Trends and determinants of adolescent fertility in Zimbabwe

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ABSTRACT

This study examines the trends and socio-demographic determinants of adolescent fertility in Zimbabwe. The study uses all six ZDHS surveys that have been conducted for Zimbabwe between 1988 and 2015. Adolescent fertility trends were examined using age-period and cohort-period fertility estimates. The Poisson regression model and the tfr2 module developed by Schoumaker (2013) are used to calculate age-period fertility estimates (ASFRS). Cohort- period fertility rates (CPFRs) were calculated using a method developed by Moultrie, Dorrington, Hill et al. (2013b). ASFRs and CPFRs trends were constructed for the 15 year prior to each ZDHS survey. The trends in both the ASFRS and CPFRs showed that total fertility and 5-year fertility levels above the age of 20 years has significantly declined from the late 1980's to the mid to around 2010 and since 2010 the fertility levels in these age groups have remained almost constant. However, fertility levels in the 15-19 years age group have been fluctuating around 110 births per 1000 women with no sign of a declining trend since around 1985. The second part of the analysis investigated the socio-demographic factors that have been influencing adolescent fertility in Zimbabwe.

Two multiple logistic regression models based on the McDevitt, Adlakha, Fowler *et al.* (1996) model of proximate determinants of adolescence fertility were used to examine the association between eight socio-demographic factors and adolescent fertility. Results of logistic regression analysis revealed that a significant association exists between adolescent fertility and use of contraception, age at first sex, age of the respondent, marital status, highest level of education attended and employment status at the time of the survey. The odds of giving birth prior to each survey were higher among adolescents who had ever used contraception, initiated sexual activities at a very young age, older adolescents, were married, with low level of education ever attended and those who were unemployed at the time of the survey. This study concluded that adolescent (15-19 years) fertility rates have remained high despite a decrease in all the other age specific and total fertility rates. There is need to introduce and evaluate existing policies and programs that focus on improving socio-economic conditions of adolescents women in Zimbabwe.

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1 INTRODUCTION

1.1 Background

Adolescent childbearing is a global challenge. Globally, an estimated 16 million women below the age of 20 years give birth every year. One of the United Nations 17 Sustainable Development goals (SDGs) is to ensure good health and wellbeing for all by 2030. Adolescent childbearing is one of the measures being used to monitor this goal with all countries targeting to provide quality sexual and reproductive health services to people of all ages. Most adolescent births occur in the developing world and they are often unplanned and unwanted births (Chandra-Mouli, Camacho and Michaud 2013). Studies that were conducted on Sub Saharan Africa countries show that adolescent fertility is influenced by various environmental, demographic and socioeconomic factors. Several studies has shown that the likelihood of adolescent fertility is high among adolescents living in rural areas, the less educated and those affected by poverty (Chandra-Mouli, Svanemyr, Amin *et al.* 2015; Krugu, Mevissen, Prinsen *et al.* 2016; Silberschmidt and Rasch 2001).

Zimbabwe has experienced a significant decline in total fertility between 1990 and 2010 (Schoumaker 2010). However, estimates published in ZDHS official reports indicates adolescent fertility rates have been fluctuating with no sign of decline, despite a significant decline in all the other five year age-specific and total fertility levels. Zimbabwe endorsed the 1994 International Conference on Population and Development programme of Action. Since then, the government in partnership with various organizations, has been working on ensuring that all adolescent women are supported to attain at least secondary education and prevent early childbearing. Laws and policies aiming to reduce adolescent childbearing have been formulated. For example, in 2013 the government adjusted the legal age of marriage from 16 to 18 years.

1.2 Problem Statement

Adolescent fertility has adverse health and socioeconomic outcomes on both the adolescent mothers and their babies. Life threatening pregnancy and birth complications including obstructed labor, complications of abortion, and post-partum sepsis are more common among adolescent mothers compared to older mothers (Macleod and Tracey 2010; Tsui, Creanga and Ahmed 2007). Infants born to adolescent mothers are more likely to be delivered preterm and have a low birth weight. Prematurity is one of the main causes of infant mortality. Taking care of the baby require energy and time, this limits the time available for other activities such as schooling. As a result the young mothers rarely continue with their education after giving birth (Eloundou-Enyegue 2004). In addition to risk of unintended pregnancies, adolescents involved in sexual relationships are also at risk and getting sexually transmitted infections (STIs) such as HIV/AIDS due to limited access to condoms and most of them lack knowledge on the possible consequences of having unprotected sex. In developing countries, women who start childbearing during the adolescent period are more likely to have poor educational achievements, limited job opportunities, low earnings and live in poverty (Umberson, Crosnoe and Reczek 2010).

A considerable body of literature on adolescent sexual and reproductive health exists for Zimbabwe. However, there is a lack of comprehensive research that attempts to understand the determinants of adolescent childbearing. This study is based on the argument that, to deal with the various consequences of adolescent fertility, there is need to identify and address factors that promote adolescent fertility. Therefore, the study investigates the socio-demographic determinants of adolescent fertility in Zimbabwe.

1.3 Research objectives

The main aim of this study is to examine the trends and socio-demographic determinants of adolescent fertility in Zimbabwe, focusing on a 30 year period from 1985 to 2015.

1.3.1 Specific Objectives of the study

This aim is translated into the following 3 specific objectives.

1. To derive age-period estimates of adolescent fertility in Zimbabwe.
2. To derive cohort-period estimates of adolescent fertility.
3. To analyse the relationship between adolescent fertility and socio-demographic factors in Zimbabwe.

1.3.2 Research Questions

The study is directed by 2 key research questions:

1. Is adolescent fertility declining in Zimbabwe?
2. What is the relationship between adolescent fertility and various socio-demographic factors in Zimbabwe?

1.4 Study organization

The study consists of five chapters. Chapter 1 presents the background, problem statement and aim of the study. Chapter 2 present a review of literature on the trends and determining factors of adolescent fertility. The literature focuses mainly on previous studies conducted on Sub Saharan Africa and Zimbabwe. The second chapter also presents an overview of the conceptual framework proposed for this study. The third chapter provides an overview of the data and methods used to address the study objectives. Chapter 4 presents the results obtained from applying the methods described in the third chapter. The thesis concludes in chapter 5 by presenting a discussion on the major findings, limitations and recommendations of the study.

2 LITERATURE REVIEW

A review of literature on adolescent fertility is presented in this chapter. The review is focused mainly on previous studies conducted for Sub Saharan Africa and Zimbabwe. The chapter also presents an overview of the theoretical framework adapted to examine the socio-demographic factors related to adolescent fertility in Zimbabwe in this particular research.

The adolescent period is a very critical phase of life, many psychosocial, biological and physiological changes occur during this phase. If not handled correctly, this period can result in negative reproductive health outcomes for adolescent women such as unwanted or unintended pregnancies. Adolescent childbearing can put a young woman and her baby at risk of life threatening birth complications. It can also have major socio-economic implications, as many adolescent mothers have start providing for themselves and their babies (Chandra-Mouli, Svanemyr, Amin *et al.* 2015). The issue of adolescent childbearing is a global challenge. However, adolescent fertility levels vary across regions, with the highest levels being observed in the Sub Saharan Africa region (Haub 2013). Therefore, it is crucial to understand the determinants of adolescent childbearing in Sub Saharan Africa and implement programmes that effectively address the problem.

2.1 Adolescent Childbearing in Sub Saharan Africa

Approximately 2.5 million women below the age of 20 years give birth in the developing world every year and Sub Saharan Africa accounts for most of these births (Loaiza and Liang 2013; Neal, Matthews, Frost *et al.* 2012). Adolescent fertility rates also vary across Sub Saharan Africa. According to Clifton and Hervish (2013), adolescent fertility rates across the continent varied from below 50 to 150 births per 1000 adolescent women in 2013, with the lowest rates being observed in Southern Africa and the highest in Central Africa. In an effort to explain why adolescent childbearing have remained very high in the Sub Saharan Africa region than the rest of the world, some the researchers have analysed the factors influencing adolescent childbearing in different parts of region. Place of residence marital status, education, use of contraception and poverty were identified as the major factors contributing to adolescent fertility in most of the most studies.

Odimegwu and Mkwananzi (2016) conducted a multi- country study on the factors influencing adolescent childbearing in Africa, their findings show that in East and Southern Africa adolescent fertility is associated with poverty, women unemployment and family disruptions whereas in West Africa it is only associated with community poverty. Their study also give some important insights on the trends of adolescent fertility from 1992-2011, the fertility rates increased moderately in Southern Africa, remained almost constant in West Africa while a downward trend was experienced in East Africa. The findings of a study that was conducted by Ojo, O. Jelili and Akindele (2013) suggests that residential density influence adolescent fertility in Nigeria, high prevalence of adolescent fertility is observed in high density suburbs compared to low density suburbs.

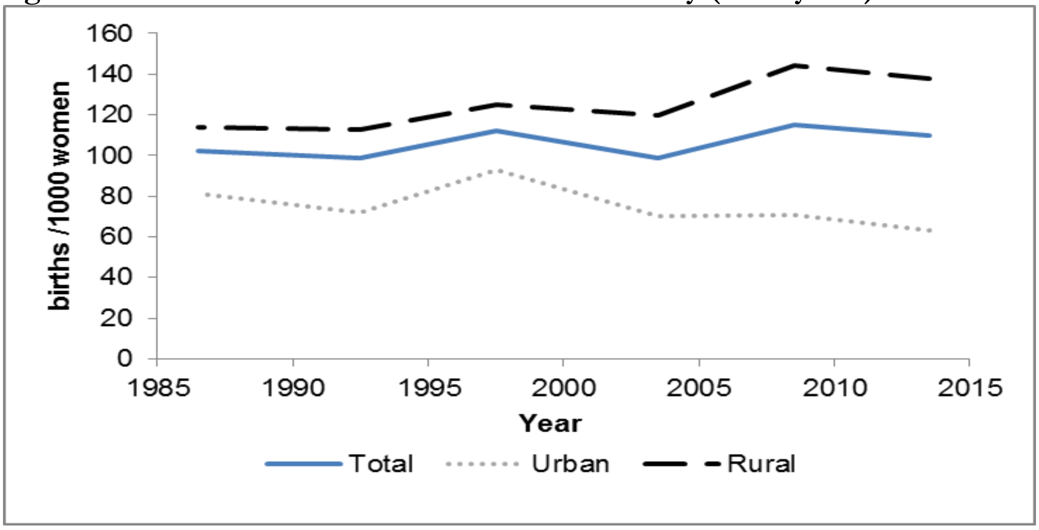
According to a study that was conducted by Alemayehu, Haider and Habte (2010) using the 2005 Ethiopian DHS data, age, employment status, educational attainment, marital status , use of contraceptives, place of residence and postpartum infecundability were identified to be the major drivers of adolescent fertility in Ethiopia. This study also revealed that about one in every adolescent women in Ethiopia had already started childbearing. A similar study was conducted by Nwogwugwu (2013) using the 2007 Zambian DHS and he concluded that marital status, age of the woman, use of modern contraception, residential area, educational attainment and age at marriage are the major influencing adolescent fertility in Zambia. According to Palamuleni (2017), the major determinants of adolescent fertility in Malawi in 2010 were level of education, access to media, wealth index and partner's occupation status. The author used data from the 2010 Malawi DHS and in his conclusion he acknowledges that these determinants are likely to change in the subsequent surveys. The study also shows that 20 per cent of adolescent women had started childbearing at the time of Malawi DHS survey of 2010.

2.1.1 Adolescent Fertility in Zimbabwe

According to an analysis on adolescent childbearing that was conducted by Clifton and Hervish (2013), more than one in every five adolescent women from rural areas are likely to begin childbearing before the age of 18 in Zimbabwe, Colombia and Senegal. They also point out that, in these countries the prevalence of adolescent fertility is higher among adolescents from poor families compared to those from wealthy backgrounds. Chawhanda (2013) used the 2010 Zimbabwean DHS to determine the proximate factors influencing adolescent fertility in the country. The author identified age at first sex, marital status and use of contraception as the major drivers of adolescent fertility.

Figure 2.1 shows the trend the adolescent fertility rates between 1988 and 2015, according to official DHS results for Zimbabwe. The graph shows that adolescent fertility is higher in rural areas than in urban areas. In recent years (2005-2015) a significant decline in adolescent fertility has occurred in urban areas whereas an increase has occurred in rural areas. The total fertility in this age group has remained almost constant in this age group from around 1985 to 2015.

Figure 2.1 Published estimates of adolescent fertility (15-19 years) for Zimbabwe



Source: (ICF 2015)

2.2 Consequences of adolescent fertility

Adolescent childbearing in developing countries has been linked with limited employment opportunities and educational attainment, poverty and increased chances of being a single parent (Umberson, Crosnoe and Reczek 2010). However, controversy surrounds the association between adolescent fertility and socio-economic factors. According to human capital theory, the most significant human capital investments are education and work experience (Becker 1994). Women who become mothers whilst still in school are likely to drop out of school to take care of their babies. As a result, this may have negative impacts on their educational achievements and job opportunities later in life. Klepinger, Lundberg and Plotnick (1999) examined the effect of human capital investment on adolescent childbearing. The authors found that adolescent childbearing has adverse impacts on formal education achievements and work experience. These reductions in human capital investment affect the wages and socio-economic well-being of adolescent mothers later in life. Controlling for background socioeconomic characteristics, Urdinola and Ospino (2015) found that adolescent mothers hold lower level jobs. Their study also revealed the young mothers are more likely to experience domestic violence and unstable marriages compared to women who delay childbearing to a later age. According to Urdinola and Ospino (2015), negative socioeconomic outcomes among young mothers reflects losses in investment of human capital due to early initiation of childbearing. Empirical data generated from a study that was conducted by Oyefara (2009) indicates that in Osun State Nigeria, women who initiate childbearing before the age of 20 are at higher risk of being divorced, unmarried or separated and have a poor socio-economic status later in life compared to their counterparts who delay childbearing at least until the age of 20.

On the other hand, the social perspective controverts that the reason adolescent fertility is related to adverse socio-economic outcomes is that it occurs mostly among adolescents from less privileged families (Geronimus, Korenman and Hillemeier 1994). As a result of generational cycles of poverty, even if these women were to delay childbearing past adolescent ages they would probably still have poor socioeconomic outcomes. Coley and Chase-Lansdale (1998) argue that negative socio-economic factors may result from early childbearing or cause women to start childbearing at an early age therefore the casual relationship is two-way.

Adolescent childbearing has many health consequences on both the adolescent mothers and their babies. The risk of maternal mortality as well as pregnancy and birth complications including preeclampsia, prolonged labour, preterm delivery, haemorrhage and post-partum sepsis is higher among adolescent mothers compared to older mothers (Chandra-Mouli, Camacho and Michaud 2013; Macleod and Tracey 2010; Tsui, Creanga and Ahmed 2007). Ganchimeg, Ota, Morisaki *et al.* (2014) used data from 29 low-income countries to analyse the negative health outcomes of pregnancy and childbirth among adolescent women. They found that babies born to adolescents were more likely to have a low weight at birth, suffer from severe health conditions such as malnutrition and have lower survival chances in the neonatal period compared to those born to women older than 19 years. Hodgkinson, Beers, Southammakosane *et al.* (2014) point out those most adolescent mothers reside in impoverished households and this can impact their psychological well-being, child rearing and behaviour of their children. In Sub Saharan Africa, many adolescents who become pregnant delay seeking health care due to the fear of being stigmatized, punished or chastised for their sexual behaviour.

Furthermore, adolescent women who engage in sexual relationships are at higher risk of getting sexually transmitted diseases such as HIV/AIDS. Younger adolescents are at a greater risk than older adolescents as many lack knowledge on the possible consequences of having unprotected sex (Clark 2004). Even in countries where condoms are available to adolescents, consistent use can be compromised by nature of their relationships: young women involved in intergenerational or transactional sexual relationships are less inclined to have capacity to demand utilizing a condom (Laga, Schwärtlander, Pisani *et al.* 2001).

In Zimbabwe, there is evidence that low socio-economic status among adolescent women from rural areas is related to adolescent marriages, high risk sexual behaviours, poor educational outcomes and increased risk of mental health disorders (Pascoe, Langhaug, Mavhu *et al.* 2015). According to the authors, some of the high-risk sexual behaviours among adolescent women include having numerous sexual partners, early initiation of sex and being involved in transactional sex relationships with older men.

