Maternal Socio-demographic Characteristics and Foetal Losses: An Analysis of Data from the 2013/14 Zambia Demographic and Health Survey.

By**:** *Paul Chishimba*

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Paul Chishimba		03/01/2017
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DECLARATION

I, the undersigned, wishes to declare that this dissertation represents my own work and that it has not previously been submitted for a degree, diploma or other qualification at this or any other University.

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CERTIFICATE OF APPROVAL

This dissertation of **Paul Chishimba** has been approved as partial fulfilment of the requirements for the award of Masters Degree in Population Studies by the University of Zambia

Signature:			
Date:	27/12/2016	29/12/2016	03/01/2017

ABSTRACT

Maternal Socio-demographic Characteristics and Foetal Losses: An Analysis of Data from the 2013/14 Zambia Demographic and Health Survey *by* Paul Chishimba

OBJECTIVES: To determine social and demographic characteristics of mothers that were risk factors for pregnancy losses and; assess the relative importance of respective socioeconomic and demographic characteristics of mothers in determining the risk of losing a pregnancy

METHODOLOGY: This was a cross-sectional, quantitative design that used data from the 2013/14 ZDHS. Binary logistic regression models were fitted to the data to explore and determine maternal factors associated with pregnancy losses among Zambian women aged 15-49. A total of 2399 cases were selected from the women's questionnaire sub dataset. The following variables were selected: *Age of the mother, education, Body Mass Index, Children ever born, Family planning use, marital status, STI symptoms and age at first child.*

RESULTS: Ten and half percent of the women reported having lost a pregnancy in the 12 months before the interview and nearly 75 percent did so within three months of pregnancy.

When all variables were considered together, education and BMI, were not statistically significantly (α=0.05). The older the woman (older than19 years) the higher the risk of pregnancy loss, (OR=2.79; 95% CI, 1.45-5.35) for those aged 30-34, (OR=2.53; 95% CI, 1.50-4.29) for those aged 20-29 and (OR=2.51; 95% CI, 1.28-4.92) for those aged 35+. The risk of losing a pregnancy reduced with increasing number of Children Ever born (CEB) (OR=0.40; 95% CI, 0.21-0.74) for CEB=1, (OR=0.14; 95% CI, 0.07-0.28) for those with 5+ children. Having had STI symptoms, significantly increased twofold the odds of losing a pregnancy (OR=2.33; 95% CI, 1.35-4.02). Women who had their first child from 17-19 years, were 32 percent less likely (OR=0.68; 95% CI, 0.47- 1.00) and those who started child bearing after 19 years, were 54 percent less likely (OR=0.46; 95% CI, 0.29-0.73) to have lost a pregnancy than those who had their first child before 17 years of age.

Women who were currently using a family planning (FP) method were about 34 percent less (OR=0.66; 95% CI, 0.45-0.98), and those who had used a method before were about 86 percent more likely (OR=1.86; 95% CI, 1.28-2.68), to experience a pregnancy loss that those who had never used any contraceptive method. Women who were currently leaving with a partner, were 17 times more likely (OR=17.04; 95% CI, 4.24-68.45), while those who were currently married were 13 times more likely (OR=13.03; 95% CI, 7.37-23.05) to experience a pregnancy loss than those who had never been in a union. Those who were separated/widowed/divorced were more likely to start FP immediately after pregnancy loss (29.2% vs 19.3% for those in a union) while those in a union (married/cohabiting) were more likely to fall pregnant again than those who were separated/widowed/divorced (22.8% vs 16.6%).

DISCUSSION AND CONCLUSION: This study provides indications in the patterns of pregnancy losses in Zambia. Findings point to concerns raised in other studies on Zambia, that cases usually reported as miscarriages are mostly induced as indicated by the higher tendency to promptly turn to family planning after loss among those who were not in formal unions. Increased access to family planning and screening for STIs may hold the key to reduced incidence of pregnancy losses, as it is likely to promote delaying the timing at first child and reduced length of exposure to syphilis during pregnancy as women in Zambia generally report late for first prenatal visit

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LIST OF ABBREVIATIONS

ACRONYM	EXPANDED DESCRIPTION
ANC	Antenatal Care
BMI	Body Mass Index
CDC	Centres for Disease Control
CGD	Centre for Global Development
CI	Confidence Interval
CSO	Central Statistical Office
df	Degrees of Freedom
DHS	Demographic and Health Survey
HL	Hosmer and Lemeshow
HMIS	Health management Information System
ICD	International Classification of Diseases
ICD10	International Classification of Diseases, 10^{th} Edition
ICPD	International Conference on Population and Development
IPT	Intermitted Presumptive Treatment
IUFD	Intrauterine Foetal Death
LL	Log likelihood
MDG	Millennium Development Goals
NSFG	National Surveys on Family Growth
OR	Odds Ratio
RH	Reproductive Health
ROC	Receiver Operating Characteristic Curve
SBR	Stillbirth Rate
SN	Student Number
SPSS	Statistical Package for Social Sciences
STI	Sexually Transmitted Infections
U.S.	United States
UHC	Universal Health Coverage
UK	United Kingdom
UN	United Nations
UNFPA	United Nations Population Fund
VIF	Variance Inflation Factor
WHO	World Health Organisation
WHOACT	World Health Organisation Antenatal Care Trial
ZDHS	Zambia Demographic and Health Survey

