1.17-7.92)
Norplant [α]	1.00
Lactational amenorrhea	8.46(5.05-14.15)
Female condom [α]	1.00
Age at First Sex	0.93(0.71-1.21)
Recent Sexual Activity	
Never had intercourse	1.00
Active in last 4 weeks	6.06(2.10-17.51)
Not active in last 4 weeks - postpartum	1.13 (0.81-1.58)
Not active in last 4 weeks - not postpartum	8.59 (0.29-255.74)

Currently Abstaining	
No	1.00
Yes	6.17 (2.30-16.60)
Desire for more children	
Wants within 2 years	1.00
Wants after 2+ years	5.52 (3.52-8.64)
Wants, unsure timing	2.27 (1.01-5.13)
Undecided	4.61 (2.55-8.34)
Wants no more	7.09 (4.34-1.56)
Sterilized [β]	1.00
Declared Infecund [α]	1.00
Ideal Family Size (Grouped)	
0	1.00
1	1.08 (0.10-11.49)
2	1.75 (0.23-13.50)
3	1.82 (0.24-13.76)
4	1.49 (0.20-11.06)
5	1.80 (0.24-13.45)
6+	2.65 (0.36-19.65)
Non-Numeric response	2.43 (0.31-19.02)
HIV Status	
Negative	1.00
Positive	0.81 (0.60-1.10)

α *- Dropped in the regression model because it predicts failure perfectly.*

β - *Omitted from the regression model due to collinearity*

With all these determinants having an influence on fertility either directly or indirectly, we examined which determinants can be deemed predictors of fertility. Using backward step regression, a model was fitted to determine which determinants are predictors of fertility. Below are the results. The table shows the determinants that were significant at $p \leq 0.05$ level. The model began with an empty model and included only predictors that were statistically significant.

Table 9: Predictors of fertility using Backward Step Multiple Regression with births as dependent variable

Character	Odds Ratio (95% CI)
Age (Grouped)	0.69 (0.65-0.73)
Current Marital Status	0.57 (0.51-0.64)
Currently Abstaining	29.58 (22.17-39.46)
Ideal Family Size	1.14 (1.07-1.21)
Current Contraceptive Use	1.16 (1.14-1.19)

The table above shows that predictors of fertility for women in Zambia were their age, their current marital status, whether they are currently abstaining or not, what they perceive as their ideal family size and their current contraceptive use.

5.3. HIV AND FERTILITY PREFERENCES

Majority of the women (59%) indicated that they would prefer to have another child whereas about 30% preferred not to have any more children. Of those women who preferred to have another child, about 11% wanted to have the child within 2 years, 33% wanted the child after 2 years and about 14% were unsure of the timing. With regard to the ideal number of children, majority of the women were inclined towards larger numbers of children. Twenty six per cent thought 4 children would be ideal while a further 26% thought 6 or more children would be ideal. Slightly over 16% thought 5 children would be ideal whereas 13% thought 2 children would be ideal. About 1% thought one child would be ideal.

With regard to prevalence of HIV among women, of the women who consented to HIV testing, 16.6% were HIV positive.

Regression models were also done to test the effects of the explanatory variables (in this case fertility preference, desire for more children, ideal number of children and HIV status) on the outcome variable, births, in order to determine their relationship. The results are displayed in the table below.

Table 10: Adjusted Odds Ratios from regression model testing births, HIV status and fertility preferences

Characteristic	aOR (95% CI)
HIV STATUS	
HIV Negative	1.00
HIV Positive	0.85 (0.70-1.03)
Desire for more children	
Wants within 2 years	1.00
Wants after 2+ years	7.82 (5.51-11.11)
Wants, Unsure of Timing	1.49 (0.97-2.29)
Undecided	3.99 (2.65-6.03)
Wants no more	4.79 (3.36-6.84)
Sterilized	0.66 (0.20-2.21)
Ideal Number of Children (grp)	
0	3.35 (0.88-12.80)
1	3.64 (1.11-12.01)
2	3.24 (0.99-10.64)
3	3.61 (1.11-11.73)
4	5.30 (1.63-17.27)
5	5.01 (1.54-16.25)
6+	5.86 (1.76-19.47)

Although HIV positive women are 15% less likely to experience childbirth, this disparity is not statistically significant (0.70-1.03 95% CI). There were significant differences in fertility preferences among women who were HIV positive and those who were HIV negative. Table 8 below shows these differences.