2.3 Models of the determinants of fertility

Fertility can be classified as natural or controlled fertility. A population that does not use birth control methods such as contraception and induced abortion has natural fertility. Natural fertility is determined by biological and socio- behavioural factors such as onset of menarche and menopause, postpartum insusceptibility, spontaneous intrauterine mortality, age at marriage and span of breastfeeding period (Henry 1961). On the other hand, controlled fertility is governed by the total number of children born and desired parity levels. Couples who prefer large families may increase their chance of conceiving by tracking the women's ovulation period whereas couples who wish to delay or limit births may abstain from sex or use artificial methods of controlling births. Models of the determinants of fertility were developed from the idea of natural and controlled fertility.

Davis and Blake (1956) developed a framework with eleven intermediate variables through which any environmental, socio-economic, cultural and demographic variables influence fertility. They grouped the eleven intermediate variables into three categories. The first category consist of six factors that affect exposure to intercourse which are age of entry into sexual union, proportions of women never entering sexual unions, amount of reproductive period spent after or between unions, voluntary abstinence involuntary abstinence and coital frequency. The second category includes three that influence exposure to conception which are fecundity as affected by in voluntary causes, fecundity as affected by involuntary causes and use of contraception. The third category has two factors that affect gestation and successful parturition gestation variables which are foetal mortality from involuntary causes and foetal mortality from voluntary causes.

Bongaarts (1978, 1982) refined Davis and Blake's framework into seven factors. This brought about a simpler and more powerful framework for analysing fertility using fewer variables. According to Bongaarts, the seven intermediate variables are marriage, induced abortion, fecundability, postpartum infecundability, perpetual sterility, contraception and natural intrauterine mortality. These seven variables were termed as the proximate determinants of fertility.

2.4 Proximate determinants of fertility

Bongaarts (1982) further demonstrates that out of the seven proximate determinants of fertility only four determinants are most important in terms of explaining differentials in fertility levels of populations. These four factors are the proportion of married women, induced abortion, duration of postpartum insusceptibility and utilization and adequacy of contraception. A review of literature on these four factors is presented in the sub-sections below.

2.4.1 Contraception

Limited access to contraception and family planning services can also influence the prevalence of adolescent fertility in a population. Maharaj (2001) contends that adolescent women remain at high risk of unplanned pregnancies and sexually transmitted diseases because their use of contraceptive methods is still very low. A qualitative study on the challenges faced by adolescent women in accessing contraception and family planning services was conducted in Limpopo, South Africa by Wood and Jewkes (2006). In spite of the fact that public health centres offer services on family planning and contraceptives for free, they found that these services are not being fully utilized and a third of women become pregnant during the adolescent period. The barriers to use of contraception among adolescent women includes pressure from their sexual partners to prove their fecundity, lack of accurate knowledge on conception and fear of having contraceptive side effects (Alli, Maharaj and Vawda 2013). On the other hand, there are also societal and health system challenges to use of contraception among adolescent women. In a study that was conducted for Malawi by Paz Soldan (2004), negative attitude from health workers, poor quality of service, fear of being labelled as promiscuous and fear of developing side effects from contraception were identified as some of the reasons for not using contraceptives among adolescent women.

The results of a study that was conducted by Mturi and Joshua (2011) suggests that a significant decline in total fertility from 7 to 3.8 births per 1000 women that occurred in Zimbabwe between 1980 and 2006 was a result of high prevalence in use of contraception. According to Remez, Woog and Mhloyi (2014), in Zimbabwe about 15 per cent of married women of reproductive age (15-49 years) have an unmet need for modern contraception, whereas about 60 per cent have access to modern contraception. However, the use of contraception among adolescents in Zimbabwe is still very low. While 20 per cent of married adolescents have an unmet need for contraception, around 35 per cent have access to modern contraception. There are also urban and rural differentials in the use of contraception among adolescent women in Zimbabwe. Remez, Woog and Mhloyi (2014) point out that most adolescents who use modern contraception reside in urban areas although the use of contraception among those from rural areas has significantly improved over the years.

2.4.2 Postpartum infecundability

According to a study that was conducted by Sibanda, Woubalem, Hogan *et al.* (2003) on the direct factors influencing fertility in Ethiopia, postpartum insusceptibility was the most significant proximate factor in reducing fertility in some urban and rural areas in 1990. In addition to postpartum infecundability, use of contraception was the only other crucial direct determinant of fertility in most urban areas. Duration of postpartum insusceptibility is often measured by the span of breastfeeding period. Stover (1998) argues that as use of modern contraception has significantly improved over the years, the use of contraceptives that coincide with postpartum insusceptibility is becoming more important in populations that support intensive breastfeeding for long periods and sexual abstinence among young people. In a study that was conducted by Letamo and Letamo (2001) on the influence of proximate factors on fertility transition in Zimbabwe, Zambia and Botswana, the use of modern contraceptive and breastfeeding were found to be the major factors influencing fertility decline in these countries.

A study that was conducted in Zimbabwe by Maxwell, Mukora-Mutseyekwa, Zvinavashe *et al.* (2015) revealed that there is higher prevalence of exclusive breastfeeding for at least 6 months among adolescents and less educated mothers compared to older and more educated mothers. The variation in breastfeeding practices by level of education can be attributed to the fact that women with higher levels of education are often professionals with limited maternity leave period and they have usually have other alternatives to breastfeeding. The authors identified lack of knowledge on the importance of breastfeeding, low male involvement in antenatal care, pressure to quickly introduce the infant to other food stuffs from in-laws and religious beliefs as the major barriers to exclusive breastfeeding among adolescent mothers in Zimbabwe.

2.4.3 Abortion

Globally, more than three quarters of unsafe abortions occur in developing countries (Chandra-Mouli, Camacho and Michaud 2013). Abortion is illegal in many Sub Saharan Africa countries such as Zimbabwe; as a result the termination of unwanted pregnancies among adolescent women is usually done either through consulting friends or by traditional healers (Bearinger *et al*, 2007). In Zimbabwe, permission to terminate pregnancies is only granted in cases of life threatening pregnancy complications or rape. However, even under these circumstances, access to legal abortion is rare due to complicated and frustrating administrative procedures and the process is very expensive. As a result most women who wish to terminate their pregnancies end up resorting to unsafe methods. Little is known about induced abortion rates in Zimbabwe since most abortions are illegal and undocumented. Sully, Madziyire, Riley *et al.* (2018) made the first attempt in 2016 to estimate abortion incidence in Zimbabwe. They estimated the national incidence to be 18 abortions per 1000 women aged 15-49. Provincial estimates showed great variation with Mashonaland provinces recording a high of 21 abortions per 1000 women whilst Masvingo and Manicaland had the lowest rates of 12 abortions per 1000 women (Sully, Madziyire, Riley *et al.* 2018). It is however worth mentioning that these estimates should be taken with caution due to the scarcity of abortion data in the country.

2.4.4 Marriage

A variation in fertility levels by marital status is likely to exist among woman of the same age group. Swartz (2009) point out that, among women of the same age married women are more likely to have more children than their unmarried counterparts. Adolescent marriages are still very common in some parts of Africa. Clifton and Hervish (2013) point out that the issue of adolescent fertility in Sub Saharan Africa is common in rural areas where women are encouraged or forced to marry at a very young age and the society pressures them to start childbearing soon after marriage to prove her fecundity. However, a rise in childbearing among unmarried adolescent women has been reported in some parts of Africa (Garenne, Tollman, Kahn *et al.* 2001). There is supporting evidence from Madagascar and Zambia where adolescent fertility has been increasing despite an increase in percentages of never married adolescents (Harwood-Lejeune 2001). Adolescent fertility outside marriage is also quite common in South Africa (Timæus and Moultrie 2015).

In 2013, the government of Zimbabwe increased the legal age of marriage from 16 years to 18 years, however, adolescent marriages are still very common despite attempts by the government to eliminate the practice (Sayi and Sibanda 2018). Women who marry before the age of 18 years are likely to have to have less negotiating power to delay childbearing. Chandra-Mouli, Svanemyr, Amin et al. 2015 points out that early marriages disrupts a young women's education, limits her employment opportunities, increases her risk of violence and abuse and jeopardizes her health. Adolescent marriages are influenced by various socio-demographic, cultural and religious factors. According to Sayi and Sibanda (2018), the major determinants of adolescent marriage in Zimbabwe are wealth index, level of education, religious affiliation, place of residence.

2.5 Indirect determinants of fertility

Early marriage, religion, poverty, education and peer influence are some of the sociocultural and economic factors that have been linked with adolescent childbearing. Research from Tanzania and Ghana shows that adolescents living in poverty are at higher risk of adolescent fertility as they often end up engaging in transactional sex with older men in order to meet their financial needs (Krugu, Mevissen, Prinsen *et al.* 2016; Silberschmidt and Rasch 2001). According to Lambani (2015), in South Africa adolescent women intentionally get pregnant in order to receive support grants from the government without considering some negative impacts of making such decisions in the long run. However, some researchers have contradicted this evidence by showing that adolescent fertility South Africa had started declining by the time the grants were introduced (Makiwane 2010; Moultrie and McGrath 2007). The work by Berquó and Cavenaghi (2005) on early childbearing in Brazil demonstrate that the risk of adolescent fertility is high among women living urban areas, from poor backgrounds and the least educated. Silk and Romero (2014) suggests that good family communication parental involvement can help postpone childbearing and initiation of sexual activities among adolescents. Marginalised adolescents who are homeless, disabled and those affected by societal issues such as war and civil strife are particularly at high risk of adolescent childbearing (Chandra-Mouli, Svanemyr, Amin *et al.* 2015).

Educational attainment is one of the factors that researchers have focused on, as a result a significant body of literature on the association between educational attainment and adolescent childbearing exists. According to Eloundou-Enyegue (2004) adolescent fertility is one of the major reasons why young girls dropout of school in Sub Saharan Africa. The author suggests that the gap in educational attainment between men and woman can be reduced by reducing the number of school dropouts due to childbearing among adolescent women. Ranchhod, Lam, Leibbrandt et al. (2011) contend that in developed countries socio-economic background of young girls has more impact on educational attainment than having a child during the adolescent years. However, controlling for pre-birth conditions the results of a study they conducted for South Africa shows that adolescent mothers had lower educational attainment than those who start childbearing at a later age. The bulk of the evidence suggests that adolescent fertility is positively associated with poor educational outcomes (Feyisetan and Pebley 1989; Gupta and da Costa Leite 1999; Lloyd and Mensch 2008). On the other hand, some studies show that poor academic performance and disliking of school increase the risk of adolescent fertility (Bonell, Allen, Strange *et al.* 2005; Grant and Hallman 2008). It has been shown that the use of internet and cell phones promotes early sex because they provide easy communication between young girls and their partners and access to pornographic materials (Adzitey, Adzitey and Suuk 2013). In Zimbabwe a majority of adolescents from urban areas have cell phones and access to internet.

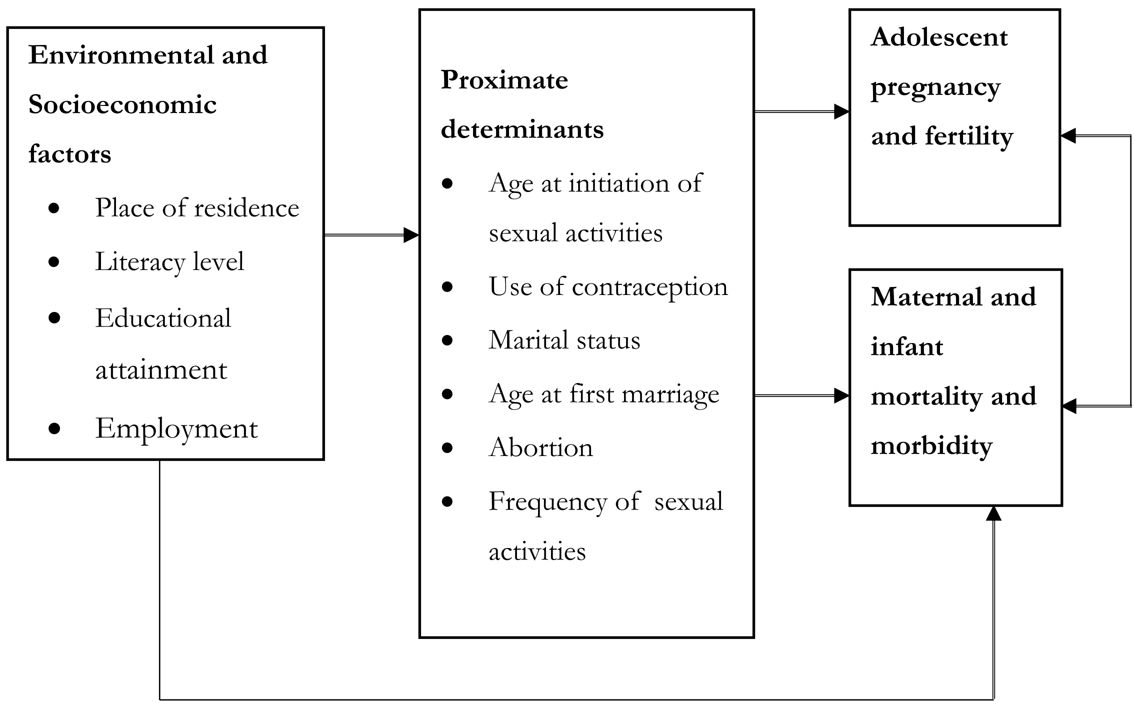
There is an association between adolescent marriage and religious affiliations in Zimbabwe (Machingura 2011; Sayi and Sibanda 2018). Christianity is the major religion in Zimbabwe. The most post popular Christian denominations include Roman Catholic, Apostolic, and Pentecostal and Protestant church. The Apostolic sect is an African indigenous church, the earliest groups of this sect were founded in the early 1930's in Zimbabwe. In recent years the apostolic sect has spread to other parts of Southern and Eastern Africa. This church was formed to protest colonialism and to link Christianity with the African culture Dodo, Banda and Dodo (2014. However, the church has been criticized for supporting adolescent marriages and polygamy. Adolescents' girls are forced to marry older men and have children at a very young age. Also, their doctrine does not allow members of the church to attend school, go to hospitals or use modern contraception (Machingura 2011; Sayi and Sibanda 2018). They have their own temporary hospitals, they use makeshift shacks and tents for their patients. As a result, death from maternal and many other health issues from this church are not documented. The religious practices of the apostolic sect increase the risk of childbearing and HIV/AIDS infection among adolescent women.

2.6 Theoretical framework

The framework developed by Bongaarts (1978, 1982) is important for examining the determinants of total fertility. McDevitt, Adlakha, Fowler *et al.* (1996) proposed a framework for examining the determinants of adolescent fertility and this framework is adapted in this study. This framework for examining determinants of adolescent fertility is also based on the concept that socioeconomic and environmental factors can only influence fertility through proximate determinants. According to McDevitt, Adlakha, Fowler *et al.* (1996), the six most important proximate variables for examining adolescent fertility are marital status, age at initiation of sexual activities, age at first marriage, utilization and adequacy of contraception, induced abortion and frequency of sexual activities.

The proximate determinants examined in this study are marital status, age at imitation of sexual activities and use of contraceptives. A diagrammatic representation of the framework given in Figure 2.2 presents how environmental and socioeconomic variables influence adolescent childbearing through proximate variables. The diagram also presents the direct and indirect relationship between background factors and maternal and infant mortality. McDevitt, Adlakha, Fowler *et al.* (1996) also points out that the relationship between adolescent fertility and maternal and infant mortality and morbidity is two-way.

Figure 2.2 Conceptual framework



Source: Adapted from (McDevitt, Adlakha, Fowler *et al.* 1996)

2.7 Summary

There is evidence that adolescent fertility rates are higher in Sub Saharan Africa than in other parts of the world. Zimbabwe has experienced a significant decline in total fertility rates between 1985 and 2015, however, adolescent fertility in the country has remained almost constant in this same time period. This research is important as it is unclear why adolescent fertility in Zimbabwe has not declined despite a decrease in the overall fertility rates. To explain how adolescent fertility rates has changed over time in Zimbabwe, this study starts by estimating age-period and cohort-period adolescent fertility rates for the period 1975 to 2015. The second part of the analysis focus on the socio-demographic factors that has been influencing adolescent fertility in the country. A significant body of literature exists on the socio-demographic determinants of adolescent fertility in Sub Saharan Africa. However, a major critique of the work that has been done on the determinants of adolescent childbearing in the Sub Saharan Africa region is that most studies were based on a single DHS survey. Giving a generalized conclusion on the determinants of adolescent fertility based on the results of a single survey may be misleading due to errors in data and the determinants are also likely to change with time as a result of economic, social, environmental and cultural dynamics. Therefore, in the case that only one survey is used there is need to specify and emphasize the particular point in time where the results apply. In this study l propose using data from all the six ZDHS surveys conducted in Zimbabwe between 1988 and 2015 and the theoretical framework presented in Figure 2.2 to examine the adolescent fertility patterns and the socio-demographic determinants adolescent fertility in Zimbabwe.