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Chapter 1: INTRODUCTION

1.1 Background

Using the definition from the Cairo International Conference on Population and Development (ICPD) of 1994 (UNFPA, 1995), Reproductive Health should cover every aspect that affects the lives of women (and men) from conception to birth. However, it's apparent from literature that some aspects from conception to birth have received more attention than others. Once a conception takes place, a couple, embarks on a nine-month long journey which takes them through a number of potential milestones, starting with the pregnancy itself to the end of the pregnancy - with an anticipation for a live birth. Unfortunately, this anticipation is not achieved by every couple or mother as some pregnancies do not survive to bring forth a living baby. Whereas a lot of global investment has gone into maternal, neonatal and child health programmes, what happens to 'unfruitful' pregnancies before 28 weeks of gestation has received paltry attention. Mullan and Horton (2011, p.1291) argue that:

> *'Maternal and child survival [were] rightly assigned their own Millennium Development Goals (MDGs 5 and 4, respectively) ……. Stillbirths [were] nowhere to be seen. ……. In trying to calculate a global stillbirth rate, [it was found that] many countries do not even include stillbirths in their national systems for vital registration. Tracking numbers and causes of stillbirth is hampered by variations in the definition of stillbirth and the baffling array of classification systems in existence. The definition of stillbirth [therefore] is a delicate task.'*

This argument is complemented by Froen et al. (2011) who contend that, whereas motherhood has been the focus of global initiatives and interventions over thirty years, there has been a lack of focus on the mothers' own most important aspiration: a live baby. Most prevention strategies begin before conception (e.g. contraception) and finish only after pregnancy has ended with a safe birth. Unfortunately, they argue, even when an attempt to collect information on foetal deaths in the last 12 weeks of pregnancy is made, the relevance to foetal death is lost; because this information is combined with early neonatal deaths to obtain perinatal mortality, thereby masking the true burden of the foetal deaths.

Stillbirths are invisible in many societies and on the worldwide policy agenda, but are very real to families who experience a foetal death. The problem is exacerbated by the traditions and beliefs in which foetal deaths are interweaved – possibility of stigma and marginalisation. Although 1 in 20–30 pregnancies end in stillbirth in most less developed countries, communal view is frequently that nothing can be done to improve birth outcomes (Van den Broek et al., 2003).

With the shift towards the post-MDG era, the World Health Organisation (WHO) has been urging member countries to revisit the Alma Ata Declaration by ensuring Universal Health Coverage (UHC) to all the peoples of the world. The goal of universal health coverage is to ensure that all people obtain the health services they needed without suffering [any form of] hardship when [accessing the service] (WHO, 2012a). The focus of foetal losses has been on those who manage to access health services. But since the majority of foetal losses take place during the first and second trimester, in the face of late first antenatal visits, most of the losses are taking place before a woman has an opportunity to seek health services (CSO, 2013). It is imperative therefore to strengthen community programmes so that women can be encouraged to seek care early in their pregnancy – but this can only be more effective if factors that predispose women to pregnancy losses were well understood so that targeted programmes can be drawn for women with the risk of losing their pregnancies even before the first antenatal visit.

1.2 Statement of the Problem

Zambia has been collecting historical data on pregnancy losses in the past three Demographic and Health Surveys. However, where an attempt to present data on stillbirths was done, the focus was only on those occurring from the 28th week of gestation or later; and only for the purposes of presenting perinatal mortality, yet foetal losses before the 28th week represented 78 percent of all foetal deaths (with 47% and 31% in the first and second trimester respectively). In Zambia, by the 3rd month, about 74 percent of pregnant women would not have made a single visit for antenatal check-up (CSO, 2013), implying that by the third month, most of the reported pregnancy losses would have silently taken place in the community. Understanding all such pregnancies can help in devising public health interventions to prevent pregnancy losses even before mothers made an initial visit for antenatal

1.3 Significance of the Study

As demonstrated in Figure 1, from a projected midyear population for 2015, it was estimated that there were 318,000 pregnancies (at 8.7 pregnancy rate (CSO, 2013)). Roughly 33,400 of these pregnancies are likely to have resulted in foetal deaths. Of these about 15,700 would have taken place in the first trimester and roughly 13,900 before the first antenatal visit. Much as the public health focus on pregnancy losses has been on the third trimester still births, every pregnancy loss should count because it matters to every mother whose desire at any planned conception is to have a live baby at the end of her pregnancy.