Table 11: Fertility preferences by HIV status

n=5,715	HIV Negative	HIV Positive
	aOR (95% CI)	aOR (95% CI)
Desire for more children		
Wants no more	1.00	1.00
Wants within 2 years	0.20 (0.14-0.30)	0.23(0.10-0.53)
Wants after 2+ years	1.56 (1.32-1.85)	2.05(1.37-3.09)
Wants, Unsure of Timing	0.27 (0.20-0.37)	0.75(0.38-1.46)
Undecided	0.82 (0.62-1.09)	0.85(0.42-1.71)
Sterilized	0.11 (0.03-0.44)	0.33(0.04-2.54)
Declared Infecund	1.00	1.00
Ideal Number of Children (grped)		
0	1.00	1.00
1	2.37 (0.57-9.86)	2.03 (0.44-9.33)
2	3.03 (0.91-10.12)	1.49 (0.51-4.34)
3	2.74 (0.83-9.08)	1.31 (0.46-3.74)
4	3.42 (1.04-11.19)	0.86 (0.31-2.41)
5	4.95 (1.51-16.24)	1.29 (0.44-3.80)
6+	4.53 (1.39-14.79)	1.52 (0.54-4.27)
Non-numeric response	5.60 (1.67-18.77)	1.00

Desire for more children was higher among women who were HIV positive. Compared to those who wanted no more children, HIV negative women were 20% more likely to want a child within the next 2 years where as HIV positive women were 23% more likely to want a child within 2 years. HIV positive women were more than twice as likely to want a child after 2 years compared to HIV negative women who were 1.5 times more likely to want a child after 2 years.

The ideal number of children, however, was higher among HIV negative women. HIV positive women seemed to be more inclined to smaller numbers of children compared to HIV negative women. Interestingly, disparities between the two groups (HIV negative and HIV positive women) were not statistically significant at 95% confidence interval.

5.4. EDUCATION AND FERTILITY

An inverse relationship was observed between fertility and education. As years of education increased, fertility levels declined. Fertility was highest among those with 3 years of education at 29%. Beyond this, it continued to reduce with increase in years to about 7% among women with 11 years of education. Among women with more than 12 years of education, the fertility levels fluctuated with women more than 16 years of education recording no fertility. Figure 5 bellow illustrates the relationship between education and fertility.

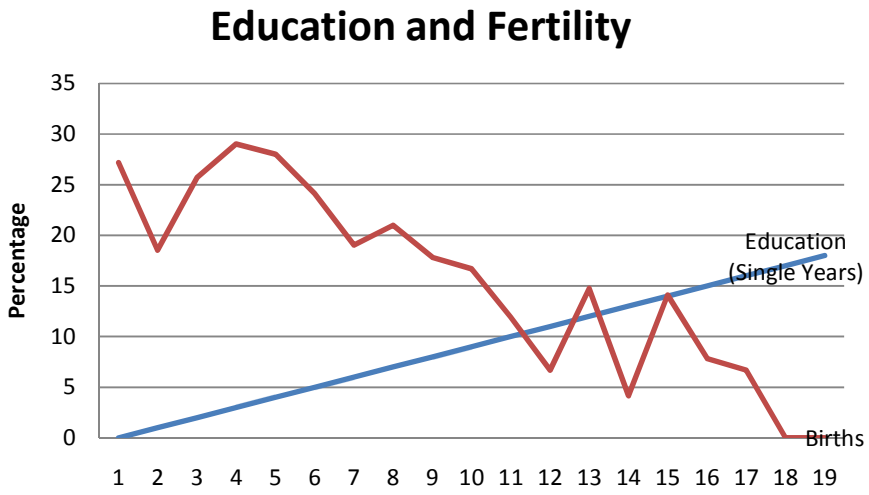

Figure 5: Relationship between Education and fertility

6. DISCUSSION

It was established that both underlying and proximate determinants have significant influences on fertility in Zambia. Education, wealth, age, marriage, contraception and sexual activity all influence on fertility in Zambia and the interaction of these factors can determine whether increases or decreases. There was also a statistically significant association between HIV status and desire for children, with the desire for children being higher among women who were HIV positive. However, there was no statistical difference in fertility between the HIV positive and HIV negative women.