3 METHODOLOGY

This chapter focuses mainly on the methods used in tackling each research objective. Estimates of age specific fertility (ASFR) and cohort period fertility rates are derived using birth histories data from all the six surveys conducted in Zimbabwe conducted between 1988 and 2015. ASFR estimates are derived using the Poisson regression model and CPFR estimates are derived using the method developed by Moultrie, Dorrington, Hill *et al.* (2013b). Univariate analysis, bivariate analysis and logistic regression models are used to analyse the socio-demographic determinants of adolescent fertility in Zimbabwe. A description of data sources, study design, study population and variables used in this study is also presented in this chapter.

3.1 Data

This study uses cross sectional data from six surveys of Zimbabwe Demographic and Health Survey (ZDHS) starting from 1988 to 2015. Demographic and Health Survey Program provides data used to derive a wide range of population, health and nutrition indicators in developing countries. In Zimbabwe, the program was established in 1988. The Zimbabwe National Statistics Agency conducts the survey after every 5 years in partnership with the government and some independent development organizations. Results of the survey contribute to the evaluation and formulation of national programs and policies. To make the data comparable across countries and surveys, the DHS program has proposed a standard model of questionnaires. However, the questionnaires can be altered where necessary to suit the background of a country. Four types of questionnaires are used in the DHS surveys, these are the household, biomarker, men's and women's questionnaires. The household questionnaire is the main questionnaire, it collects information on both the permanent and temporary residents of a household. It includes variables on the age, sex, educational background and employment status for each listed individual. Age and sex are used to identify individuals eligible for the men's and women's questionnaires from the household questionnaire. Men between the ages of 15 and 54 years qualify for the men's questionnaire whereas female between the ages of 15 to 49 years qualify for the female's questionnaire women.

The women's questionnaire is the longest, it includes questions on various background characteristics, reproductive behaviour and intentions, children's health, contraception, antenatal and postnatal care. This study uses detailed information on birth histories and background characteristics from this questionnaire to estimate adolescent fertility rates and examine the socio-demographic determinants of adolescent fertility in Zimbabwe. The background section includes questions on socio-demographic characteristics of the respondent such as employment status, marital status, educational attainment, religious affiliation and place of residence. The birth histories and fertility intentions section includes information on total children ever born, the date of birth of children, total number of living and dead children and future fertility intentions of the woman. The contraception section covers questions on knowledge and use of contraception as well as unmet need for contraception. The antenatal and postnatal care includes information on pregnancy and birth complications, support and services used during pregnancy, at birth and after birth. The section on child health covers information on immunization coverage, child's diet treatment and occurrence of disease.

Birth histories from DHS surveys are likely to be affected by various respondent and study design errors. Respondent errors include omissions of births omissions of births, and exaggeration of date of birth. Study design errors include sampling errors and selection bias (Goldman *et al*, 1985). The child's date of birth is usually misreported when the respondent is not the biological mother of the child or is an older women and does not remember the exact date, this can translate to Potter effects or Brass effects. Detailed questions are asked about each child below the age of 5 years in the child health section of the women's questionnaire this may result in interviewers or respondent omitting or displacing births to avoid completing this section. Potter effects are due to women reporting older births much closer to the survey than they occurred. This may result in overestimation of recent fertility and underestimation of fertility for years further from the date of interview. The error is more common if births are recorded starting with first born. Brass effects are due to displacements of births to distant time periods, this error is common among older women. This may result in overestimation of distant fertility and underestimation of recent fertility. Schoumaker (2010) point out that the DHS surveys conducted in Zimbabwe have little data problems. Therefore, these errors are not likely to have a significant impact on the results of this study.

3.2 Sample design

The sample of a study influences fertility estimates, since overrepresentation or under representation of a certain group of women may result in overestimation or under estimation of fertility rates. Fertility estimates may be biased if there is a variation in the fertility of women who participated and those who did not participate in the survey due to death or international migration. The process of selecting individuals to participate in a survey from a list of all individuals in the target population is called survey sampling. A good sample should represent the entire population.

Zimbabwe has ten provinces which are subdivided into districts and wards. During a census or a survey the wards are further broken down into enumeration areas (EAs). To ensure that the sample used in ZDHS surveys represent the entire nation, a population census prior to the survey is used as the sampling frame and stratified two-stage cluster sampling method is used. Therefore, findings from the present study can be generalized for the entire Zimbabwean population. The stratified two-stage cluster sampling method involves a random selection of clusters followed by random picking of individuals from each cluster. In the first stage of selecting the ZDHS sample, enumeration areas are used as clusters. The second stage involves the random selection of private households from the selected enumeration areas. The list of enumeration areas used for 1988, 1994 and 1999 surveys were stratified (sorted) according to residential areas; rural and urban areas. After the 2000 land reform program, the list were stratified according to land use that is large-scale and small-scale agricultural areas as well as urban and semi-urban areas (Central Statistical Office and Macro International Inc. 2007).

3.3 Study population

The aim of this study is to analyse the trends and socio-demographic determinants of adolescents in Zimbabwe for the period 1988 to 2015. Adolescents are individuals aged between 10 to 19 years according to the World Health Organization (Tylee, Haller, Graham *et al.* 2007). ZDHS data does not include information on adolescents below the age of 15 years. Therefore, for the purpose of this research, the study population is the number of adolescent women aged 15-19 years interviewed at the time of the 1988, 1994, 1999, 2005, 2010 and 2015 ZDHS surveys. Even though the main focus of this study is to examine the fertility of women aged 15-19 years (adolescent fertility), the fertility of women aged of 20-49 years is also calculated to show how fertility in the other age groups have changed over the years. Table 3.1 present the number of adolescents and all eligible women interviewed at the time of each DHS survey.

Table 3.1 Study population

Year	Women aged 15-49	Women aged 15-19	Percentage 15- 19
1988	4 201	1 021	24.3
1994	6 128	1 486	24.3
1999	5 907	1 468	24.9
2005	8 907	2 130	23.9
2010	9 171	1 980	21.6
2015	9 955	2 156	21.7
All surveys combined	**44 269**	**10 241**	**23.1**

3.4 Data Analysis

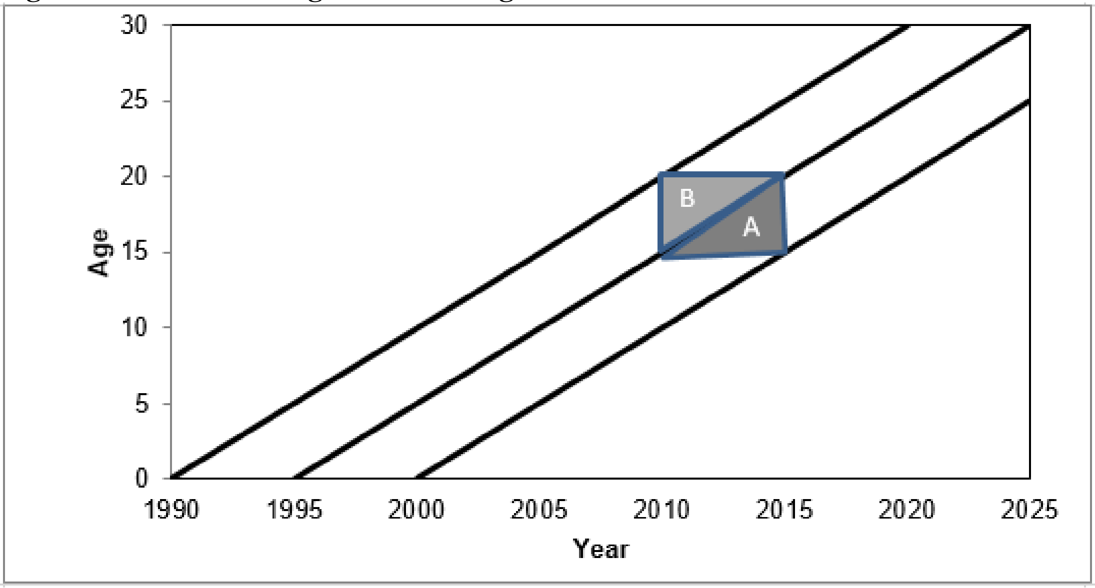
Stata version 12 (StataCorp 2015) and Microsoft Excel are used to perform data analysis. Stata allows for easy generation of new variables, recoding of existing variables, combining various data files into one big dataset and statistical analysis. ASFR are computed using a Stata module called tfr2 and CPFRs are computed using Microsoft Excel in combination with Stata. Univariate, bivariate and multiple logistic regression analyses are performed using Stata and all graphs and tables are created using Microsoft Excel.

3.5 Age specific fertility and cohort period fertility rates

The age specific fertility rate (ASFR) is an age-period measure of fertility and the CPFR is a cohort-period of fertility. Each one of the two measures of fertility has its own advantages and disadvantages. ASFRs are mainly used as a measure of fertility in recent years. The major disadvantage of ASFRs is that they are more affected by conditions in the period they are measured. CPFRs reflect the fertility experiences of a real cohort of women and they smooth out temporal variations in fertility. However, the CPFRs are more likely to be affected by recall bias than ASFRs. In this study, fertility trends are examined using both the ASFRs and CPFRs fertility estimates.

The Lexis diagram presented in Figure 3.1 illustrates the main contrast between age-period and age-cohort fertility. In Figure 3.1, the CPFR for women born between 1995 and 2000 that were aged 15-19 years between 2010 and 2015 is derived from the total number of births in triangle A. On the other hand, the ASFR for women aged 15-19 years between 2010 and 2015 is derived from the total number of births in both triangles A and B. Therefore, the ASFR look across cohorts at a particular age and time point and the CPFR looks at a specific cohort at a particular age and time point.

Figure 3.1 The Lexis diagram illustrating the difference between ASFR and CPFR



3.6 Estimation of Age Specific Fertility Rates

ASFR can be derived from survey data using the method developed by Rutstein and Rojas (2006) or Poisson regression model.

The ASFR published in DHS official reports are calculated directly from birth histories using the method of developed by Rutstein and Rojas (2006). The ASFR derived using this method are calculated by dividing the total number of births in a specific age group for a 3- year time interval from date of survey with total number of woman-years of exposure to the specific age and time interval. All women in the specific age group, both those who had a birth or no birth in the 3-year time interval contribute to the denominator. Each woman's month and year of birth are used to calculate her age in the time interval. Seven five-year age groups from 15-19 to 45-49 years are. The major disadvantage of this method is that, working in five-year age groups and thee-year time intervals makes the calculation of ASFR complex. For survey that are carried out over an extended time interval it becomes difficult to locate the time point to which the estimates derived using this method apply. Also, births and exposure in the month of survey interview are not included in the calculations.

Schoumaker (2013) developed an important STATA module, called tfr2, for deriving fertility rates directly from survey data using Poisson regression. The tf2 is a simpler and less time consuming way of producing ASFR. The tfr2 module can be used to produce three-year ASFRs that are consistent with those produced using Rutstein and Rojas (2006) method but it is flexible and allows working five-year time intervals instead of three years. Working in five –year age groups and five-year time intervals make it much easier to interpret ASFRs rates. In addition to five-year point estimates of ASFRs, the tfr2 module also allows backward projection of fertility rates in a particular age for several years from the date of the survey. However, Schoumaker (2013) points out that backward projection of fertility rates beyond 15 years from the date of survey is likely to produce unreliable estimates due to recall bias on self-reported fertility experiences. Therefore, in this study the Poisson regression model and the tfr2 module are used to compute five-year point estimates of ASFRs and to perform backward projection of fertility rates only up to 15 years from each survey date. All the six DHS surveys conducted for Zimbabwe from 1988 to 2015 are used in this study. A description of how the Poisson regression model used to derive ASFR is given in the next sub-section.

3.6.1 Poisson Regression Model

The regression model assumes that X_i, a Poisson random variable representing the total number of births occurring to women aged i in a given interval of time has a probability distribution function given in equation (3.1) (Winkelmann and Zimmermann 1994). A time interval between 1 and 5 years is often used when estimating recent fertility, DHS official reports use a length of 3 years Rutstein and Rojas (2006) .

$$P(X_i = x_i \mid \mu_i) = \frac{\exp(\mu_i)\mu_i^{x_i}}{x(x-1)(x-2)(x-3)....1} \qquad (3.1)$$

where i denotes the 5 year age groups from 15-49 years. The mean number of births (μ_i) is a function of age specific fertility rates (λ_i) and (e_i) is the women years of exposure to the risk of giving birth.

$$\mu_i = \lambda_i e_i \qquad (3.2)$$

The Poisson regression model given in equation (3.2) is nonlinear in parameters, a log transformation can be used to transform it into a linear model. A crucial assumptions of the linear regression model is that the relationship between the outcome and the explanatory variables is linear. Applying logarithms to both sides of equation 2 gives a log-log model.

$$\log(\mu_i) = \log(e_i) + \log(\lambda_i) \qquad (3.3)$$

The logarithm of age specific fertility rate is a linear function of predictor variables such as age and time.

$$\log(\lambda_i) = \beta + f(age) + g(covariates) \qquad (3.4)$$

Substituting log (λ_i) in equation (3.3) with equation (3.4), the model in terms of the logarithm of mean number of births for women in age group *i* becomes:

$$\log(\mu_i) = \beta + \log(e_i) + f(age) + g(covariates) \qquad (3.5\ )$$

After fitting the regression model given in equation (3.5), the fertility level for women in age group *i* can be computed as:

$$\lambda_i = \exp[\beta + f(age) + g(covariates)] \qquad (3.6)$$

A simple regression model for computing point estimates of age specific fertility uses age as the only independent variable. To estimate the fertility level for a specific age group the dummy variable for age is 1 for that age category and 0 for all the other categories. On the other hand, a model for backward projection of fertility estimates can have age and time as predictor variables. Therefore, to estimate the fertility level for a specific age group and year the variables take the value of 1 for the given age category and year and 0 for all the other ages and years. Fertility estimates projected backward using the Poisson regression and multiple surveys provide a useful tool for checking the consistency of fertility estimates across surveys. Evidence of omissions or displacement of births is indicated by an abrupt decline in fertility levels for years close to the date of the survey (Schoumaker 2013).

3.7 Estimation of cohort period fertility

CPR estimates are derived from birth histories using a proposed by Moultrie, Dorrington, Hill *et al.* (2013b). The method can be used to construct a trend in the fertility levels for women aged 15-19 up to 34 years before the survey. However, estimates for time periods further from the survey date are likely to be overestimated because older cohorts of women tend to displace their first births to more distant periods (Moultrie, Dorrington, Hill *et al.* 2013b, Potter, 1977). Therefore to avoid overestimation of adolescent fertility for older cohorts of women, CPFRs are only constructed for 15 years from the date of each survey in this study. This method can also be used to check for data quality problems. Implausibly high cohort period fertility rates in distant periods indicate Brass effects whilst Potter effects are indicated by high fertility rates in the intermediate periods.

The method requires data on the number of women from each age group that were interviewed at the time of the survey from the individual DHS file and data on the number of births from the child file by women's age group, classified by five-year time intervals before the survey $(N_{i,t})$. The time of birth, (t) represents the successive five year intervals before the date of the survey is computed as:

$$t = (\frac{DOI - DOB_c - b}{60}) ; \qquad t = 0,1,2,3....$$

where DOI and DOB_c denotes date of survey interview and date of child's birth respectively, b apportions births that occurred in the month of the survey interview into two adjacent periods. If the child's birthday falls in the first half of the month b is equal to 0 and if it falls in the second half b is equal to 1. An assumption is made that the fertility of women interviewed in the survey is the same as those who died or emigrated.

Cohort period fertility levels are categorised by age of women at the time of survey. The rates are computed as:

$$f_{i,t} = \frac{1}{5}(\frac{B_{i,t}}{N_i})$$

where N_i denotes the number of women in age group i and $B_{i,t}$ denotes the number of births given by women in age group *i* at time *t*. The 5 in the denominator represents the exposure period to the risk of giving birth. The rates are reclassified by mother's age at the end of each successive five-year period instead of age at the time of survey. This reclassification is done by transposing the rates and the transposed rates are called the CPFRs:

$$f_{i,t}^{*} = f_{i+t,t}$$

3.8 Violation of assumptions in fertility estimation

The Poisson regression model for estimating ASFRs and Moultrie, Dorrington, Hill *et al.* (2013b) method for estimating CPFRs assume that the fertility of women interviewed in the survey is the same as those who died. This assumption is violated particularly in populations where the HIV/AIDS mortality is high like Zimbabwe. In the 15-919 years group, the bias maybe small in the years close to date of each survey because the infections are likely to be recent and the HIV/AIDS infected adolescent women are less likely to be dead at the time of the survey. Since the prime objective of this research is to analyse trends in adolescent fertility correction for bias induced by HIV/AIDS is not done.