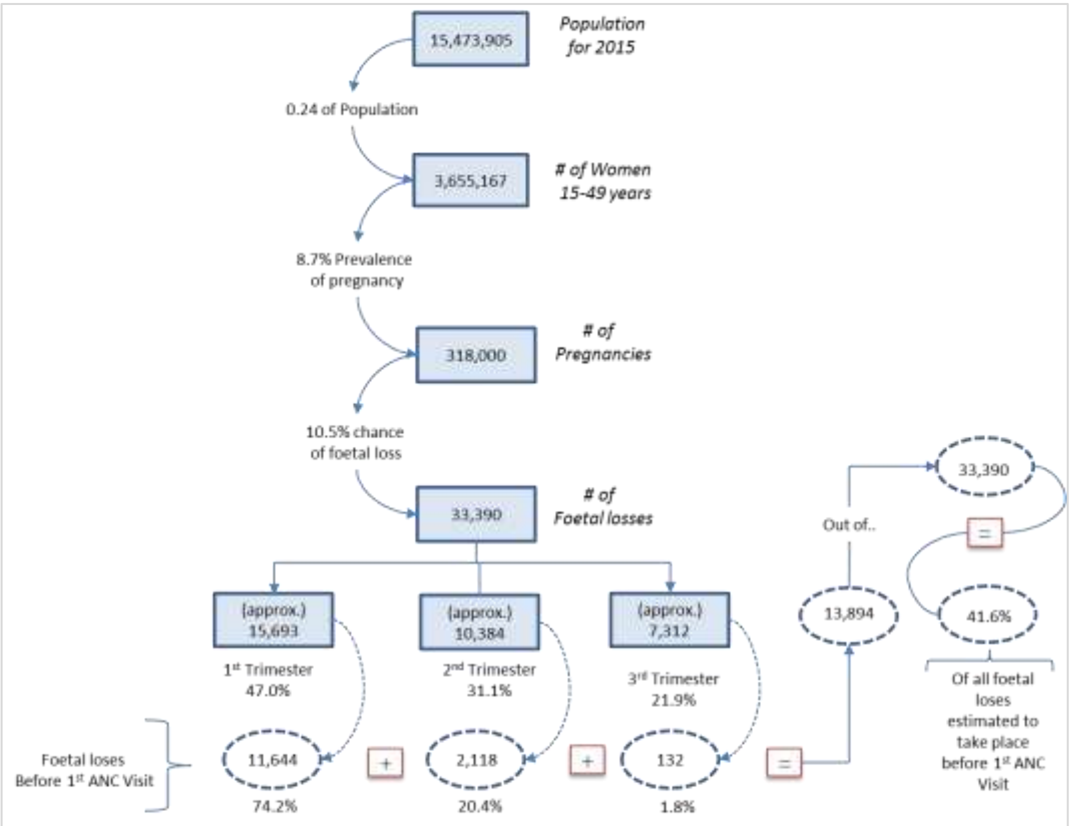

Figure 1: The Burden of Pregnancy Losses before the 1st ANC Visit
(Source: 2010 Census & ZDHS2013)

In order to reduce antepartum foetal mortality rate in a population, it is necessary to know the socio-demographic characteristics that dispose women to risk factors for foetal death. It is also important to know the relative importance of these factors, in order to effectively direct health actions towards the most prevalent causes and propose strategies for mitigating the burden.

1.4 Study Objectives

1) To determine socioeconomic and demographic characteristics of mothers that were risk factors for pregnancy losses.
2) To assess the relative importance of socioeconomic and demographic characteristics of mothers in determining the risk of losing a pregnancy

1.5 Conceptual Framework

In his contribution to the long debate on when life begins, Beazley (1980) as cited by Society for the Protection of Unborn Child (undated.), argues that 'Life does not begin with birth. When born, we are already nine months old ... we have a responsibility to learn how to study the life in utero, and how to care for it'. This argument is reinforced by Condic (2008) that 'a new human life commences at conception - precise moment when the membranes of the sperm and egg cells fuse – called conception.'

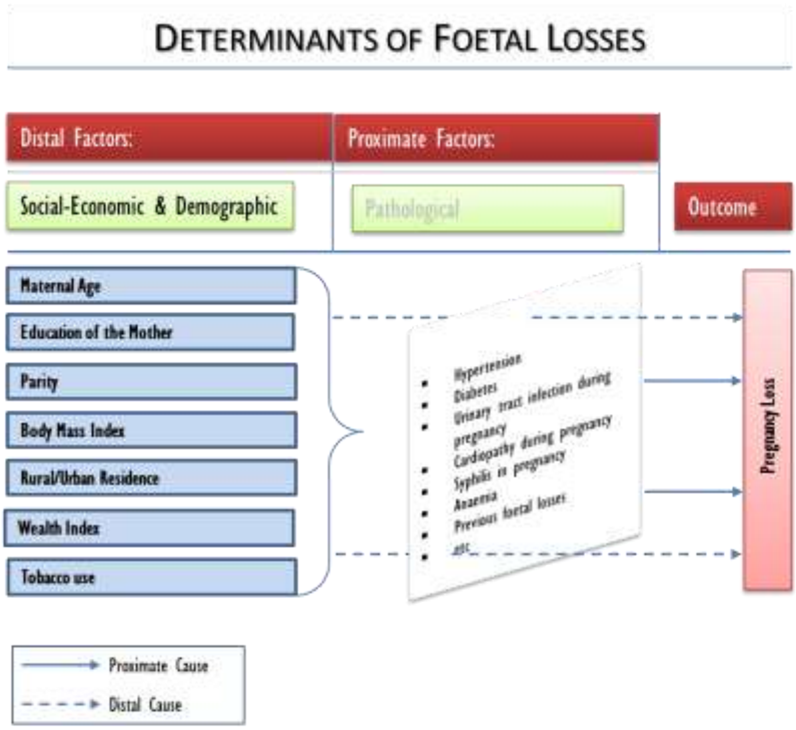

Figure 2: Determinants of Foetal Losses

The focus for Figure 2 (Conceptual framework), like Figure 3 is on pregnancy losses that take place without human intervention. Pregnancy losses therefore covers miscarriages (if lost in the first 21 weeks); early stillbirths (for losses from 22 to 27 weeks) and late stillbirths (from 28 weeks of gestation). Although causes for a large proportion of foetal losses go unexplained (Robson et al., 2001), maternal risk factors associated with foetal losses have been well documented for some time (see Chapter 2).