The findings of this study determined that fertility was higher among the younger women as evidenced by the high number of births among women aged below 35 years. Women aged 20-24 were 22% more likely to give birth while those aged 25-29 years were 9% more likely than those aged 15-19 years. This can be largely attributed to the women's biological clock in which female reproduction usually peaks at ages between 20 and 29 years. According to the website MelbourneIV (MelbourneIVF, 2013), once a woman turns 36, her chances of conceiving are naturally halved compared to her chances at 20 years of age. This implies that younger women will naturally tend to have higher fertility than older women.

An inverse relationship was observed between fertility and education as well as fertility and wealth. As the level of education increased, fertility declined. Similar findings have been shown in other studies (Chani et al., 2011, Mekonnen and Worku, 2011, Ushie et al., 2011) . It was found that fertility was almost twice as high among uneducated women in comparison to women with higher education. The fertility reducing effects of education may be due to delayed pregnancy and marriage among the educated women because they spend more time in school. Educated women tend to postpone marriage (Adhikari, 2010) which seems to be a driver of fertility as the highest fertility rates are recorded among married women. Furthermore, educated women are more likely to be aware of contraception methods than women with no education. More educated women (39%) used at least one contraception method compared to uneducated women (28%). As such, educated women may prefer to limit their family sizes to smaller numbers than those with little or no education. This may also contribute to the fertility inhibiting effects of education. An inverse relationship was reported between wealth and fertility. Fertility was also almost twice as high among poor women as the richest women. This is also consistent with findings from other studies (Jara et al., 2013, Adhikari, 2010, Weerasinghe, 2002). This may be attributed to the child preferences and access to and usage of contraception among the richer women (Weerasinghe, 2002). Richer women may also delay child birth and have wide birth intervals which may contribute to their low fertility rates.

With regard to the contraception, knowledge of at least one modern contraceptive method was almost universal. About 97% of the women reported knowing at least one method. While knowledge was almost universal, only about 56% had ever used a modern

contraceptive method and 70% were not currently using any contraceptive method. Although reasons for this disparity were beyond the scope of this study, it can be assumed that the women do not translate the knowledge into behaviour change through which usage can be increased. The low usage of contraception (30%), however, could account for the low inhibiting effect of contraception on fertility. Findings from the Bongaarts proximate determinants model showed that contraception accounted for only 8% in the reduction of fertility from its biological maximum. These findings are consistent with those found in Uganda where contraception had the least fertility inhibiting effects (Moses and Kayizzi, 2007).

Significant associations were observed between births and specific contraception methods such as male condom, withdrawal method and lactational amenorrhoea. Compared to those not using any contraception methods, women who used these 3 methods had significantly higher fertility. These methods rank among the less effective methods of contraception and use of these methods may result in unintended or unplanned pregnancies. According to the Centre for Disease Control and Prevention (CDC), 22 out of every 100 women who use withdrawal method as a contraception method experience unintended pregnancy in the first year of typical use of the method. In the case of male condoms, 18% of women experience unintended pregnancy. With regard to lactational amenorrhoea, it has been deemed an effective but temporal method and may also result in unintended pregnancies(CDC, 2011). Therefore, this may account for the observed higher fertility among women who use these 3 methods.

Of all the women in the study, 59% reported being married. Married women recorded the highest percentage of births and had the highest odds of giving birth. Furthermore, with the mean age at first marriage being 15 years, marriage as an institution is likely to contribute significantly to fertility due to women being exposed to pregnancy at an early age. Raj et al (Raj et al., 2009) found that there was a significant association between early marriage or child marriage and high fertility after controlling for duration of marriage. This may be the case in this study although such analysis was not conducted. Adhikari (Adhikari, 2010) also found that age at first marriage was one of the contributing factors for high fertility. However, although married women contributed the most towards fertility, marriage had the highest fertility inhibiting effect accounting for 40% fertility reduction from its biological maximum of 18.83 children per mother. This effect could be attributed to considerably high contraception use among married women with about 60% of the married women reported using at least one form of contraception. The most common modern methods included the pill (11%), injections (9%) and male condom (5%). Other methods included lactational amenorrhoea (6%) and withdrawal method (5%). This suggests that family planning methods targeted at married women may have a huge impact on fertility reduction.