3.9 Statistical Methods

The statistical analysis is performed in three stages. First, univariate analysis is used to describe the distribution of study variables and to provide simple summaries about the sample of adolescent women. The summaries create an underlying foundation of data descriptions required for conducting more complex statistical analysis. Some crucial relationships between adolescent fertility and socio-demographic factors are not readily visible when examining survey responses. Examples of these important relationships include variations in the proportions of births in the last year among adolescent women by marital status, religious affiliation, education and employment status. Cross tabulations and a Chi- Square test are also used to assess the independence between the dependent variable; birth in the last year and each predictor variable. The test is based on the following null hypothesis: there is no relationship between birth in the last year and each predictor variable. Finally, the relationship between birth in the last year and socio-demographic variables is investigated using multiple logistic regression.

3.10 Variables

One of the main objectives of this study is to analyse the impact of socio-demographic factors on adolescent fertility. The framework used to examine the determining factors of adolescent fertility Zimbabwe is adapted from McDevitt, Adlakha, Fowler *et al.* (1996). A description of the framework is presented in Chapter 2.

3.10.1 Dependent variable

The outcome variable having given birth in the last year was calculated from complete birth history information focusing only on adolescent women. The variable birth is recoded into a binary variable, it takes the value 1 if the adolescent woman gave birth in the last year and 0 in the case of no births in last year.

3.10.2 Independent variable.

The major proximate determinants of adolescent fertility are age at initiation of sexual activities, marital status, frequency of sexual intercourse, utilization and adequacy of contraception and induced abortion (McDevitt, Adlakha, Fowler *et al.* 1996). Available data from ZDHS surveys limits this study to focus on, marital status, age at initiation of sexual activities and knowledge of contraception. Abortion is illegal in Zimbabwe and even though recent ZDHS surveys included questions on abortion, the variable is excluded because the data on abortion are not reliable. Bongaarts (1982) also point out the difficulty of estimating the influence of induced abortion on fertility due to lack of reliable sources of data on induced abortions, especially in developing countries. The effect of 8 indirect and direct variables socio-demographic on adolescent fertility is examined in this study and a brief description of these variables is presented in Table 3.2. To avoid having very wide confidence intervals due to insufficient observations when performing logistic regression, variables with few observations in some categories are recoded by combining categories. For example, no education and some primary education are combined and labelled as "primary/no education". Also, occasional and permanent employment is also combined into one category called "employed". The variable representing total children ever born is not included in the regression model because it is almost identical to the one representing the number of births that occurred in the year before the survey date.

Table 3.2 Description of predictor variables

Variable	Description
Household wealth index at interview	Is a categorical variable, the first 2 categories are relabelled as poor, the third as medium and the last 2 as rich.
Highest level of education attended	The variable is recoded into 2 categories. Incomplete and complete secondary education or higher education is combined into one category. Incomplete and complete primary and no education are also combined.
Place of residence at interview	Residential area is categorised as rural and urban.
Religion at survey interview	Religion is labelled as Apostolic sect, Non-apostolic Christian and other religions. The Apostolic sect is an indigenous African church. The non-apostolic category includes denominations that were introduced by missionaries such as Roman catholic, Anglican and Methodist. Other religions include traditional and Muslim.
Age at survey interview	Single year age categories for women aged 15-19 years are used
Age at first sex	Is a categorical variable representing the age at initiation of sexual activity among adolescents. The first category represent early initiation of sexual activities (16 years and below). The second category represent delayed initiation of sexual activities (17-19 years), and the third category represents those who have never had sex at the time of the interview.
Ever used contraception	The variable is recoded into a binary variable. 1 representing ever used any method of contraception, and 0 otherwise.
Marital status at interview	The variable is recoded into a binary variable. Married, living together, not living together, divorced, widowed and separated are combined into one category labelled as ever married. The other category is labelled as never married.
Type of employment at interview	The variable is recoded into a binary variable. Permanent and occasional employment is combined and labelled as employed. The other category is unemployed

3.11 Multiple logistic regression

Multiple logistic regression is a statistical method used to investigate the relationship between a dichotomous outcome variable and at least two predictor variables. The outcome variable used in this study, birth in the last year is dichotomous; it takes a value of 1 if the adolescent women gave birth in the year prior to the survey date and 0 otherwise. The multiple logistic regression model is written as:

$$\log it(\pi) = \ln(\frac{\pi}{1-\pi}) = a + b_1 X_1 + b_2 X_2 + b_3 X_3.....$$

where π represents the conditional probability of a adolescent women giving birth in the last year, a is the intercept and the b_i 's are the regression coefficients and the predictor variables are represented by X_i's. The logistic regression model assumes that the relationship between the logit of the outcome variable and each of the predictor variables is linear. It also assumes that there is no high multicollinearity among the predictor variables and no outliers in continuous independent variables. Several studies have shown that age and education tend to be positively related (Kirton and Dotson, 2016; Lauderdale 2001). Therefore, to reduce multicollinearity between age and highest level of education attendance, an interaction term between the two variables is included in the logistic regression models. The model can be interpreted in terms of odds ratios by applying antilog to the equation are written as follows.

$$\pi = \frac{\exp(a + b_1 X_1 + b_2 X_2 + b_3 X_3.....)}{1 + \exp(a + b_1 X_1 + b_2 X_2 + b_3 X_3.....)}$$

In this study, odds ratios are used to explain the likelihood of women aged 15-19 years giving birth in the year prior to the survey. Two logistic regression models are used to explore the relationship between adolescent birth in the year before the survey among and socio-demographic variables. The first model is used to present an overall estimate of association between the socio-demographic characteristics of adolescent women at the time of the survey and birth outcome in the year before the date of the survey. The model uses data from all the ZDHS six surveys combined. However, this model does not reflect any changes in the determinants in the socio-demographic determinants that may have occurred over the years.

To address this issue, the socio-demographic determinants of adolescent fertility are further examined by stratifying the data from all the six surveys by birth cohort. A separate logistic regression model is run for three adolescents' birth cohorts. The purpose of this model is to investigate whether the odds of giving birth among adolescent women have changed from one cohort to another over the years or whether the determinants of adolescent fertility have remained unchanged between

3.12 Likelihood ratio test

Likelihood ratio test is often used to investigate the difference between two nested regression models. Two models are said to be nested if a simpler model (first model) can be produced by excluding some variables from a complex model (second model) and as a result, the simpler model has fewer parameters than the complex model. In order to test if the additional variables of the more complex model make a significant difference the likelihood ratio computes the difference between the likelihoods of two models. A log transformation of the difference between the likelihoods is used because the likelihoods are very small numbers. In the event that a statistically significant difference exists, the model with more parameters is considered to fit the data better than the model with fewer parameters. The likelihood ratio statistic $(LR_{statistic})$ is computed as:

$$LR_{statistic} = -2\ln(\frac{L_1}{L_2}) = -2\ln(L_1 - L_2)$$

where L_1 and L_2 represents the likelihood of the first and second models respectively. The likelihood ratio statistic follows a chi-square distribution. The degrees of freedom for the distribution are equivalent to the difference in number of variables between the two models. In this study, the test is used to examine the significance of including interaction between time and each one of the socio-demographic variables in the regression model. The test is based on the following hypothesis:

H_0: There is no interaction between time and x
H_1: There is an interaction between time and x

where x represents any of the socio-demographic variables. The interaction effect is tested by adding interaction variables between time and each of the predictor variables one at a time to the model with no interaction. The model with no interaction is then compared with the model with an interaction term to see if adding a specific interaction improves the model. Therefore, the model with no interaction term is nested in the model with interaction effects. The likelihood ratio test is performed using STATA version 12 (StataCorp 2015).

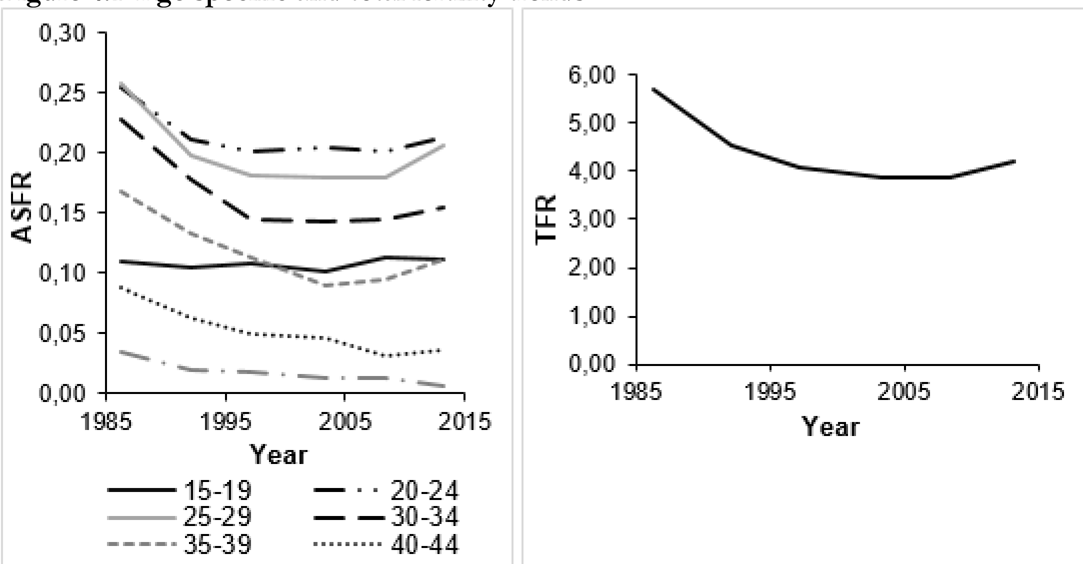
4 RESULTS

The results of the study are presented in this chapter. The first sections present age-specific and cohort-period fertility estimates. This is followed by the statistical analysis results of the association between socio-demographic factors and adolescent fertility in Zimbabwe. The last section of the chapter presents a discussion on the results on the of the study.

4.1 Age Specific Fertility Rates (ASFRs)

Figure 4.1 gives a pictorial representation of the age specific and total fertility rates. In this study, point estimates of ASFRs are calculated for the five- year prior to each survey therefore the estimates presented in Figure 4.1 are located two and half years from the date of each survey.

Figure 4.1 Age specific and total fertility trends



The total fertility rate decreased from around 5.4 children to 4.0 children per women between 1988 and 2015. The total fertility graph shows that a steep decline from 5.4 children per women to 3.8 occurred between 1985 and 2005 and a slight increase occurred in the late 2000's. There has been a general decline in the fertility of women aged 20-24, 30-34 and 35-39 from the late 1980's up to the early 2000's when their fertility started to slowly increase again. The 25-29 age group experienced a sharp increase in fertility rates between 2005 and 2015 after it had declined significantly during the period 1988 to 2005. The 40-44 and 40-49 age groups experienced a steady decrease since 1988. However, since 1985 fertility in the 15-19 age group (adolescent fertility) has been fluctuating around 100 births per 1000 women with no clear sign of decrease or increase. This might be a genuine phenomenon or could be driven by some errors in the measurement of adolescent fertility, such as omissions and displacement of births and age misreporting. It is therefore imperative to conduct a further analysis on the estimates of fertility before drawing conclusions on the pattern of adolescent fertility in Zimbabwe.

To further investigate the fertility patterns, Poisson regression model is used to perform backward projection of fertility rates 15 years before each ZDHS survey as described in the methodology. The backward projected age specific are presented in Figure 4.2, the trends show a general there is consistency across surveys between the backward projected fertility rates and ZDHS official fertility rates for women in the 15-19, 20-24, 40-44 and 45-49 age groups as well as the total fertility rates. However, there are inconsistencies across surveys between 1995 and 2005 for women aged 25 -34 years, between 1985 and 1995 for women aged 35-39 and across all surveys (1985-2015) for women aged 40-44 years. This inconsistency between estimates can be attributed to change in the age composition for time periods further from the survey date. Generally, the backward projected fertility rates show a clear downward trend in the total fertility and age specific fertility rates for women aged 20-24, 25-29,30-34 and 35-39 from around 1988 to 2005 and fertility levels these age groups in seem to have stalled after 2005. Adolescent fertility rates show a downward trend from around 1978 to 1988, however, from around 1990 onwards there is no clear downward or upward trend.

Figure 4.2 Trends of backward projected ASFRs

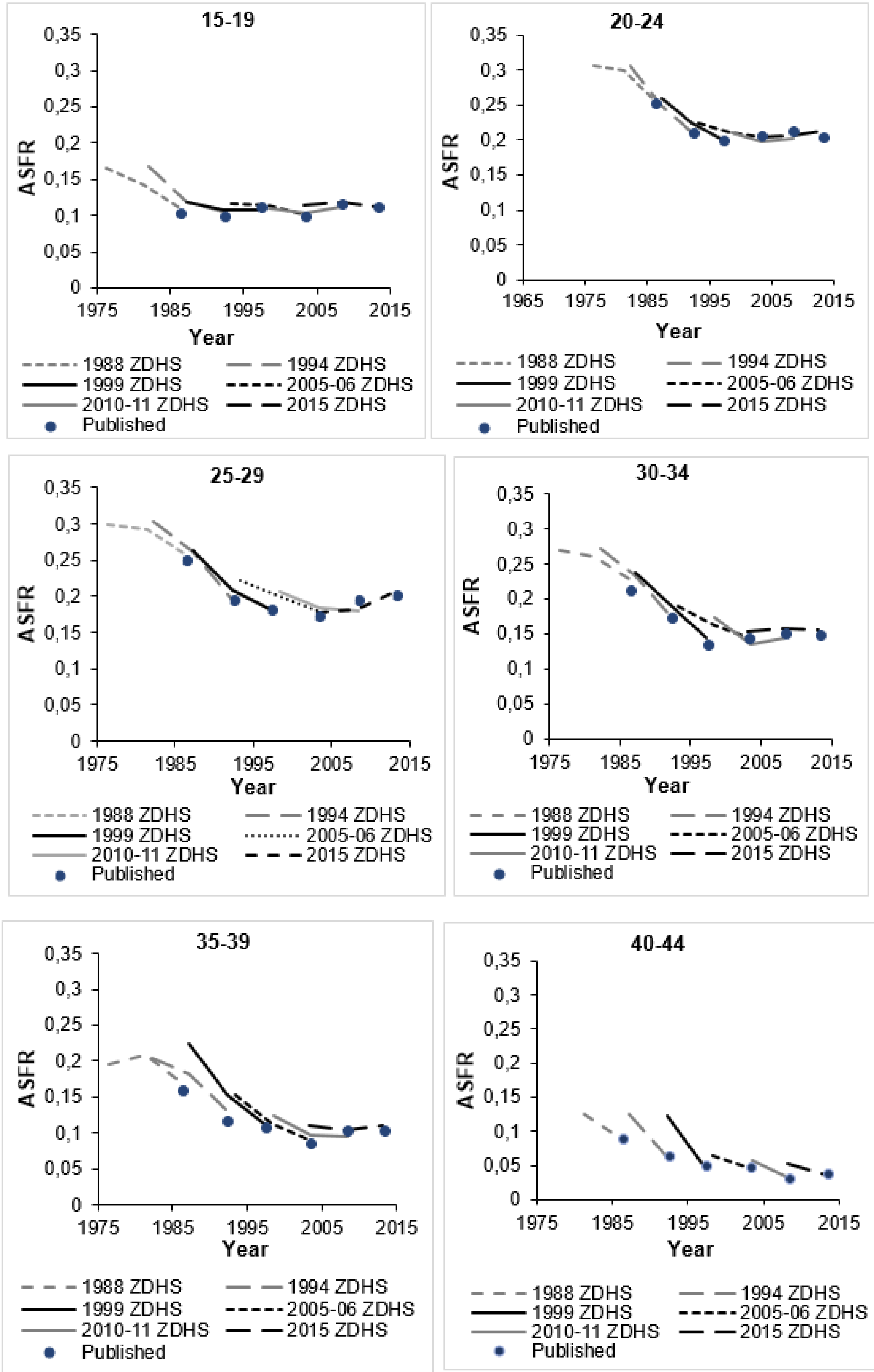


Figure 4.2 Continued

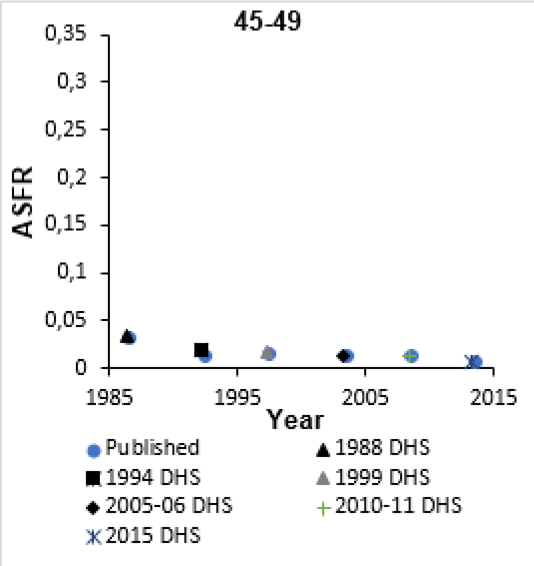
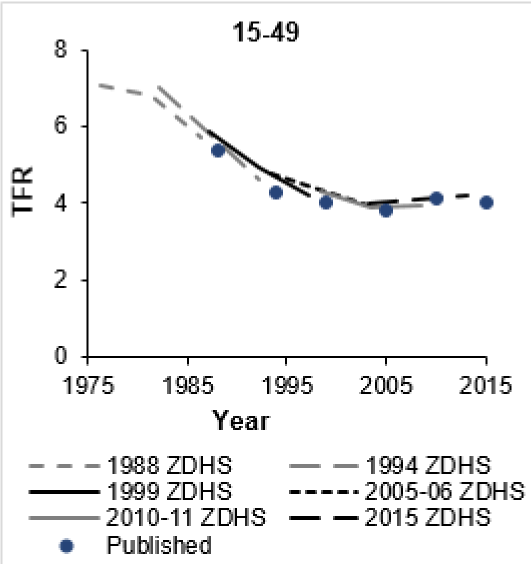