Most known pathological factors (proximate determinants) can be explained through maternal socioeconomic and demographic characteristics (distal determinants), and these have been included in the standard package of care for a pregnant woman. This, at the minimum include folic acid supplementation/ fortification, malaria in pregnancy, (to prevent anaemia); Syphilis detection and treatment; detection and management of hypertensive diseases (to reduce, among others, the risk of *abruptio placentae*) (WHO 2012b; WHO, 2014).

Management of these pathological factors requires that an expectant mother accesses health services in the first place in order to be screened and treated for identified problems. However, according to the 2013/14 ZDHS (CSO, 2013), by the end of the third month, about 75 percent of women would not have made a single visit to a health facility for antenatal check-up. Hence the focus of this framework on distal determinants, so that appropriate messages on these risk factors can be packaged and communicated at community level through community structures even before a woman accesses health services during a pregnancy.

1.6 Study Questions

Study questions have been arranged around the two study objectives thus:

1) What socio-demographic characteristics of mothers are risk factors for pregnancy losses?
2) What is the relative importance of each maternal socio-demographic characteristic in determining the risk of pregnancy loss in the population?

Chapter 2: LITERATURE REVIEW

2.1 Foetal Deaths: What are they?

'Foetal death' is rarely used in classifying pregnancies that do not result into a live birth, instead the term 'stillbirth' is colloquially used in its place. However, the two terms cannot be considered to be synonyms due to varying gestation cut-off ages, depending on where they are applied. In order to account for all pregnancies that do not result into a live birth, the term 'pregnancy loss' is used to cover miscarriages, abortions and stillbirths. Depending on the lower cut-off gestational age and weight used in defining stillbirths, any spontaneous termination of pregnancy taking place before a set cut-off point is classified as a miscarriage.

2.1.1 International Classification of Disease (ICD10)

According to the World Health Organisation, a foetal death is defined as

> *'death prior to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy as long as it is not an induced termination of pregnancy. The death is indicated by the fact that after such expulsion or extraction, the foetus does not breathe or show any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles. Heartbeats are to be distinguished from transient cardiac contractions; respirations are to be distinguished from fleeting respiratory efforts or gasps*' (WHO, 1994, p. 95).

Under the ICD10 definition, WHO uses the following inclusion criteria for stillbirths: gestation of 22 completed weeks or more, a birthweight of 500g or more or length of 25cm or more. This means therefore that any spontaneous loss of pregnancy earlier than 22 weeks or birthweight of less than 500g qualifies to be classified as a miscarriage under this definition.

2.1.2 Country-Specific Definitions

According to Lawn et al. (2011), over the past 50 years, more than 35 stillbirth classifications systems have been published, with more than 15 of these in the past 15 years. Frøen (2001) states that the inconsistent use of the terminology has contributed to the confusion about stillbirths. The terminology has evolved over time despite attempts at the international level to provide global guidelines, Woods (2008), adds that variations between countries are still abound, with far-reaching variations in high-income countries than in low-income countries.

The U.S. Department of Health and Human Services (Ventura et al., 2009), through its agencies, groups the outcome of a pregnancy termination into foetal loss and induced abortion. In the vital registration system, foetal losses are classified as *any pregnancies terminating from 20 weeks onwards that do not result in a live birth* while the National Survey of Family Growth (NSFG), *terminations before 20 weeks are also included as foetal losses*. In England and Wales[1], the definition of 'stillborn child' as contained in the *Births and Deaths Registration Act 1953* section 41 as amended by the *Stillbirth (Definition) Act 1992* section 1 (Stillbirth (Definition Act), 1992) is defined as '*a child which has issued forth from its mother after the 24th week of pregnancy and which did not at any time breathe or show any other signs of life*'. In Australia and New Zealand, stillbirth is defined as a '*death of a baby before or during birth, from the 20th week of pregnancy onwards, or 400grams birthweight*' (Australia and New Zealand Stillbirth Alliance, undated).

2.1.3 The UN Definition for International Comparison

It is the varying classifications (like the ones above) of stillbirths that prompted WHO to come up with a supplementary definition (WHO, undated) to allow for statistical reporting and international comparisons, which defines a stillbirth as '*a baby born with no signs of life at or after 28 weeks of gestation'*. The recommended cut-off value of 28 weeks (also in **Figure 3**) takes into account the reality that in many low-income and middle-income countries, neonatal survival is limited for babies born before 28 weeks' gestation and with birthweights lower than 1000g. **Figure 3** is an attempt at reconciling the ICD-10 definition and the WHO international comparison classification by grouping stillbirths into 'early stillbirths' (22-27 weeks) and third trimester (late) stillbirths (28 weeks or more). Although WHO encourages countries to report separately on stillbirths before 27 weeks, advancement in neonatal intensive care technology, has extended the boundary to as low as 18 weeks (Smith, 2007) in advanced economies, thereby complicating further the global picture of stillbirths and trends over time.