Desire for more children was significantly associated with high fertility. Fertility among women who wanted children after 2 years or more was almost 5 times higher than women who wanted children within 2 years. This was the case in both rural and urban areas with the fertility being higher in rural areas. Interestingly, although fertility was lower among HIV positive women compared to HIV negative women, the desire for more children was higher among the HIV positive women compared to those who were HIV negative. This association was significant for women who wanted more children with in 2 years and in 2 or more years. Similar findings which show increased desire for more children among HIV positive people and People Living with HIV/AIDS (PLWHA) have been observed. Mmbaga et al. (Mmbaga et al., 2013) found that fertility desire and intention of PLWHA was substantially high though lower than that of the general population in Tanzania. In America, it was found that overall, 28-29% of HIV-infected men and women receiving medical care in the United States desire children in the future. Among those desiring children, 69% of women and 59% of men actually expect to have one or more children in the future (Chen et al., 2001). This fertility desire can be attributed to individual perceived health and socio-family related factors. This may also be due to the availability of Anti-retroviral Therapy and Prevention of Mother-to-Child Transmission programs which have seemingly increased the chances of HIV women having HIV negative babies. An understanding of the factors that contribute this form the basis for further research as they were not explored in this study.

Postpartum infecundity, as reported in the findings, had an inhibiting effect of 33%. This suggests that prolonged breastfeeding has the potential to contribute to fertility reduction. These findings are similar to those found in Ethiopia (Alene and Worku, 2009) and Malawi (Palamuleni, 2010) where it was found that postpartum infecundity had a dominant inhibiting effect. The only difference is that whereas in these studies postpartum infecundity was the most dominant, in the case of Zambia, it was the second most dominant.

Infecundity prevalence in Zambia among women aged 15-49 years was at 7.6%. The definition of infecundity was based on the World Health Organisation (WHO) definition, which is referred to as secondary infecundity. The reported prevalence of 7.6% represents a decline from 18.8% as reported by the WHO in 2004 (Rutstein and Shah, 2004) in the same age group. Infecundity was highest among women aged 40-44 years (14.3%) and lowest among women aged 15-19 with less than 1% being infecund.

Rural-urban distribution showed that infecundity was higher in rural areas (8.6%) compared to urban areas (6.4%). Distribution by region or province showed that infecundity was highest in Luapula and Central provinces which had prevalence rates of 10.1% and 9.7% respectively. Infecundity rates were lowest in Copperbelt and Southern provinces with rates standing at 5.1% and 5.6% respectively.

Disparities in fertility rates in terms of residence were similar to those recorded in other studies. Fertility rates were significantly higher in rural areas than in urban areas. Analysis of fertility and residence while controlling for age, marital status, education, wealth and

religion showed that there was no significant difference between urban and rural residence. This is similar to findings reported in previous studies (Ahmad, 1985). This suggests that although fertility rates were higher in rural areas, this may be due to other factors other than residence itself. These disparities could be due to the fertility reducing effects of factors such as wealth and education being stronger in urban areas than in rural areas (Hollos and Larsen, 1992).

7. CONCLUSION

High fertility rates, as have been reported in Zambia, have far reaching consequences. The major consequence especially for a developing country like Zambia is that these high fertility rates lead to rapid population increase. If this population increase is not coupled with development and economic growth, this results in a strain on the limited resources that are available. Resultantly, the general population will lack the necessary social amenities such as access to quality health care, education, clean water and employment. Therefore, where economic resources are scarce, it may be prudent to manage fertility by influencing its determinants.

It has been shown that the major predictors or drivers of fertility for women in Zambia are age, current marital status, sexual activity, ideal family size and current contraceptive use. It has also been shown that the determinants which contribute towards fertility reduction from its biological minimum were marriage, postpartum infecundity and contraception. The combined effect of these drivers and inhibitors of fertility will thus determine the fertility rates and the population growth rate.

Therefore, with the knowledge of the drivers and inhibitors of fertility, this information can be used to shape policy and devise strategies that can be aimed at managing fertility in Zambia. Any measures aimed at maintaining fertility levels that do not strain the resources of the country should take into consideration these drivers and inhibitors. Success in managing fertility levels can only be achieved through strategies that focus on the determinants that have the largest inhibiting effect on fertility while negating the effects of the drivers of fertility.