Figure 4.3 Trends of backward projected TFRs



4.2 Cohort-Period Fertility Rates (CPFRs)

The CPFRs presented in Figure 4.4 were calculated using Moultrie, Dorrington, Hill *et al.* (2013b) method for calculating cohort-period fertility described in the methodology chapter. Estimates of CPFRs show that for the time period 1985 to 2015, fertility has significantly declined in all the other age groups between except for the 15-19 year age group. The CPFRs for the 15-19 years age group has remained almost constant from around 1985 to 2015. At all age group, there is generally higher consistency in the CPFRs estimates from the most recent surveys (2005, 2010 and 2015 surveys) and higher in consistency in the estimates is visible for the 1994 and 1988 ZDHS surveys.

Figure 4.4 Trends of cohort-period fertility (CPFRs)

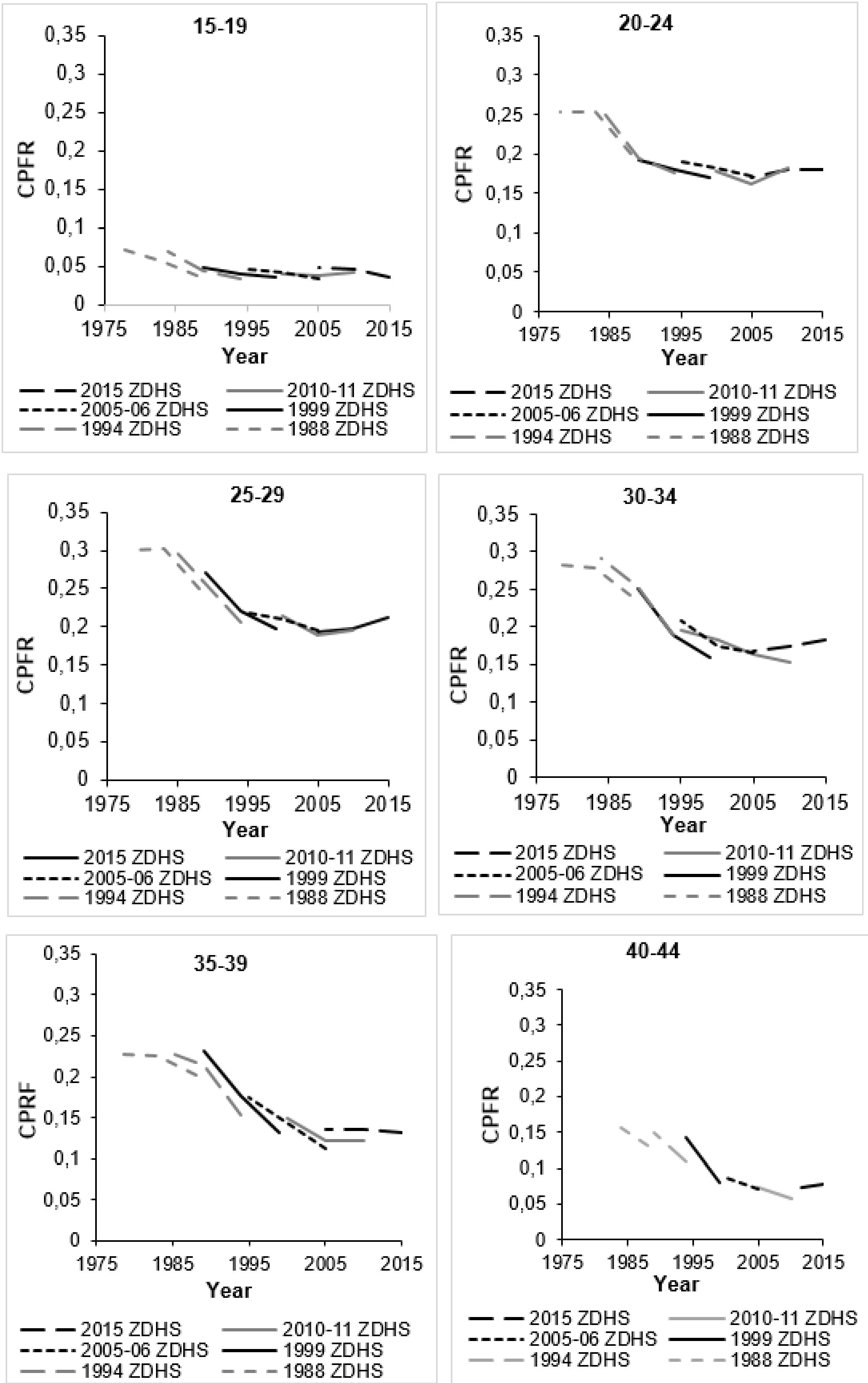
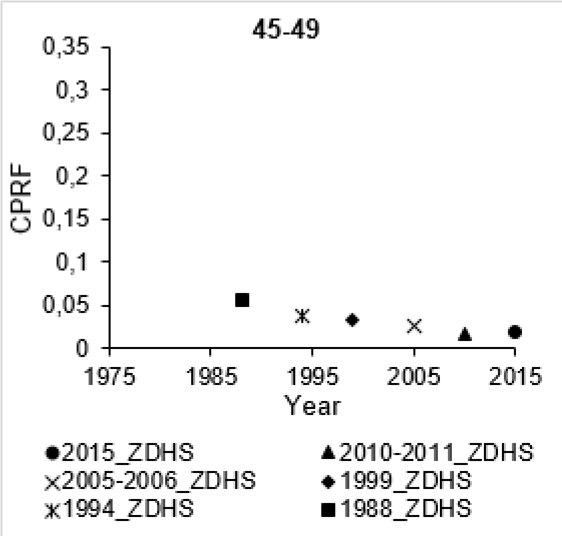


Figure 4.3 Continued



Tables of the derived CPFRs are presented in Appendix A. The cohort period fertility estimates given in Appendix A indicate the presence of data quality problems such as Brass effects and Potter effects described in the methodology section. Potter effects are observed by younger cohorts of women having higher fertility rates than older cohorts in all the surveys. Brass effects exist in the most recent surveys they are identified by high fertility rates in periods further from the date of survey. However, the data errors are very few and can be ignored as they do not have serious implications on the fertility estimates.

4.3 Univariate analysis

Univariate analysis is used to present a summary of the socio-economic background of adolescent women. The results of univariate analysis are given in Table 4.1. About 20 per cent of the adolescent women had already started childbearing at the time of each survey. As anticipated, the results show that most of the births among young women occurred in the year before the survey According Moultrie, Dorrington, Hill *et al.* (2013a), for women below the age of 24 years recent fertility is almost equal to lifetime fertility because most of their births would have occurred in recent years. Adolescent marriages are very common in Zimbabwe; about 20 per cent of the adolescents were ever married at the time of each survey. The country is still predominantly rural, more than 60 per cent of the adolescents resided in rural areas. Most of them had at least some secondary education. In fact, the proportion of adolescents with some secondary or higher education significantly increased between 1988 and 2015 from 50 to 78 per cent. About 20 per cent of the adolescent women said they had ever used contraceptives at the time of each survey.

Table 4.1 Socio-demographic characteristics of adolescent women

Survey Year	1988	1994	1999	2005	2010	2015	All surveys
	Percentage of women 15-19 years						
Number of births in the year before the survey							
0	92.46	91.45	90.64	91.44	89.11	90.43	90.76
≥1	7.54	8.55	9.36	8.56	10.89	9.57	9.24
Total children ever born(at interview)							
0	83.7	84.1	82.6	84.5	82.1	83.3	83.4
≥1	16.3	15.9	17.4	15.5	17.9	16.7	16.6
Age (at interview)							
15 years	22.43	21.09	18.05	16.11	19.57	22.16	19.74
16 years	19.10	20.73	24.07	23.32	21.61	21.45	21.87
17 years	17.63	21.07	21.19	17.88	18.53	19.77	19.30
18 years	21.06	20.19	17.53	21.94	20.30	17.45	19.73
19 years	19.78	16.92	19.16	20.75	19.99	19.16	19.36
Marital Status (at interview)							
Never married	80.22	79.41	78.61	78.17	76.77	79.64	78.65
Ever Married	19.78	20.59	21.39	21.83	23.23	20.36	21.35
Use of Contraceptives							
Never used contraceptives	92.30	91.51	87.78	83.42	84.24	82.28	83.88
Ever used contraceptives	7.70	8.49	12.22	16.58	15.76	17.72	16.12
Residential area (at interview)							
Urban	31.6	29.6	35.1	39.5	38.3	32.9	35.4
Rural	68.4	70.4	64.9	60.5	61.7	67.1	64.6
Level of education attended (at interview)							
No education	2.6	1.0	1.3	0.4	0.1	0.2	0.7
Primary	47.7	40.2	30.7	28.2	21.9	21.8	29.7
Secondary+	49.8	58.8	68.0	71.4	78.0	78.0	69.6
Type of employment (at interview)							
Unemployed	87.0	68.0	72.3	75.8	82.0	78.9	78.5
Permanent	9.2	13.6	12.6	8.4	7.9	10.4	9.2
Occasional	3.8	18.4	15.1	15.8	10.1	10.7	12.3
Religion (at interview)							
Non-apostolic Christian	66.6	56.4	55.9	57.3	49.7	50.7	56.1
Apostolic sect	23.9	34.5	32.0	28.0	33.8	38.2	31.7
Other	9.5	9.1	14.1	14.7	16.6	11.1	12.1

4.4 Bivariate analysis

Cross tabulations of births in the last year and each categorical socio-demographic variable are used to compare the characteristics of adolescent women who did not give birth in the year prior to the survey with those who gave birth.

Table 4.2 Socio-demographic variations in adolescent fertility

Ever given birth in the last year (Percentage of women 15-19 years)				
	No	**Yes**	χ^2	
Socio-demographic factors				
Age (at interview)				
15 years	21.74	3.99	87.64	***
16 years	22.77	9.34		
17 years	19.50	18.47		
18 years	18.85	29.80		
19 years	17.14	38.41		
Marital Status (at interview)				
Never Married	84.47	21.93	110.56	***
Ever Married	15.53	78.07		
Use of contraceptive				
Never used contraceptives	89.07	33.26	108.52	***
Ever used contraceptives	10.92	66.74		
Place of residence (at interview)				
Urban area	43.4	28.10	143.13	***
Rural area	56.6	71.94		
Level of education attended (at interview)				
Primary/ None	26.84	48.08	308.62	***
Secondary +	73.39	52.01		
Wealth index (at interview)				
Poor	31.00	47.7	164.45	***
Middle	18.08	22.72		
Rich	50.92	29.6		
Employment (at interview)				
Unemployed	80.00	69.03	99.78	***
Employed	20.00	31.05		
Religion (at interview)				
Apostolic	19.07	27.76	140.93	***
Non-Apostolic Christian	70.25	55.94		
Other Religions	10.68	16.49		

Significance: ***p<0.005;**p<0.01;*p<0.05

For all the ZDHS surveys combined, the results of the cross tabulations and Chi-Square test are presented in Table 4.2. The total number of births in the year prior to each survey was significantly higher among older adolescent than younger adolescent women. More than 70 per cent of adolescents who gave birth in the year before the survey were ever married and residing in rural areas. The results show that adolescent fertility is less common among adolescents with at least some secondary education, those with high wealth index and among adolescents who had never used contraceptives at the time of the survey. A statically significant relationship exists between the outcome variable and all the categorical predictor variables at 5 per cent level of significance.

4.5 Logistic Regression

Binary logistic Regression is used to examine the relationship between adolescent fertility in the last year and each socio-demographic variable, taking into account other socio-demographic factors binary logistic regression. Birth in the last year fertility is equal to 1 if an adolescent woman gave birth one year before to the survey and zero otherwise.

4.5.1 Model 1: Adjusted odds of adolescent fertility by background characteristics

The output from logistic regression model using all surveys combined is given in Table 4.3. The relationship between adolescent births in the year before the date of survey interview and marital status, use of contraceptives and employment status at the time of the survey is statically significant at 0.5 per cent level of significance. The likelihood of giving birth in the year before the survey is 2 times higher for ever married than never married adolescents, 80 per cent higher for unemployed than for employed adolescents and almost 4 times higher for adolescents who ever used contraceptives than those who never used any contraceptive method. At 1per cent level of statistical significance, the odds of giving birth in the year before the date of the survey interview are significantly lower for adolescents aged 15 years compared to those ages 17, 18 and 19 years at the time of the survey. Age at first sex and highest level of education attended at the time of the survey interview are significantly related to adolescent births in the year before the survey at 5 per cent level of significance. The odds of giving birth in the year before the date of the survey interview are about 80 per cent lower for adolescents with some secondary or higher education than for those with some primary education or no education. The odds are also 25 per cent lower for adolescents who delay initiation of sexual activities beyond 17 years than their counterparts who initiate sexual activities before the age of 16 years. The interaction term between age and highest level of education attended is also significant at 5 per cent level of statistical significance. A year increase in age results in a 20 percentage points decrease in the odds of giving births among adolescents with some secondary or tertiary education than those with primary or no education. Controlling for other variables, the relationship between adolescent births in the last year and wealth index, place of residence and religion of the adolescent women at the time of the survey are not statistically significant at 5 per cent level.