[1] Definition also applies to Scotland and Northern Ireland

According to **Figure 3**, a pregnancy may not last to full-term and produce a live birth. On the way, a pregnancy may be lost due to numerous causes. If lost within the first 21 weeks, it is termed as a 'miscarriage'. After that any pregnancy loss is termed as still birth but for purposes of international comparison only those foetal deaths occurring from 28 weeks and afterwards are counted to produce national statistics. This is a compromise the World Health Organisation had to make in an attempt to standardise reporting at international level. However, each country is encouraged to collect data on foetal deaths before 28 weeks, for local level use.

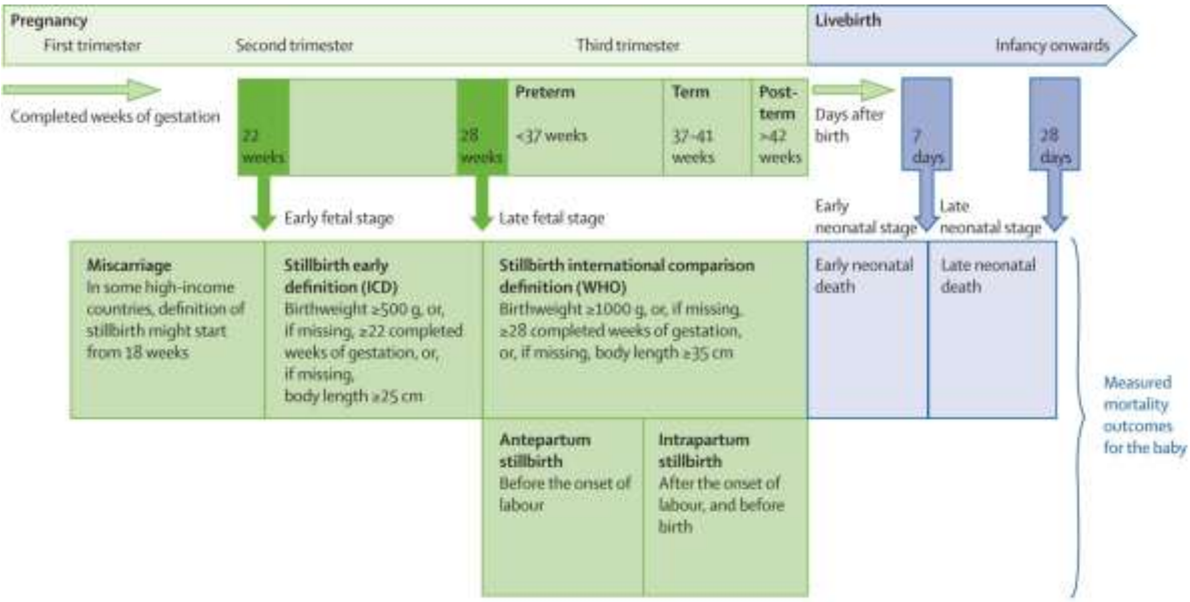

Figure 3: Pregnancy Pathway - Adapted from the Lancet 377(1448-63).

To get around this classification problem, Lawn et al. (2011), argue that the most practical grouping of stillbirths is by time of death: antepartum (before the onset of labour) or intrapartum (during labour and birth) as shown in Figure 3. This classification, they contend, can assist to focus efforts on causes of foetal deaths. This includes the identification and management of risk factors during antenatal and providing safe conditions during delivery.

2.1.4 Foetal Loses – the Zambian Context

The two major sources of data on stillbirths in Zambia are the facility-based routine statistics from the national health information system (HMIS) and the Demographic and Health Surveys. The Births and Deaths Registration Act, Cap 51 (undated) of the laws of Zambia states that,

> '*still-born' shall apply to any child which has issued forth from its mother after the twenty-eighth week of pregnancy and which did not at any time after being completely expelled from its mother, breathe or show any other signs of life'.*

This definition is at variance with the World Health Organisation for international comparisons, in that it excludes the 28th week from the count.

In the Zambian statutes, the terms 'miscarriage' and 'abortion' are used interchangeably in a number of places. For example, Act No. 15 of 2005 (c.05), states that:

> '*Any person who, with intent to procure the miscarriage of a woman or female child, whether she is or is not with child, unlawfully administers to her or causes her to take any poison or other noxious thing, or uses any force of any kind, or uses any other means whatsoever, commits a felony and is liable, upon conviction, to imprisonment for a term not exceeding seven years*'. This is despite this clause being titled, 'Attempt to procure an abortion'.

In the ZDHS of 2013, 2007 and 2001, data on stillbirths was collected by asking women the question: '*Have you ever had a pregnancy that miscarried, was aborted, or ended in a stillbirth?'*, with a follow up question on the gestation at which the last pregnancy miscarried, was aborted, or ended in a stillbirth (CSO, 2013). The interviewer's manual that accompanied this questionnaire explained thus: '*If a pregnancy ended early and involuntarily, it was a miscarriage. If a woman voluntarily ended a pregnancy, it was an abortion. If a woman gave birth to a child that showed no signs of life, it was a stillbirth*. In the report published after the survey, the term 'stillbirths' was clarified as being '*foetal deaths in pregnancies lasting seven or more months' (*ICF international, 2012). Implied in these definitions is that any pregnancy loss before 7 months of gestation is either a miscarriage or an abortion, which ends up lumping abortions and miscarriage together, probably due to the fact that the legality of abortions is Zambia is restricted to medical conditions (Termination of Pregnancy Act, Cap 304 of the Laws of Zambia), as such even abortions are likely to be reported as miscarriages.