8. LIMITATIONS

The study was not without limitations. Firstly, the research focused on the 2007 ZDHS because this was the most recent version of the ZDHS. This may have implication in that similar research may yield different results from those presented above. It is recommended that similar research be conducted using more recent data.

Secondly, the research only focused on women and did not include males. Although males were not included in the study, culturally, they play a major role in fertility preferences which have a bearing on fertility rates (Ibisomi and Odimegwu, 2011). This is more so in rural areas where cultural norms and values may be stronger in comparison to urban areas. This, however, can be further investigated by examining the socio-cultural determinants of fertility in Zambia.

9. RECOMMENDATIONS

From the above findings, the following recommendations can be made;

- Education and wealth: Based on the inverse relationship between fertility and education, and fertility and wealth, enhancing women's education levels and wealth status can contribute to fertility reduction. Devising programs that target these factors can greatly contribute to fertility reduction. Promoting female education has the advantage of also delaying marriage by increasing the age at marriage. This is because young women will spend more time on thus reducing their exposure to. Furthermore, improving the wealth status among women will also have a profound effect on fertility. Raising the socio-economic status of the women can greatly influence the levels of fertility as this will impact on their fertility preferences and age at first marriage among other things.
- Contraception: Contraception use (or lack of use) can be both a driver and inhibitor of fertility as has been shown. Promoting contraceptive use can also contribute to fertility reduction. Although knowledge of modern contraceptive methods is almost universal, there's a gap in terms of usage of contraceptives. Translating this knowledge into behavioural change to get the women to use these methods can ultimately result in reduction in fertility rates. Further research into the reasons why women do not use these contraceptive methods may prove vital in influencing this behaviour change.
- Marriage: Marriage is a driver and inhibitor of fertility. Marriage as an institution contributes greatly to fertility because most children are born among married women. However, the fact that married women have high contraceptive prevalence rates and are most likely to use contraceptives is something that should be exploited. Encouraging contraception usage, particularly modern methods of contraception, can greatly impact on the existing high fertility rates through inhibiting fertility among married women.
- Postpartum Infecundity: Postpartum infecundity, an inhibitor of fertility, has the potential to contribute significantly to fertility reduction. Promotion of breastfeeding can aid in fertility reduction. With campaigns focussing on breastfeeding children for 2 years and also on the benefits of breastfeeding to child development that are currently being conducted, the effects that breastfeeding has on fertility could be a positive "side-effect" as it will contribute to fertility management. Therefore, continuation of these messages can prove vital in fertility management.
- Fertility Preferences: This is a driver of fertility. Promoting the economic and social benefits of smaller families can help in reducing fertility rates in Zambia.
    - HIV and Fertility: With fertility preferences being high among HIV positive women, there is an unmet need for family planning services in this population. With 88% of the women who are HIV positive being sexually active, promotion of contraception use is not only vital in managing fertility in this demographic but also essential in reducing the spread of HIV/AIDS.

10. REFERENCES

ADHIKARI, R. 2010. Demographic, socio-economic, and cultural factors affecting fertility differentials in Nepal. *BMC Pregnancy and Childbirth,* 10.

AHMAD, S. 1985. Rural–urban differentials in marital fertility in four Muslim populations. *Journal of Biosocial Science,* 17, pp 157-166. doi:10.1017/S0021932000015613.

ALENE, G. D. & WORKU, A. 2009. Estimation of the total fertility rates and proximate determinants of fertility in North and South Gondar zones, Northwest Ethiopia: An application of the Bongaarts' model *Ethiop.J.Health Dev.,* 23, 19-27.

BAYLIES, C. 2000. The impact of HIV on family size preference in Zambia. *Reprod Health Matters.,* 8(15):, 77-86.

BOERMAA, J. T. & WEIR, S. S. 2005. Integrating Demographic and Epidemiological Approaches to Research on HIV/AIDS: The Proximate-Determinants Framework. *The Journal of Infectious Diseases,* 191(Suppl 1).

BONGAARTS, J. & POTTER, J. E. 1983. Fertility, biology and behavior. *New York: Academic Press*.