Table 4.3 Adjusted odds of adolescent fertility by socio-demographic characteristics

Covariates	Odds Ratio	Std. Error	95% - CI	p
Birth Cohort				
1996- 2000 (R C)				
1991-1995	1.02	0.14	(0.78 ,1.34)	
1986-1990	0.89	0.15	(0.58 , 1.08)	
1981-1985	0.93	0.31	(0.56 , 1.99)	
Age (at interview)				
15 years (R C)				
16 years	1.49	0.51	(1.74 , 2,95)	
17 years	1.63	0.56	(1.82, 3.23)	**
18 years	1.43	0.54	(1.68, 3.01)	**
19 years	1.74	0.70	(1.79, 3.32)	**
Marital Status (at interview)				
Never married (R C)				
Ever Married	2.05	0.31	(1.52, 2.78)	***
Use of any contraceptives				
Never used				
Ever used	3.86	0.55	(2.91, 5.01)	***
Place of residence (at interview)				
Urban (R C)				
Rural	1.46	0.28	(0.99 ,2.14)	
Level of education attended (at interview)				
Primary- (R C)				
Secondary +	0.18	0.37	(0.00 , 0.95)	*
Wealth index (at interview)				
Poor (R C)				
Middle	0.88	0.12	(0.68 ,1.14)	
Rich	0.69	0.19	(0.40 , 1.17)	
Type of Employment (at interview)				
Employed (R C)				
Unemployed	1.79	4.41	(1.37, 2.30)	***
Religion (at interview)				
Non-apostolic sect (R C)				
Apostolic	1.04	0.19	(0.73 , 1.48)	
Other religions	1. 04	0.17	(0.75 , 1.43)	
Age at first sex				
<17 years(R C)				
17-19 years	0.75	0.11	(2.91, 5.11)	*
Never had sex	1.00	0.00		
Interaction between education and age				
Age and Primary/none + (R C)				
Age and Secondary	0.80	0.09	(0.64, 0.97)	*

R C: Reference Category; Significance: ***p<0.005;**p<0.01;*p<0.05

4.5.2 Model 2: Adjusted odds of giving birth in the year prior to the survey for 3 cohorts birth cohort of adolescent women

The results of the logistic regression model presented in Table 4.3 give the overall association between socio-demographic factors and adolescent fertility for all the six surveys combined. These results can be misleading if the magnitude of association between giving birth in the last year and some of the socio-demographic factors varied over time and from one cohort of adolescents to another. Therefore, the association between socio-demographic variables and giving birth in the year before the date of the survey interview among adolescent women is further examined by stratifying the data by birth cohort and the results are presented in **Error! Reference source not found.**. Generally, the determinants of adolescent fertility in Zimbabwe have not changed much across the 3 cohorts. The results show that across cohorts a statistically significant relationship exists between adolescent births in the year prior to the date of survey interview and use of contraceptives, marital status and employment status at the time of the survey. However, the level of statistical significance in the relationship between adolescent births in the year before the survey interview and employment and marital status varies across cohorts. The odds of giving birth in the last year are significantly higher among ever married adolescents than never married adolescents and they indicate a decreasing trend across cohorts. The odds are also higher among unemployed adolescents than employed adolescents and they indicate an increasing trend from 1.36 for the1986 – 1990 birth-cohort to 2.11 for the 1996-2000 birth-cohort. At 5 per cent level of statistical significance, the likelihood of giving birth in the year before the survey interview is significantly higher for adolescents who ever used contraceptives compared to those who never used any method of contraceptive across cohorts. For the 1986-1990 birth-cohort, highest level of education attended and place of residence at the time of the survey are also significantly related to adolescent births in the year before the survey interview at 0.5 per cent level of significance.

Table 4.4 Adjusted odds of adolescent fertility for three cohorts of adolescent women

Birth Cohort	1986 - 1990 Odds Ratio		1991 – 1995 Odds Ratio		1996 - 2000 Odds Ratio	
Age (at interview)						
15 years(R C)						
16 years	0.98		2.20		1.44	
17 years	0.94		1.74		2.48	*
18 years	1.11		1.72		1.42	
19 years	0.77		2.64		2.14	
Marital Status (at interview)						
Never married (R C)						
Ever Married	2.64	***	1.59	*	1.52	*
Use of any contraceptives						
Never used						
Ever used	3.23	***	2.71	***	5.12	***
Place of residence (at interview)						
Urban (R C)						
Rural	2.39	***	1.42		1.34	
Level of education attended (at interview)						
Primary- (R C)						
Secondary +	2.59	***	0.01		0.02	
Wealth index (at interview)						
Poor (R C)						
Middle	1.14		0.89		0.58	*
Rich	1.20		0.71		0.36	*
Type of Employment (at interview)						
Employed (R C)						
Unemployed	1.35	*	1.70	*	2.11	***
Religion (at interview)						
Non-apostolic (R C)						
Apostolic sect	1.00		1.21		1.16	
Other religions	0.89		0.84		1.45	
Age at first sex						
<17 years (R C)						
17-19 years	0.80		0.95		0.65	*
Never had sex	1.00		1.00		1.00	
Interaction between Education and Age						
Age and Secondary + (R C)						
Age and Primary/none	1.05		0.77		0.81	

R C: Reference Category; Significance: ***p<0.005;**p<0.01;*p<0.05

4.5.3 Testing interaction effect using the likelihood ratio test

The changes in the odds of giving birth a year before the survey across three birth cohorts of adolescents suggest that an interaction effect may exist between time and some of the predictor variables. Therefore, a likelihood ratio test is used to examine the interaction between time and each one of the soci-demoggraphic variables.

The results of the likelihood test presented in Table 4.5 show that the interaction between time and all the socio-demographic variables is not significant at 5% level of statistical significance. This means adding interaction term(s) between time and socio-demographic characteristics to model 1 (Table 4.3) does not significantly improve the model, despite a change in the odds of giving birth in the year prior to the survey across birth cohorts of adolescent women. To avoid over fitting the regression model, interaction terms are not added to the model 1.

Table 4.5 Likelihood ratio test

	Log likelihood	Likelihood Ratio -test	Degrees of freedom
Model with no interaction (Model 1)	-1120.57		
Model with Interaction between time and:			
Age	-1119.73	1.95	1
Marital status	-1120.52	0.37	1
Place of residence	-1119.36	2.81	1
Highest level of education	-1119.55	2.03	1
Wealth index	-1119.10	2.92	1
Employment	-1120.57	0.00	1
Religion	-1120.38	0.67	1
Age at first sex	-1120.56	0.00	1

Significance: ***p<0.005;**p<0.01;*p<0.05

4.6 Summary

The first part of the analysis examined the fertility trends using estimates of ASFRs and CPFRs. The trends in ASFRs and CPFRs has shown that fertility levels for women in the five year age groups from 20-49 years has declined significantly in the period 1985 to around 2000 and from around 2005 to 2015 the fertility levels of women in these age groups started stalling. On the other hand, the results has shown that adolescent fertility in Zimbabwe has not declined since the late 1980's, it has been fluctuating with no clear pattern of increase or decrease.

The second part of the analysis examined the socio-demographic determinants of adolescent fertility in Zimbabwe. Results from the logistic regression models revealed that the major determinants of adolescent fertility in Zimbabwe are age, use of contraception, employment, marital status, age at initiation of sexual activities, highest level of education attended. The odds of giving birth in the year prior to the survey were higher among and older adolescents, those who had ever used contraception, unemployed, married and those with lower level of education ever attended at the time of the survey. The likelihood of giving birth in the year before the survey was also higher among adolescents who initiated sexual activities at a younger age. The odds of giving birth in the year prior to each ZDHS survey among adolescents women have changed across cohorts of adolescents' women over the years. However, results from the likelihood test revealed that the interaction between time and each one of the socio-demographic factors is not statistically significant at 5 per cent level of significance.

5 CONCLUSION

The aim of this study was to analyse the trends and socio-demographic determinants of adolescent fertility in Zimbabwe using all data from all the six ZDHS surveys conducted between 1988 and 2015. The adolescent fertility trends were examined using age-period fertility estimates (ASFRs) and cohort- period fertility estimates (CPRFs). The determinants of adolescent fertility were examined using two logistic regression models. This chapter presents a discussion on the findings, limitations of the study and some areas for further research.

5.1 Fertility Trends

The age-period fertility estimates derived using the Poisson regression model and the tfr2 module has shown that there has been a general decline in the ASFRs for women aged 20-49 years from around 1988 to 2000 and then a fertility stall was observed from around 2000 to 2015 in these age groups. Surprisingly, the results has shown that for the period 1988 to 2015, ASFRs for women in the 15-19 age group (adolescent fertility) has been fluctuating with no sign of steady decrease. The CPFRs estimates derived using the method of estimating cohort-period fertility developed by Moultrie, Dorrington, Hill et al. (2013b), also revealed similar patterns. Since 1988, the CPFRs for adolescent women have been unsteady despite a significant decline in the CPFRs for women aged 20- 49 years from 1988 to 2005. The CPFRs for women aged 20-49 years have remained relatively constant from around 2005 to 2015.

The stalling fertility patterns observed in women aged 20-49 years also agrees with Bongaarts (2008) observation that many Sub Saharan Africa countries, Zimbabwe included, are experiencing a fertility stall. Bongaarts suggests that the fertility stall can be attributed to economic challenges and high AIDS mortality in most parts of the region. In Zimbabwe AIDS mortality has significantly declined due to successful anti-retro viral therapy and HIV prevention programmes (Sayi and Sibanda 2018). However, the country has been going through enormous economic challenges in recent years. Adolescent women may not understand the economic implications of fertility whereas older are likely to take these economic challenges seriously when making fertility decisions hence this can be one of the factors contributing to fertility stalls in the older age groups. In this study, the association between socio-demographic factors and adolescent fertility in Zimbabwe was explored.

The constant fertility levels observed in the recent years in the five year age groups between 20-49 years can also be attributed to delays in fertility and longer birth intervals due to women using contraception as a method of birth spacing rather than birth control (Timæus and Moultrie 2013).

5.1.1 Data quality

The CPFRs and ASFRs estimates for recent years were generally consistent across surveys. However, from around 1995 going backwards, the fertility estimates from both methods showed some inconsistency across surveys at all age group. The inconsistency was much more visible in ASFR than CPFR trends. Change in age composition for period's further back, recall bias in women's reports of their children date of birth and systematic errors in earlier ZDHS surveys could be the reasons for the inconsistency. Applying the methods for longer periods from the survey date may yield more bias therefore, in this study ASFs and CPFRs were only calculated for the 15 years prior to date of each survey.

Results from the cohort period fertility method also indicated some Potter and Brass effects due to data errors in the birth histories data from ZDHS surveys. However, the effects were minor and did not have any serious implications on the fertility estimates. These effects can be attributed to older cohorts of women misreporting the date of birth of their eldest children. Younger cohorts are likely to report their births correctly since most of them would have occurred recently.

5.2 Determinants of adolescent Fertility

Two regression models based on the McDevitt, Adlakha, Fowler *et al.* (1996) model of examining determinants of adolescents were used to examine the association between socio-demographic and giving birth a year prior to the survey among adolescent women. According to McDevitt, Adlakha, Fowler *et al.* (1996), socio-economic and environmental factors can only influence adolescence fertility through the following the proximate; marital status, age at initiation of sexual activities, age at first marriage, utilization and adequacy of contraception, induced abortion and frequency of sexual activities. However, induced abortion and frequency of sexual activities were excluded in the regression models due to lack of sufficient and reliable on the two variables. The first model used data from all the six ZDHDS surveys combined, the results of this model gave the overall association across all surveys between socio-demographic factors and adolescent births a year before each survey date. In the second model, the data from all surveys was stratified into three birth-cohorts. Stratifying the data by birth-cohort was done to show how the socio-demographic determinants of adolescent fertility has changed over time or varied from one cohort to another.

The two models showed that the major determinants of adolescent fertility in Zimbabwe are use of contraception, marital status and employment status at the time of the survey. As expected, from the McDevitt, Adlakha, Fowler *et al.* (1996) framework, the regression results revealed that the likelihood of adolescent births in the year before the survey is higher among married than unmarried adolescents at the time of the survey. Also, many African societies discourage premarital sexual activities but once a woman is married she is expected to start childbearing as soon as possible (Ezeah 2012; Nwogwugwu 2013). Therefore adolescent fertility in these societies is usually higher among married than unmarried adolescents. Interestingly, the likelihood was higher for adolescents who reported having ever used a method of contraceptives than those who never used contraceptives. This is probably due to the fact that the socio-demographic examined in this study were measured at the time of the survey not at the time of pregnancy or birth. One possible explanation for this result is that most of adolescent mothers who gave birth in the year may have started using contraceptives after receiving some antenatal or postnatal counselling services on use and importance of contraceptives. As anticipate, the odds of giving births in the year prior to the survey were also higher among unemployed than employed adolescents.

In addition, the results of model 1 presented in Table 4.3 has also shown a statistically significant relationship between adolescent fertility and age at initiation of sexual activities, highest level of education attended and repondnt's age at the time of the survey. The likelihood of giving birth a year prior to the survey is lower among adolescents who delay initiation of sexual activities to an age beyond 17 years than those who initiate sex before the age of 17 years. This is consistent with previous research, a positive association between adolescents' fertility and an increase in age at first sex has been confirmed in most studies conducted for Sub Saharan Africa countries (Nwogwugwu 2013; Palamuleni 2017; Swartz 2002). Also, according to Harwood-Lejeune (2001), one of the factors contributing to fertility decline in many parts of Southern and Eastern Africa is a delay in the onset of sexual activities. The results of model 1revealed that the likelihood of adolescent births in the year before is lower among adolescents with some secondary or higher education than those with some primary or no education at the date of the survey. According to Bongaarts, Frank and

Lesthaeghe (1984) having higher educational attainment is positively correlated to low fertility levels. The likelihood of giving birth in the year before the survey also increases with an increase in respondent's age at the time of the survey. Similar results were obtained for Ethiopia (Alemayehu, Haider and Habte 2010).

This study has also shown that about 16 per cent of adolescent women had already started childbearing at the time of each ZDHS survey. Even though adolescent fertility is common in Zimbabwe, the rates are fairly low compared to some Sub Saharan Africa countries. For example, the prevalence of adolescents fertility Ghana, 18.5 in Kenya, 19.2 in Uganda, 19.6 in Tanzania, 22.8 in Malawi and 22.8 in Zambia (Alemayehu, Haider and Habte 2010; Gideon 2013; Nwogwugwu 2013; Palamuleni 2017).

5.3 Study Limitations

The methods used to calculate ASFRs and CPFRs has their shortcomings. These methods assume that the fertility of women who died before the survey interview is the same as the fertility of women who survived to the time of the interview. For a country with high HIV prevalence like Zimbabwe, this assumption is violated. A significant proportion of HIV positive women are likely to have not survived to the time of the survey interview especially for ZDHS surveys conducted between 1988 and 2005 before the introduction of antiretroviral therapy in the country. This study did not look at the impact of HIV on adolescent fertility and this is one of the major limitations of the study.

Further, the logistic regression model used in this study assumes that the relationship between adolescent births in the year prior to date of the survey interview and each of the predictor variables is linear and that there is no high multicollinearity among the predictor variables. These assumptions are likely to have been violated. The relationship between adolescent fertility in the year before the survey and socio-economic is potentially bi-directional not linear. To avoid over fitting the regression models, only multicollinearity between the highest level of education attended and age was addressed by including an interaction term between the two variables. A major limitation of this study is that the socio-demographic factors used in the current status the logistic regression models were measured at the time of the time of the survey. Therefore, there was some loss of precision in defining the association between adolescent fertility in the year before the survey and socio-demographic factors even though since it is not certain that the women's responses would be the same if the variables were measured at the time of pregnancy or birth. Also, two proximate determinants of adolescent fertility; induced abortion and frequency of sexual activities were excluded in the regression models due to lack of reliable on the two variables.

5.4 Areas for further research

One of the limitations of this study is that it does not take the impact of HIV on adolescent fertility into consideration. Further research can be done to assess the impact of HIV on fertility and how it may have changed overtime with improvements in treatment programs. Also, the exposure of younger adolescent women to pregnancy is likely to be very low, further analyses of adolescent fertility trends can be done using methods that consider the exposure to pregnancy. This study has revealed some associations between adolescent fertility and socio-demographic variables in Zimbabwe. These associations can be examined using longitudinal data and this will give insights into the directions of associations, that is to examine whether adolescent fertility result or a consequence of low socio-demographic status. The results of this study can be used in formulation and evaluation of existing programs and policies on adolescent fertility.

REFERENCES

Adzitey, S.P., Adzitey, F. and Suuk, L. 2013. "Teenage pregnancy in the Builsa District: A focus study in Fumbisi", *Journal of Life Science Biomed* ***3***(3):185-188.

Alemayehu, T., Haider, J. and Habte, D. 2010. "Determinants of adolescent fertility in Ethiopia", *Ethiopian Journal of Health Development* ***24***(1).

Alli, F., Maharaj, P. and Vawda, M.Y. 2013. "Interpersonal relations between health care workers and young clients: barriers to accessing sexual and reproductive health care", *Journal of Community Health* ***38***(1):150-155.

Becker, G.S. 1994. "Human capital revisited," In Human Capital*: A Theoretical and Empirical Analysis with Special Reference to Education.* Vol 3. The University of Chicago Press, pp.15-28.

Berquó, E. and Cavenaghi, S. 2005. "Increasing adolescent and youth fertility in Brazil: a new trend or a one-time event", In *Annual Meeting of the Population Association of America, Philadelphia, Pennsylvania* **30**(1).

Bonell, C., Allen, E., Strange, V., *et al.* 2005. "The effect of dislike of school on risk of teenage pregnancy: testing of hypotheses using longitudinal data from a randomised trial of sex education", *Journal of Epidemiology & Community Health* ***59***(3):223-230.

Bongaarts, J. 1978. "A framework for analyzing the proximate determinants of fertility", *Population and Development Review*, pp. 105-132.