2.2 The Prevalence of foetal losses

2.2.1 Incidence of Spontaneous Abortions

Studies have shown that spontaneous abortion is the most prevalent complication during the first trimester of a pregnancy (NCCWCH, 2012). About 30% to 40% of all fertilized eggs miscarry, often before a woman knows she is pregnant (Johns Hopkins University, 2012). However, the rate of miscarriage drops after the baby's heart beat is detected (MedlinePlus, 2014). About 8-20 percent of clinically recognised pregnancies up to 20 weeks of gestation result in miscarriages (Regan and Rai, 2000). Other studies have estimated the burden to be about 10% to 15% of pregnancies and that about 85% of miscarriages occur during the first 12 weeks of pregnancy, with as many as 25% of all pregnancies ending in a miscarriage during the first 12 weeks of pregnancy Miscarriages are more common in high-risk pregnancies, particularly when women are not receiving adequate medical care (Antonnete, 2013).

2.2.2 Prevalence of Induced Abortions

According to Sedgh et al. (2012), between 2003 and 2008, the global abortion rate changed marginally, from 29 to 28 abortions in every 1000 women of childbearing age (15-44). A difference between developing and developed countries was observed: In 2008, the rate stood at 29 for developing countries and 24 for developed ones. In Africa, regional differences were equally observed. Southern Africa had the lowest abortion rates of 15 per 1000 women with East Africa recording the highest at 38 per 1000 women. North Africa, West Africa and Middle Africa recorded 18, 28 and 36 per 1000 women respectively.

In Zambia, termination of pregnancy is only legal if the woman’s life or health is endangered or that of existing children, or because if the foetus was left to be born, it would experience unbearable suffering. Most of the studies that have been conducted have focused on the outcomes of abortions (Dahlbäckae et al., 2010; Castle et al., 1990; Sims, 1996; Likwa et al., 2009b). There is paucity of data on abortion rates in Zambia, enough to provide a national picture. The few cases that are reported may not be reflective of the true picture, as prescribed by the Termination of Pregnancy Act. This is confirmed by Likwa et al. (2009a), that *‘No national data on abortion are* *available for Zambia'*, however statistics from major hospitals may provide a clue on the incidence of induced abortions. In a study from five major hospitals, Likwa, et al. (2009b), observed that whereas *'a total of 616 women obtained safe induced abortions between 2003 and 2008…. the number of women admitted to the hospitals with abortion-related complications (including complications from spontaneous abortion) increased from about 5,600 in 2003 to more than 10,000 in 2008.'* However, this analysis in itself is indicative of lack of adequate data in that it mixes spontaneous and induced abortions thereby masking the true level of the problem of interest – induced abortion.

2.2.3 The Stillbirth Rate

The earliest attempt at estimating the global burden of stillbirths and perinatal deaths, was in 1983, when the World Health Organisation (WHO) published an estimate of 8 million perinatal deaths (Edouard, 1985) and later in 1996, a perinatal mortality rate of 58 per 1000 total births and a stillbirth rate of 32 per 1000 total births for the developing world. Despite this attempt, it was not until 2006 that estimates for individual countries started emerging (WHO, 2006; Stanton, 2006). Using data from 190 countries, stillbirth rates ranged from 5 per 1000 in rich countries to 32 per 1000 in South Asia and sub-Saharan Africa. The estimated number of global stillbirths was 3·2 million (uncertainty range 2·5-4·1 million).

Although, in Zambia, the Ministry of Health has been collecting facility-based data on stillbirths for some time now, these data are not sufficient to provide a national picture. This deficiency arises from the fact that about one-third of all deliveries take place outside health facilities (CSO, 2013), as such, recorded numbers on stillbirths are likely to be an underestimate. The most recent demographic and health survey have provided a population-based estimate with a rate of 13.9 stillbirths for every 1000 total births in 2006 and 13.2 in 2013 (CSO, 2013).

2.3 Underlying Causes of foetal losses

2.3.1 Advanced Maternal Age

A study of deliveries at the Royal Victoria Hospital in Montreal, Canada, Fretts et al. (1995), reviewed 94,346 obstetric and neonatal records to evaluate risk factors for foetal death. After controlling for high risk factors in pregnancy (such as diabetes and hypertension), women with 35 years of age or older, when compared to those <30 years, continued to have significantly high rate of foetal death than their younger counterparts, with odds ratio of 1.9 (95%, CI: 1.3, 2.7) for women aged 35 to 39 years and; 2.4 (95%, CI: 1.3 to 2.7) for those aged 40 years or older.