CDC. 2011. *Effectiveness of Contraception Methods* [Online]. Available: http://www.cdc.gov/reproductivehealth/UnintendedPregnancy/PDF/effectiveness_of_contraceptive_methods.pdf [Accessed 19-07 2013].

CENTRAL STATISTICAL OFFICE (CSO), M. O. H. M., TROPICAL DISEASES RESEARCH CENTRE (TDRC), UNIVERSITY OF ZAMBIA, AND MACRO INTERNATIONAL INC. 2009 Zambia Demographic and Health Survey 2007. Calverton, Maryland, USA CSO and Macro International Inc.

CHANI, M. I., SHAHID, M. & HASSAN, M. U. 2011. Some Socio-economic determinants of fertility in Pakistan:An Empirical Analysis. *Munich Personal RePEc Archive.* Munich University Library.

CHEN, J. L., PHILIPS, K. A., KANOUSE, D. E., COLLINS, R. L. & MIU, A. 2001. Fertility desires and intentions of HIV-positive men and women. *Fam Plann Perspect,* 33, 144-52, 165.

CHENG, C. & RAJULTON, F. 1992. Determinants of fertility decline in China, 1981: analysis of intermediate variables. *Soc Biol,* 39, 15-26.

CSO 2002. 2000 Census of Population and Housing, Presentation of Selected Indicators. Lusaka, Zambia: Central Statistical Office.

CSO 2012. 2010 Census of Population and Housing; population Summary Report. Central Statistical Office

DAVIS, K. & BLAKE, J. 1956. Social structure and fertility: an analytical framework. *Econ Dev Cult Change,* 4:211–35.

DZEKEDZEKE, K. & NYANGU, N. 1994. Fertility Patterns and Their Determinants. *DHS Regional Analysis Workshop fro Anglophone African.*

HOLLOS, M. & LARSEN, U. 1992. Fertility differentials among the Ijo in southern Nigeria: does urban residence make a difference? *Soc Sci Med.,* 35, 1199-210.

IBISOMI, L. & ODIMEGWU, C. 2011. Understanding resolution of differential fertility preferences among couples in Nigeria. *International Journal of Business and Social Science,* Vol 2, 98-105.

ISLAM, M. M., ISLAM, M. A. & CHAKROBORTY, N. 2004. Fertility transition in Bangladesh: understanding the role of the proximate determinants. *J Biosoc Sci,* 36, 351-69.

JARA, D., DEJENE, T. & TAHA, M. 2013. 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,* 3, 9-17.

JUHN, C., KALEMLI-OZCAN, S. & TURAN, B. 2008. HIV and Fertility in Africa: First Evidence from Population Based Surveys. *JEL No. I12,J13,O12*.

LETAMO, G. 1996. Contributions of the proximate determinants to fertility change in Botswana. *J Biosoc Sci. ,* 28(3):, 325-38.

LEWIS, J. J. C., RONSMANSB, CARINE , EZEHC, ALEX GREGSONA, SIMON 2004. The population impact of HIV on fertility in sub-Saharan Africa. *AIDS,* Vol 18 S35–S43.

MAYER., K. 1962. Developments in the Study of Population. *Social Research.,* 29, 292–320.

MEKONNEN, W. & WORKU, A. 2011. Determinants of fertility in rural Ethiopia: the case of Butajira Demographic Surveillance System (DSS). . *BMC Public Health,* 11:.

MELBOURNEIVF. 2013. *Effect of Age* [Online]. Available: http://mivf.com.au/about-fertility/female-reproductive-system/effect-of-age-on-fertility [Accessed 17-07 2013].

MMBAGA, E. J., LEYNA, G. H., EZEKIEL, M. J. & KAKOKO, D. C. 2013. Fertility desire and intention of people living with HIV/AIDS in Tanzania: a call for restructuring care and treatment services. *BMC Public Health,* 13, 86.

MOFNP, M. O. F. A. N. P. 2010. Zambia : Population Factors & National Development. Lusaka.

MOSES, L. Y. A. & KAYIZZI, J. B. 2007. Using the Bongaarts model in explaining fertility decline in Urban areas of Uganda. *Fifth African Population Conference.* Arusha.