Bongaarts, J. 1982. "The fertility-inhibiting effects of the intermediate fertility variables", *Studies in Family Planning*, **13**(7):179-189.

Bongaarts, J. 2008. "Fertility transitions in developing countries: Progress or stagnation?", *Studies in Family Planning* **39**(2):105-110.

Bongaarts, J., Frank, O. and Lesthaeghe, R. 1984. "The proximate determinants of fertility in sub-Saharan Africa", *Population and Development Review* **10**(3):511-537.

Central, Statistical, Office and International Macro, Inc. 2007. *Zimbabwe Demographic and Health Survey 2005-06*. Calverton, Maryland: Central Statistics Office [Zimbabwe] Macro International Inc.

Chandra-Mouli, V., Camacho, A.V. and Michaud, P.A. 2013. "WHO guidelines on preventing early pregnancy and poor reproductive outcomes among adolescents in developing countries", *Journal of adolescent health* **52**(5):517-522.

Chandra-Mouli, V., Svanemyr, J., Amin, A., *et al.* 2015. "Twenty years after International Conference on Population and Development: where are we with adolescent sexual and reproductive health and rights?", *Journal of Adolescent Health* **56**(1):S1-S6.

Chawhanda, C. 2013. "Proximate Determinants of Adolescent Fertility in Zimbabwe." Unpublished thesis, University of KwaZulu-Natal, Durban.

Clark, S. 2004. "Early marriage and HIV risks in sub-Saharan Africa", *Studies in Family Planning* **35**(3):149-160.

Clifton, D. and Hervish, A. 2013. *The World's Youth 2013 Data Sheet.* Washington, DC: Population Reference Bureau. https://www.prb.org/youth-datasheet-2013/ [Accessed: August 19 2018]

Coley, R.L. and Chase-Lansdale, P.L. 1998. "Adolescent pregnancy and parenthood: Recent evidence and future directions", *American Psychologist* **53**(2):152.

Davis, K. and Blake, J. 1956. "Social structure and fertility: An analytic framework", *Economic Development and Cultural Change* **4**(3):211-235.

Dodo, O., Banda, R.G. and Dodo, G. 2014. "African Initiated Churches, pivotal in peace-building: a case of the Johane Masowe Chishanu", *Journal of Religion and Society* **16**(1):1-12.

Eloundou-Enyegue, P.M. 2004. "Pregnancy-related dropouts and gender inequality in education: A life-table approach and application to Cameroon", *Demography* **41**(3):509-528.

Ezeah, P. 2012. "Marriage and fertility: a study of the reproductive health status and needs of married adolescent girls in Nsukka, Nigeria", *Journal of Sociology and Social Anthropology* **3**(1):1-6.

Feyisetan, B. and Pebley, A.R. 1989. "Premarital sexuality in urban Nigeria", *Studies in Family Planning* **20**(6):343-354.

Ganchimeg, T., Ota, E., Morisaki, N., *et al.* 2014. "Pregnancy and childbirth outcomes among adolescent mothers: a World Health Organization multicountry study", *BJOG: An International Journal of Obstetrics & Gynaecology* **121**(1):40-48.

Garenne, M., Tollman, S., Kahn, K., Collins, T. and Ngwenya, S. 2001. "Understanding marital and premarital fertility in rural South Africa", *Journal of Southern African Studies* **27**(2):277-290.

Geronimus, A.T., Korenman, S. and Hillemeier, M.M. 1994. "Does young maternal age adversely affect child development? Evidence from cousin comparisons in the United States", *Population and Development Review* **20**(3): 585-609.

Rutaremwa, G. 2013. "Factors associated with adolescent pregnancy and fertility in Uganda: analysis of the 2011 demographic and health survey data", *American Journal of Sociological Research* **3**(2):30-35.

Goldman, N., Rutstein, S.O. and Singh, S. 1985. "Assessment of the quality of data in 41 WFS Surveys: a comparative approach", *WFS Comparative Studies* **44**.

Grant, M.J. and Hallman, K.K. 2008. "Pregnancyrelated school dropout and prior school performance in KwaZuluNatal, South Africa", *Studies in Family Planning* **39**(4):369-382.

Gupta, N. and da Costa Leite, I. 1999. "Adolescent fertility behavior: trends and determinants in northeastern Brazil", *International Family Planning Perspectives*:125-130.

Harwood-Lejeune, A. 2001. "Rising age at marriage and fertility in Southern and Eastern Africa", *European Journal of Population/Revue Européenne de Démographie* **17**(3):261-280.

Haub, C. 2013. Trends in adolescent fertility a mixed picture. Available from http://www.prb.org/Publications/Articles/2013/adolescent-fertility.aspx [Accessed: July 30 2018].

Henry, L. 1961. "Some data on natural fertility", *Eugenics Quarterly* **8**(2):81-91.

Hodgkinson, S., Beers, L., Southammakosane, C., *et al.*2014. "Addressing the mental health needs of pregnant and parenting adolescents", *Pediatrics* **133**(1):114-122.

ICF. 2015. *The DHS Program STATcompiler*. Funded by USAID. Available from: http://www.statcompiler.com [Accessed: August 18 2018].

Jelili, M., Akindele, O. and Akintayo, O., 2013. "Teenage pregnancy and home environment factors in Ogbomoso, Nigeria." *Research on Humanities and Social Sciences* ***3***(18):69-77.

Kirton, J.W. and Dotson, V.M. 2016. "The interactive effects of age, education, and BMI on cognitive functioning." *Aging, Neuropsychology, and Cognition*, **23**(2):253-262.

Klepinger, D.H., Lundberg, S. and Plotnick, R. 1997. "How does adolescent fertility affect the human capital and wages of young women?". Institute for Research on Poverty, University of Wisconsin, pp 421-448

Krugu, J.K., Mevissen, F.E.F., Prinsen, A., *et al.* 2016. "Who's that girl? A qualitative analysis of adolescent girls' views on factors associated with adolescent pregnancies in Bolgatanga, Ghana", *Reproductive health* **13**(1):39.
Laga, M., Schwärtlander, B., Pisani, E., Sow, P.S. and Caraël, M. 2001. "To stem HIV in Africa, prevent transmission to young women", *Aids* **15**(7):931-934.
Lambani, M.N. 2015. "Poverty the cause of adolescent pregnancy in thulamela municipality", *Journal of Sociology and Social Anthropology* **6**(2):171-176.
Lauderdale, D.S. 2001. "Education and survival: Birth cohort, period, and age effects." *Demography* ***38*****(**4):551-561.
Letamo, G. and Letamo, H.N. 2001. "The role of proximate determinants in fertility transition: A comparative study of Botswana, Zambia and Zimbabwe", *Southern African Journal of Demography* **8**(1):29-35.
Lloyd, C.B. and Mensch, B.S. 2008. "Marriage and childbirth as factors in dropping out from school: an analysis of DHS data from sub-Saharan Africa", *Population Studies* **62**(1):1-13.
Loaiza, E. and Liang, M. 2013. "Adolescent pregnancy: a review of the evidence", New York: UNFPA. Available from: https://www.unfpa.org/sites/default/files/pub-pdf/ADOLESCENT%20PREGNANCY_UNFPA.pdf [Accessed: June 18 2018]
Loonstra, A.S., Tarlow, A.R. and Sellers, A.H. 2001. "COWAT metanorms across age, education, and gender." *Applied neuropsychology*, **8**(3):161-166.
Machingura, F. 2011. "A Diet of Wives as the Lifestyle of the Vapostori Sects: The Polygamy Debate in the Face of HIV and AIDS in Zimbabwe", *Africana* **5**(2):185-210.
Macleod, C.I. and Tracey, T. 2010. "A decade later: follow-up review of South African research on the consequences of and contributory factors in teen-aged pregnancy", *South African Journal of Psychology* **40**(1):18-31.
Maharaj, P. 2001. "Obstacles to negotiating dual protection: perspectives of men and women", *African Journal of Reproductive Health* **27**(2):150-161.
Makiwane, M. 2010. "The child support grant and adolescent childbearing in South Africa", *Development Southern Africa* **27**(2):193-204.
Mhlanga M., Mukora-Mutseyekwa, F., Zvinavashe M., *et al.* 2015. "Perceptions and Barriers to Exclusive Breastfeeding in Manicaland, Zimbabwe",*Journal of Health, Medicine and Nursing* **21**(1):1-5
McDevitt, T.M., Adlakha, A., Fowler, T.B. and Harris-Bourne, V. 1996. *Trends in Adolescent Fertility and Contraceptive Use in the Developing World* . Washington, DC: U.S. Government Printing Office: Bureau of the Census. http://www.census.gov/ipc/prod/ipc95. [Accessed 10 June 2018].
Moultrie, T.A., Dorrington, R.E., Hill, A.G. *et al.* 2013a. *Tools for Demographic Estimation.* International Union for the Scientific Study of Population.
Moultrie, T.A., Dorrington, R.E., Hill, A.G.*et al.* 2013b. *Tools for Demographic Estimation.* International Union for the Scientific Study of Population.
Moultrie, T.A. and McGrath, N. 2007. "Adolescent fertility rates falling in South Africa", *South African Medical Journal* **97**(6):442.
Mturi, A. and Kembo, J. 2011. "Falling Fertility and increase in use of uontraception in Zimbabwe", *African Journal of Reproductive Health* **15**(2).
Neal, S., Matthews, Z., Frost, M., *et al.* 2012. "Childbearing in adolescents aged 12–15 years in low resource countries: a neglected issue. New estimates from demographic and household surveys in 42 countries", *Acta Obstetricia et Gynecologica Scandinavica* **91**(9):1114-1118.

Nwogwugwu, N.C. 2013. "Socio-demographic determinants of adolescent fertility in Zambia." Unpublished thesis, University of the Witwatersrand, Johannesburg.

Odimegwu, C., and Mkwananzi, S. 2016. "Factors associated with teen pregnancy in sub-Saharan Africa: a multi-country cross-sectional study", *African Journal of Reproductive health* **20**(3):94-107.

Oyefara, JL. 2009. "Socio-economic consequences of adolescent childbearing in Osun State, Nigeria", *KASBIT Business Journal* **2**(1-2):1-18.

Palamuleni, M E. 2017. "Determinants of adolescent fertility in Malawi", *Gender and Behaviour* **15**(4):10126-10141.

Pascoe, S.J., Langhaug, L.F., Mavhu, W. *et al.* 2015. "Poverty, food insufficiency and HIV infection and sexual behaviour among young rural Zimbabwean women", *PLoS One* **10**(1):e0115290.

Paz Soldan, V.A. 2004. "How family planning ideas are spread within social groups in rural Malawi", *Studies in Family Planning* **35**(4):275-290.

Potter, J.E. 1977. "Problems in using birth-history analysis to estimate trends in fertility", *Population Studies* **31**(2):335-364.

Ram, B. and Rahim, A. 1993. "Enduring effects of women's early employment experiences on child-spacing: the Canadian evidence", *Population Studies* **47**(2):307-317.

Ranchhod, V., Lam, D., Leibbrandt, M. and Marteleto, L."Estimating the effect of adolescent fertility on educational attainment in Cape Town using a propensity score weighted regression." Working Paper. *Cape Town: SALDRU, UCT.*

Remez, L., Woog, V. and Mhloyi, M. 2014. "Sexual and Reproductive Health Needs of Adolescents in Zimbabwe", *Issues in Brief (Alan Guttmacher Institute)* **1**(3):1-8.

Rutstein, S.O. and Rojas, G. 2006. *Guide to DHS statistics*, *Calverton, MD: ORC Macro* , pp.27-31. https://dhsprogram.com/pubs/pdf/DHSG1/Guide_to_DHS_Statistics_DHS-7.pdf

Sayi, T.S. and Sibanda, A. 2018. "Correlates of Child Marriage in Zimbabwe", *Journal of Family Issues* **39**(8):2366-2388.

Schoumaker, B. 2010. "Reconstructing fertility trends in sub-Saharan Africa by combining multiple surveys affected by data quality problems," In *Proceedings of the 2010 Annual Meeting of the Population Association of America*.

Schoumaker, B. 2013. "A Stata module for computing fertility rates and TFRs from birth histories: tfr2", *Demographic Research* **28**:1093-1144.

Sibanda, A., Woubalem, Z., Hogan, D.P. and Lindstrom, D.P. 2003. "The proximate determinants of the decline to below replacement fertility in Addis Ababa, Ethiopia", *Studies in Family Planning* **34**(1):1-7.

Silberschmidt, M. and Rasch, V. 2001. "Adolescent girls, illegal abortions and "sugar-daddies" in Dar es Salaam: vulnerable victims and active social agents", *Social Science & Medicine* **52**(12):1815-1826.

Silk, J. and Romero, D. 2014. "The role of parents and families in teen pregnancy prevention: An analysis of programs and policies", *Journal of Family Issues* **35**(10):1339-1362.

StataCorp, LP. 2015. "STATA 12 [Computer software]", *College Station, TX: StataCorp LP*

Stover, J. 1998. "Revising the proximate determinants of fertility framework: What have we learned in the past 20 years?", *Studies in Family Planning*: **29**(3):255-267.

Sully, E.A., Madziyire, M.G., Riley, T*., et al.* 2018. "Abortion in Zimbabwe: A national study of the incidence of induced abortion, unintended pregnancy and post-abortion care in 2016", *PLoS One* **13**(10):e0205239.

Swartz, L. 2009. "Fertility transition in South Africa and its implications on the four major population groups", *Association of Scientists, Developers and Faculties*: **48**(9):487.

Timæus, I.M. and Moultrie, T.A. 2013. "Distinguishing the impact of postponement, spacing and stopping on birth intervals: Evidence from a model with heterogeneous fecundity", *Journal of Biosocial Science* **45**(3):311-330.

Timæus, I.M. and Moultrie, T.A. 2015. "Adolescent childbearing and educational attainment in South Africa", *Studies in Family Planning* **46**(2):143-160.

Tsui, A.O., Creang,a A.A. and S, A. 2007. "The role of delayed childbearing in the prevention of obstetric fistulas", *International Journal of Gynecology & Obstetrics* **99**:98-107.

Tylee, A., Haller, D.M., Graham, T., Churchill, R. and Sanci, L.A., 2007. "Youth-friendly primary-care services: how are we doing and what more needs to be done?", *The Lancet* **369**(9572):1565-1573.

Umberson, D., Crosnoe, R. and Reczek, C., 2010. "Social relationships and health behavior across the life course", *Annual Review of Sociology* **36**:139-157.

Urdinola, B.P. and Ospino, C., 2015. "Long-term consequences of adolescent fertility: The Colombian case", *Demographic Research* **32**:1487-1518.

Winkelmann, R. and Zimmermann, K.F., 1994. "Count data models for demographic data", *Mathematical Population Studies* **4**(3):205-221.

Wood, K. and Jewkes, R., 2006."Blood blockages and scolding nurses: barriers to adolescent contraceptive use in South Africa", *Reproductive Health Matters* **14**(27):109-118.