In a similar study of maternal age and the risk of stillbirth, Reddy, Ko and Willinger (2006), analysed a total of 5,458,735 singleton gestations for 2001/2 using perinatal mortality and natality files from the US National Center for Health Statistics, with a focus on records that did not report congenital anomalies. They discovered that when women younger than 35 years were compared with the older ones, relative risk of stillbirth was 1.32 (95% CI 1.22, 1.43) for women 35 to 39 years old and 1.88 (95% CI 1.64, 2.16) for women 40 years or older at 37 to 41 weeks of gestation. This effect of maternal age persisted despite accounting for medical diseases, parity, and race/ethnicity, leading to a conclusion that women who were of advanced maternal age are at higher risk of stillbirth throughout gestation.

In another study Bahtiyar (2008), in a search to determine if advanced maternal age was a risk factor for intrauterine foetal demise (IUFD) used the US Centers for Disease Control and Prevention database to analyse pregnancy outcomes in women 15 to 44 years with term singleton gestations. Cox proportional hazards models and Cochran-Mantel-Haenszel tests were used. A total of 6,239,399 singleton term deliveries were included in the analysis (after controlling for maternal smoking and race). When compared with women 25 to 29 years of age, the risk of IUFD increased with advancing age: 30 to 34 years, odds ratio [OR] = 1.24 (95% CI, 1.13 to 1.36); 35 to 39 years, OR = 1.45 (95% CI, 1.21 to 1.74), and 40 to 44 years, OR = 3.04 (95% CI, 1.58 to 5.86).

The observations above were also confirmed by a related study. Using a Norwegian database of more than 575,000 women to investigate unexplained antepartum stillbirths (stillbirth for which there is no explanation despite post-mortem examinations), Froen et al. (2001) found that in singleton gestations, women aged 35 or older had a 5.1-fold increased risk of having a stillbirth compared with women younger than 25 years.

2.3.2 Education of the mother

Although data on foetal death and maternal education had been part of the National Vital Statistics System of the United States, the first attempt at reporting foetal losses by maternal education, was in 1996, when Hoyert (1996) conducted a retrospective analysis of the 1990 data. It was noted that foetal mortality inversely changed with the educational attainment of women, with higher rates for those with less schooling, especially so, for women aged 20-34 and 35-49 years; and for the white population of all ages combined. Even when other characteristics (such as marital status, metropolitan/non-metropolitan and birth order) were considered, mortality differential by education persisted.

In a similar study by Chen et al. (1998), to examine differences in foetal and infant mortality by maternal education, in the province of Quebec, it was revealed that mortality was higher in offspring of mothers with less than 12 years of education as compared to those with at least 14 years, regardless of maternal age, parity and marital status. In a review of the global health policy and a survey of community perceptions in 135 countries, Frøen et al. (2001) observed that stillbirth rates inversely correlated with the wealth and development of nations, specifically with factors such as secondary education and reproductive control. However, education of the mother was not found to be statistically significant in a study of risk factors associated with foetal death at a São Paulo Hospital in Brazil (Aquino, 1998). This finding was probably influenced by the fact this hospital predominantly provided care to low-income female population; likely to have most of them with low education.

2.3.3 Prior pregnancies

Mixed findings, from different studies, have been reported on the influence of prior pregnancies on foetal death. In a retrospective study conducted in a Montreal Hospital, to assess foetal, maternal, and pregnancy-related determinants of unexplained antepartum foetal death, Huang et al. (2000) found that nulliparity, multiparity of three or more previous births was associated with unexplained foetal death. In a similar study in India, Nayak and Gark (2010), reported unexplained foetal death to be associated with primiparity in 43% of the cases studied.

Contrasting results were found by Avachat, Phalke and Phalke (2015). They stated that, although a slightly higher percentage of stillbirths (38.29%) occurred to primiparas women; there was no significant association found between parity and occurrence of stillbirths. This finding was similar to those observed by others. In a case-control study of factors associated with intrauterine foetal deaths, Savvas et al. (2004), found that although para 2 when included in a multivariate analysis showed some reduced risk of foetal death, on its own, parity showed a weak relationship with the risk of foetal death. Similarly, in a study of risk factors for sudden intrauterine unexplained death in Norway, Froen (2001) et al. found that primiparity was not associated with sudden intrauterine unexplained death.

2.3.4 Body Mass Index

Although the optimal body mass index (BMI) for public health prevention has not been universally agreed, evidence from studies suggests that maternal obesity increases the risk of foetal death. In a meta-analysis of 77 publications on PubMed and Emabse, conducted by Aune et al. (2014), these publications revealed that even a modest increase in maternal obesity was associated with increased risk of pregnancy loss. The greatest risk was observed in women with a BMI of 40 - approximately 2- to 3-fold increase in the RR of these outcomes compared with those with a BMI of 20. A cohort study by Khashan and Kenny (2009), from a register of 99,403 births (born in 2004 to 2006), based at the University of Manchester in UK, revealed that excessive leanness and obesity were associated with different adverse pregnancy outcomes with major maternal and foetal complications.

In a retrospective cohort study of mothers who received prenatal or/and intrapartum care from public facilities in Lusaka between February 2006 and March, 2009, Stringer et al. (2011), found that baseline body mass index greater than 26 was significantly associated with stillbirth (adjusted OR 1.8, 95% CI 1.4 –2.3).