MYER L, C. R., KATYAL M, TORO P, EL-SADR WM, ET AL. 2010. Impact of Anteretroviral Therapy on Incidence of Pregnancy of among HIV-Infected Women in Sub-Saharan Africa: A Cohort Study. *PLoS Medicine,* 7(2).

NATTABI, B., LI, J., THOMPSON, S. C., ORACH, C. G. & EARNEST, J. 2009. A systematic review of factors influencing fertility desires and intentions among people living with HIV/AIDS: implications for policy and service delivery. *AIDS Behav.,* 13(5):, 949-68.

OMRAN, A. R. 2005. The Epidemiologic Transition: A Theory of the Epidemiology of Population Change. *The Milbank Quarterly,* 83, 731-757.

PALAMULENI, M. 2010. Fertility decline in Malawi: An analysis of the proximate determinants. *Journal of Social Development in Africa* Vol 25.

PORTA, M. 2008. *A Dictionary of Epidemiology,* New York, Oxford University Press.

RAJ, A., SAGGURTI, N., BALAIAH, D. & SILVERMAN, J. G. 2009. Prevalence of child marriage and its effect on fertility and fertility-control outcomes of young women in India: a cross-sectional, observational study. *The Lancet,* 373, 1883-1889.

RUTSTEIN, S. O. & SHAH, I. H. 2004. Infecundity, Infertility, and Childlessness in Developing Countries. *DHS Comparative Reports No. 9. Calverton.* Maryland, USA: ORC Macro and the World Health Organization.

SIBANDA, A. 1999. Reproductive change in Zimbabwe and Kenya: the role of the proximate determinants in recent fertility trends. *Soc Biol. ,* 46(1-2):, 82-99.

STATACORP. 2013. *Stata Release 12* [Online]. Available: http://www.stata.com/stata12/ 2013].

TEY, N. P., NG, S. T. & YEW, S. Y. 2012. Proximate determinants of fertility in peninsular Malaysia. *Asia Pac J Public Health,* 24, 495-505.

USHIE, M. A., AGBA, A. M. O., OLUMODEJI, E. O. & ATTAH, F. 2011. Socio-cultural and economic determinants of fertility differentialsin rural and urban Cross River State, Nigeria. *Journal of Geography and Regional Planning,* 4(7), 383-391.

VAN ROSSEM, R. & MEEKERS, D. 2007. The reach and impact of social marketing and reproductive health communication campaigns in Zambia. *BMC Public Health* 7:352.

WASSERTHEIL-SMOLLER, S. 2003. *Biostatistics and epidemiology : A primer for health and biomedical professionals,* New York, Springer-Verlag New York, Inc.

WEERASINGHE, D. P., PARR, NICHOLAS J. 2002. Effect of Wealth on Marital Fertility in Sri Lanka. *J Health Popul Nutr,* 20, 112-119.

YEATMAN, S. 2009. The impact of HIV status and perceived status on fertility desires in rural Malawi. *AIDS Behav. ,* Suppl 1: . 12-9.

11. APPENDIX

11.1. BUDGET

ITEM	QUANTITY	UNIT COST	TOTAL
Printer	1	1,500,000	1,500,000
Toner	1	1,200,000	1,200,000
A4 Ream of paper	5	150,000	750,000
External hard disc	1	1,000,000	1,000,000
Flash disc (4GB)	3	150,000	450,000
Transport	1	1,000,000	1,000,000
Data verification	1	5,000,000	5,000,000
Data extraction and cleaning	2	5,000,000	10,000,000
Data analysis	1	5,000,000	5,000,000
Binding of proposals	5	250,000	1,250,000
The University of Zambia Research Ethics Committee fees	1	1,000,000	1,000,000
Binding of the final report	5	250,000	1,250,000
Poster	1	1,000,000	1,000,000
Communication	1	1,200,000	1,200,000
Publication of findings in Journal	1	4,000,000	4,000,000
Total			**35,600,000**
Contingency (10%)			**3,560,000**
GRAND TOTAL			**39,160,000**

11.2. WORK PLAN

Activity	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13
Protocol development									
Presentation to graduate forum									
Submission to UNZABREC									
Data Analysis									
Report Writing									
Submission to Assistant Dean									
Publication									

11.3. ETHICAL CLEARANCE