APPENDICES

Appendix A: Cohort-period fertility rates

Table A. 1 Cohort-period fertility rates (1988_ZDHS)

Number of years before the survey		0-4	5-9	10-14	15-19	20-24	25-29	30-34
		1983-1988	1978-1983	1973-1978	1968-1973	1963-1968	1958-1963	1953-1958
Age of cohort At survey	Number of women			Number of births				
15-19	1 021.0	188.0	4.0					
20-24	840.0	843.0	236.0	12.0				
25-29	679.0	851.0	857.0	242.0	15.0			
30-34	589.0	713.0	888.0	747.0	202.0	10.0		
35-39	464.0	471.0	646.0	698.0	569.0	163.0	22.0	
40-44	318.0	210.0	359.0	450.0	495.0	372.0	138.0	11.0
45-49	290.0	82.0	235.0	329.0	389.0	447.0	360.0	131.0
	Birth Cohort			Cohort-period fertility				
15-19	1969-1973	0.037	0.001					
20-24	1964-1968	0.201	0.056	0.003				
25-29	1959-1963	0.251	0.252	0.071	0.004			
30-34	1954-1958	0.242	0.302	0.254	0.069	0.003		
35-39	1949-1953	0.203	0.278	0.301	0.245	0.070	0.009	
40-44	1944-1948	0.132	0.226	0.283	0.311	0.234	0.087	0.007
45-49	1939-1943	0.057	0.162	0.227	0.268	0.308	0.248	0.090
Age of cohort(end of period)				Cohort-period fertility				
15-19		0.037	0.056	0.071	0.069	0.070	0.087	0.090
20-24		0.201	0.252	0.254	0.245	0.234	0.248	
25-29		0.251	0.302	0.301	0.311	0.308		
30-34		0.242	0.278	0.283	0.268			
35-39		0.203	0.226	0.227				
40-44		0.132	0.162					
45-49		0.057						
P				Cumulative fertility (end of period)				
15-19		0.184	0.281	0.356	0.343	0.351	0.434	0.452
20-24		1.285	1.619	1.611	1.578	1.604	1.693	
25-29		2.872	3.119	3.082	3.160	3.234		
30-34		4.329	4.474	4.575	4.576			
35-39		5.489	5.704	5.710				
40-44		6.365	6.521					
45-49		6.803						
F				Cumulative fertility (within period)				
15-19		0.184	0.281	0.356	0.343	0.351	0.434	0.452
20-24		1.188	1.543	1.625	1.569	1.521	1.675	
25-29		2.441	3.051	3.129	3.126	3.062		
30-34		3.652	4.443	4.544	4.467			
35-39		4.667	5.572	5.679				
40-44		5.327	6.382					
45-49		5.610	6.665					
P / F								
15-19		1.000	1.000	1.000	1.000	1.000	1.000	1.000
20-24		1.082	1.049	0.992	1.005	1.054	1.011	
25-29		1.177	1.022	0.985	1.011	1.056		
30-34		1.186	1.007	1.007	1.024			
35-39		1.176	1.024	1.006				
40-44		1.195	1.022					
45-49		1.213						

Brass effects

Table A. 2 Cohort-period fertility rates (1994_ZDHS)

Number of years before the survey		0-4	5-9	10-14	15-19	20-24	25-29	30-34
		1989-1994	1984-1989	1979-1984	1974-1979	1969-1974	1964-1969	1959-1964
Age of cohort At survey	**Number of women**			**Number of births**				
15-19	1 471.6	242.9	5.4					
20-24	1 269.4	1 116.8	274.4	6.2				
25-29	914.8	941.9	888.0	312.9	20.1			
30-34	871.0	825.2	1 115.4	1 115.3	309.3	18.9		
35-39	661.5	507.4	836.2	1 014.7	802.4	216.9	13.9	
40-44	532.4	294.2	568.1	772.9	809.0	616.5	163.4	11.4
45-49	407.3	75.1	303.8	469.9	561.9	620.0	487.1	150.3
	Birth Cohort			**Cohort-period fertility**				
15-19	1975-1979	0.033	0.001					
20-24	1970-1974	0.176	0.043	0.001				
25-29	1965-1969	0.206	0.194	0.068	0.004			
30-34	1960-1964	0.189	0.256	0.256	0.071	0.004		
35-39	1955-1959	0.153	0.253	0.307	0.243	0.066	0.004	
40-44	1950-1954	0.111	0.213	0.290	0.304	0.232	0.061	0.004
45-49	1945-1949	0.037	0.149	0.231	0.276	0.304	0.239	0.074
Age of cohort(end of period)				**Cohort-period fertility**				
15-19		0.033	0.043	0.068	0.071	0.066	0.061	0.074
20-24		0.176	0.194	0.256	0.243	0.232	0.239	
25-29		0.206	0.256	0.307	0.304	0.304		
30-34		0.189	0.253	0.290	0.276			
35-39		0.153	0.213	0.231				
40-44		0.111	0.149					
45-49		0.037						
P				**Cumulative fertility (end of period)**				
15-19		0.165	0.216	0.342	0.355	0.328	0.307	0.369
20-24		1.096	1.313	1.636	1.541	1.465	1.565	
25-29		2.342	2.916	3.075	2.985	3.087		
30-34		3.864	4.339	4.437	4.466			
35-39		5.106	5.504	5.620				
40-44		6.057	6.366					
45-49		6.550						
F				**Cumulative fertility (within period)**				
15-19		0.165	0.216	0.342	0.355	0.328	0.307	0.369
20-24		1.045	1.187	1.623	1.568	1.486	1.503	
25-29		2.074	2.467	3.157	3.088	3.008		
30-34		3.022	3.732	4.608	4.467			
35-39		3.789	4.799	5.762				
40-44		4.342	5.545					
45-49		4.526	5.729					
P / F								
15-19		1.000	1.000	1.000	1.000	1.000	1.000	1.000
20-24		1.049	1.106	1.008	0.983	0.986	1.041	
25-29		1.129	1.182	0.974	0.967	1.026		
30-34		1.279	1.163	0.963	1.000			
35-39		1.348	1.147	0.975				
40-44		1.395	1.148					
45-49		1.447						

Brass effects; Potter effects

Table A. 3 Cohort-period fertility rates (1999_ZDHS)

Number of years before the survey		0-4	5-9	10-14	15-19	20-24	25-29	30-34
		1994-1999	1989-1994	1984-1989	1979-1984	1974-1979	1969-1974	1964-1969
Age of cohort At survey	**Number of women**			**Number of births**				
15-19	1 446.6	262.4	2.5					
20-24	1 294.2	1 098.7	258.3	9.7				
25-29	1 034.4	1 021.9	928.9	246.0	4.6			
30-34	667.7	530.9	738.4	638.4	149.2	6.3		
35-39	637.0	421.9	600.5	863.4	790.3	200.1	3.7	
40-44	465.7	184.7	411.4	585.0	710.4	549.3	135.9	1.6
45-49	361.5	58.4	257.3	418.4	503.6	539.8	404.5	84.0
	Birth Cohort			**Cohort-period fertility**				
15-19	1980-1984	0.036	0.000					
20-24	1975-1979	0.170	0.040	0.001				
25-29	1970-1974	0.198	0.180	0.048	0.001			
30-34	1965-1969	0.159	0.221	0.191	0.045	0.002		
35-39	1960-1964	0.132	0.189	0.271	0.248	0.063	0.001	
40-44	1955-1959	0.079	0.177	0.251	0.305	0.236	0.058	0.001
45-49	1950-1954	0.032	0.142	0.231	0.279	0.299	0.224	0.046
Age of cohort(end of period)				**Cohort-period fertility**				
15-19		0.036	0.040	0.048	0.045	0.063	0.058	0.046
20-24		0.170	0.180	0.191	0.248	0.236	0.224	
25-29		0.198	0.221	0.271	0.305	0.299		
30-34		0.159	0.189	0.251	0.279			
35-39		0.132	0.177	0.231				
40-44		0.079	0.142					
45-49		0.032						
P				**Cumulative fertility (end of period)**				
15-19		0.181	0.200	0.238	0.223	0.314	0.292	0.232
20-24		1.049	1.136	1.180	1.555	1.472	1.352	
25-29		2.124	2.285	2.910	2.997	2.845		
30-34		3.080	3.853	4.254	4.238			
35-39		4.516	5.137	5.395				
40-44		5.534	6.107					
45-49		6.269						
F				**Cumulative fertility (within period)**				
15-19		0.181	0.200	0.238	0.223	0.314	0.292	0.232
20-24		1.030	1.098	1.194	1.464	1.494	1.411	
25-29		2.018	2.203	2.550	2.990	2.987		
30-34		2.813	3.146	3.806	4.383			
35-39		3.476	4.030	4.963				
40-44		3.872	4.742					
45-49		4.034	4.903					
P / F								
15-19		1.000	1.000	1.000	1.000	1.000	1.000	1.000
20-24		1.018	1.035	0.988	1.062	0.985	0.958	
25-29		1.052	1.037	1.142	1.002	0.952		
30-34		1.095	1.225	1.118	0.967			
35-39		1.299	1.275	1.087				
40-44		1.429	1.288					
45-49		1.554						

Brass effects

Table A. 4 Cohort-period fertility rates (2005-2006_ZDHS)

Number of years before the survey		0-4	5-9	10-14	15-19	20-24	25-29	30-34
		2000-2005	1995-2000	1990-1995	1985-1990	1980-1985	1975-1980	1970-1975
Age of cohort At survey	**Number of women**			**Number of births**				
15-19	2 151.5	366.2	12.5					
20-24	1 952.1	1 676.9	416.4	8.1				
25-29	1 466.4	1 426.1	1 339.9	331.9	19.3			
30-34	1 215.5	1 006.5	1 270.5	1 153.6	300.6	14.3		
35-39	834.0	469.0	725.0	908.6	755.7	222.9	8.1	
40-44	698.9	248.8	504.1	726.1	860.5	867.5	181.5	7.4
45-49	588.5	78.8	256.7	512.5	717.6	904.2	694.4	171.2
	Birth Cohort			**Cohort-period fertility**				
15-19	1986-1990	0.034	0.001					
20-24	1981-1985	0.172	0.043	0.001				
25-29	1976-1980	0.195	0.183	0.045	0.003			
30-34	1971-1975	0.166	0.209	0.190	0.049	0.002		
35-39	1966-1970	0.112	0.174	0.218	0.181	0.053	0.002	
40-44	1961-1965	0.071	0.144	0.208	0.246	0.248	0.052	0.002
45-49	1956-1960	0.027	0.087	0.174	0.244	0.307	0.236	0.058
Age of cohort(end of period)				**Cohort-period fertility**				
15-19		0.034	0.043	0.045	0.049	0.053	0.052	0.058
20-24		0.172	0.183	0.190	0.181	0.248	0.236	
25-29		0.195	0.209	0.218	0.246	0.307		
30-34		0.166	0.174	0.208	0.244			
35-39		0.112	0.144	0.174				
40-44		0.071	0.087					
45-49		0.027						
P				**Cumulative fertility (end of period)**				
15-19		0.170	0.213	0.226	0.247	0.267	0.260	0.291
20-24		1.072	1.140	1.196	1.173	1.501	1.471	
25-29		2.113	2.242	2.263	2.732	3.007		
30-34		3.070	3.132	3.771	4.226			
35-39		3.694	4.492	5.097				
40-44		4.848	5.533					
45-49		5.667						
F				**Cumulative fertility (within period)**				
15-19		0.170	0.213	0.226	0.247	0.267	0.260	0.291
20-24		1.029	1.127	1.175	1.153	1.508	1.439	
25-29		2.002	2.172	2.265	2.384	3.045		
30-34		2.830	3.042	3.304	3.604			
35-39		3.392	3.763	4.174				
40-44		3.748	4.199					
45-49		3.882	4.333					
P / F								
15-19		1.000	1.000	1.000	1.000	1.000	1.000	1.000
20-24		1.042	1.012	1.018	1.017	0.995	1.022	
25-29		1.055	1.032	0.999	1.146	0.988		
30-34		1.085	1.030	1.141	1.173			
35-39		1.089	1.194	1.221				
40-44		1.293	1.318					
45-49		1.460						

Brass effects; Potter effects

Table A. 5 Cohort-period fertility rates (2010_ZDHS)

Number of years before the survey		0-4	5-9	10-14	15-19	20-24	25-29	30-34
		2005-2010	2000-2005	1995-2000	1990-1995	1985-1990	1980-1985	1975-1980
Age of cohort At survey	**Number of women**			**Number of births**				
15-19	1 944.9	401.3	2.4					
20-24	1 841.2	1 681.0	355.5	2.9				
25-29	1 686.4	1 650.7	1 369.8	343.4	3.3			
30-34	1 295.9	994.7	1 226.8	1 150.7	239.0	5.3		
35-39	1 050.6	637.1	857.9	1 126.2	925.1	235.0	5.0	
40-44	732.3	212.2	445.9	671.9	760.7	727.1	176.4	4.5
45-49	619.6	53.6	226.7	462.8	607.8	766.2	746.7	175.3
	Birth Cohort			**Cohort-period fertility**				
15-19	1991-1995	0.041	0.000					
20-24	1986-1990	0.183	0.039	0.000				
25-29	1981-1985	0.196	0.162	0.041	0.000			
30-34	1976-1980	0.154	0.189	0.178	0.037	0.001		
35-39	1971-1975	0.121	0.163	0.214	0.176	0.045	0.001	
40-44	1966-1970	0.058	0.122	0.184	0.208	0.199	0.048	0.001
45-49	1961-1965	0.017	0.073	0.149	0.196	0.247	0.241	0.057
Age of cohort(end of period)				**Cohort-period fertility**				
15-19		0.041	0.039	0.041	0.037	0.045	0.048	0.057
20-24		0.183	0.162	0.178	0.176	0.199	0.241	
25-29		0.196	0.189	0.214	0.208	0.247		
30-34		0.154	0.163	0.184	0.196			
35-39		0.121	0.122	0.149				
40-44		0.058	0.073					
45-49		0.017						
P				**Cumulative fertility (end of period)**				
15-19		0.206	0.193	0.204	0.184	0.224	0.241	0.283
20-24		1.106	1.016	1.072	1.104	1.234	1.488	
25-29		1.995	2.019	2.176	2.272	2.725		
30-34		2.787	2.993	3.190	3.705			
35-39		3.599	3.799	4.452				
40-44		4.089	4.818					
45-49		4.905						
F				**Cumulative fertility (within period)**				
15-19		0.206	0.193	0.204	0.184	0.224	0.241	0.283
20-24		1.119	1.005	1.092	1.065	1.217	1.446	
25-29		2.098	1.952	2.163	2.104	2.453		
30-34		2.866	2.769	3.081	3.085			
35-39		3.472	3.378	3.828				
40-44		3.762	3.743					
45-49		3.848	3.830					
P / F								
15-19		1.000	1.000	1.000	1.000	1.000	1.000	1.000
20-24		0.988	1.010	0.982	1.037	1.014	1.029	
25-29		0.951	1.034	1.006	1.080	1.111		
30-34		0.972	1.081	1.035	1.201			
35-39		1.037	1.125	1.163				
40-44		1.087	1.287					
45-49		1.274						

Brass effects; Potter effects

Table A. 6 Cohort-period fertility rates (2015_ZDHS)

Number of years before the survey		0-4	5-9	10-14	15-19	20-24	25-29	30-34
		2010-2015	2005-2010	2000-2005	1995-2000	1990-1995	1985-1990	1980-1985
Age of cohort At survey	**Number of women**			**Number of births**				
15-19	2 198.6	397.9	1.6					
20-24	1 696.6	1 522.3	383.4	6.3				
25-29	1 657.5	1 758.6	1 494.1	396.7	2.7			
30-34	1 618.8	1 486.6	1 592.9	1 367.6	343.9	3.9		
35-39	1 235.8	817.1	1 075.3	1 196.5	1 132.1	257.3	8.2	
40-44	965.2	372.9	655.4	806.3	1 062.7	876.3	178.3	6.4
45-49	582.5	55.3	202.7	392.3	536.7	622.3	518.7	140.6
	Birth Cohort			**Cohort-period fertility**				
15-19	1996-2000	0.036	0.000					
20-24	1991-1995	0.179	0.045	0.001				
25-29	1986-1990	0.212	0.180	0.048	0.000			
30-34	1981-1985	0.184	0.197	0.169	0.042	0.000		
35-39	1976-1980	0.132	0.174	0.194	0.183	0.042	0.001	
40-44	1971-1975	0.077	0.136	0.167	0.220	0.182	0.037	0.001
45-49	1966-1970	0.019	0.070	0.135	0.184	0.214	0.178	0.048
Age of cohort(end of period)				**Cohort-period fertility**				
15-19		0.036	0.045	0.048	0.042	0.042	0.037	0.048
20-24		0.179	0.180	0.169	0.183	0.182	0.178	
25-29		0.212	0.197	0.194	0.220	0.214		
30-34		0.184	0.174	0.167	0.184			
35-39		0.132	0.136	0.135				
40-44		0.077	0.070					
45-49		0.019						
P				**Cumulative fertility (end of period)**				
15-19		0.181	0.226	0.239	0.212	0.208	0.185	0.241
20-24		1.123	1.141	1.057	1.124	1.093	1.132	
25-29		2.202	2.041	2.092	2.194	2.200		
30-34		2.959	2.963	3.029	3.122			
35-39		3.624	3.708	3.795				
40-44		4.094	4.143					
45-49		4.238						
F				**Cumulative fertility (within period)**				
15-19		0.181	0.226	0.239	0.212	0.208	0.185	0.241
20-24		1.078	1.127	1.084	1.129	1.116	1.075	
25-29		2.139	2.111	2.052	2.230	2.184		
30-34		3.057	2.981	2.888	3.151			
35-39		3.719	3.661	3.561				
40-44		4.105	4.009					
45-49		4.200	4.104					
P / F								
15-19		1.000	1.000	1.000	1.000	1.000	1.000	1.000
20-24		1.042	1.012	0.975	0.996	0.979	1.053	
25-29		1.029	0.967	1.020	0.984	1.007		
30-34		0.968	0.994	1.049	0.991			
35-39		0.974	1.013	1.066				
40-44		0.997	1.034					
45-49		1.009						

Brass effects