There are doesn’t appear to be an agreed time point when BMI should be taken. The study by Stringer and colleagues attempted to specify that the measurements referred to the baseline, which is typically the weight and height taken at first antenatal visit. However, this equally falls short of the required standard as women report for their first antenatal visit at different gestation ages. To be able to compare women at the end of the pregnancy, women should be measured at the same gestation age.

2.3.5 Access to Antenatal Care Services

In a meta-analysis of early antenatal visits and whether this has an effect on outcomes of pregnancy, after reviewing articles done by a number of authors, (Hawkes, Gomez and Broutet, 2013), found that the general prevalence for any unfavourable outcome of pregnancy was higher among women who made their first antenatal care visit in the third trimester compared to any reference group (making the first visit earlier than the third trimester) with an odds ratio 2.24. In a WHO Antenatal Care Trial (WHOACT) study in which two groups of pregnant women (high-risk and low-risk) were subjected to two models of antenatal service delivery: one with an antenatal care package of evidence-based screening, therapeutic interventions and education across four antenatal visits and the other with as many as seven visits, it was found that both high- and low-risk women who were subjected to only four visits had an increased relative risk of foetal death between 32 and 36 – weeks of gestation (Vogel et al., 2013). Though this is probable, the reduced number of visits, in themselves may not explain this as other factors such as the quality of services and timing of the first visit may play a role.

In a population-based retrospective study conducted in 293,091 deliveries from 1996 to 2000 in the State of Hesse, Germany, Künzel and Misselwitz (2003) found that if the available methods for foetal surveillance were employed early in the pregnancy to detect indications of foetal oxygen deprivation, foetal and partum deaths could be reduced by half.

In a systematic review of randomised trials and observational studies that can reduce the burden of stillbirths, Bhutta et al. (2011), identifies folic acid supplementation or fortification, prevention of malaria, and improved detection and management of syphilis during pregnancy as known interventions that can reduce undesirable pregnancy outcomes. This study like most others in this area have focused on the events from the first antenatal visit. Scanty information exists on women who lose their pregnancies for the visiting a health facility. Some of the factors that determine late access to health care may also be responsible for early pregnancy loss.

Chapter 3: METHODOLOGY

3.1 Study Type

This is a cross-sectional, quantitative study. A binary logistic regression model was used to explore and determine maternal factors associated with pregnancy losses among women aged 15-49. The source of data was the Zambia Demographic and Health Survey of 2013/14. Data on pregnancy losses, socioeconomic and demographic characteristic was collected through a structured questionnaire standardised for all Demographic and Health Surveys for the period 2013-18.

3.2 Definition of Terms

Important Terms	Definitions
Pregnancy loss	Is any pregnancy that does not result in a live birth, regardless of duration of pregnancy or cause
Miscarriage	Is the spontaneous termination of pregnancy by removal or expulsion from the uterus of a foetus or embryo before (22 weeks of gestation) viability.
Stillbirth	Is a birth to a dead foetus or infant from 22 weeks of gestation or more.
Early Stillbirth	Is a birth to a dead foetus or infant from 22 and 27 weeks of gestation
Late Stillbirth	Is a birth to a dead foetus or infant from 28 weeks of gestation
Delivery	Delivery is the expulsion or extraction of the child and foetal membranes at birth after 22 weeks of gestation
Abortion	Is the termination of pregnancy by the removal or expulsion from the uterus of a foetus or embryo before viability through human intervention
Live birth	Live birth refers to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life - e.g. beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles - whether or not the umbilical cord has been cut or the placenta is attached.

3.3 Study Population

The study population was women who were aged 15-49 years at the time of the interview in the Zambia Demographic and Health Survey of 2013-14. A total of 16,411 women aged 15-49 answered the women questionnaire. Of these 16,409, responded to a question on pregnancy losses. Therefore, a total of 16,409 valid records were included in the exploratory analysis (See Figure 4) and a subsequent subsample of 251 records for women who reported having had a miscarriage, an abortion or a stillbirth in the 12 months before the interview in the 2013/14 ZDHS), formed the core dataset for building the Logistic Regression Model.

3.4 Data Collection Methods

This study used secondary data from the 2013/14 ZDHS and did not therefore undertake data collection. Nonetheless, to answer each of the two study questions, data were processed as follows:

- Firstly, the ZDHS dataset for the 2013/14 Demographic and Health Survey was requested and downloaded from Measure DHS server.
- Afterwards data for the woman's questions that were specific to past pregnancy losses were extracted together with selected background information to create a subset of data that were relevant to this study. For a complete listing of questions initially selected for this study, please refer to Annex 1.

3.5 Data Procession and Analysis

3.5.1 Data Preparation

Since this study was based on secondary data, understanding the original intention of each variable on the ZDHS questionnaire was of paramount importance. After reviewing both the questionnaire and the SPSS data file for the woman module, a mapping table for the variables needed in this study was developed (See Annex 1).

The original dataset on the Measure DHS server for the Zambia 2013/14 DHS Woman's Module has a total of 16,411 records and 4269 variables. At total of 16,409 women responded to the question: '*Have you ever had a pregnancy that miscarried, was aborted, or ended in a stillbirth?'* Of these, 1717 said 'Yes', while 14,692 responded that they hadn't (as shown in Figure 4). However, this study did not need each variable and every record. Therefore, the following preliminary steps (also in Figure 4) were taken to reduce the data file to the necessary cases and variables.

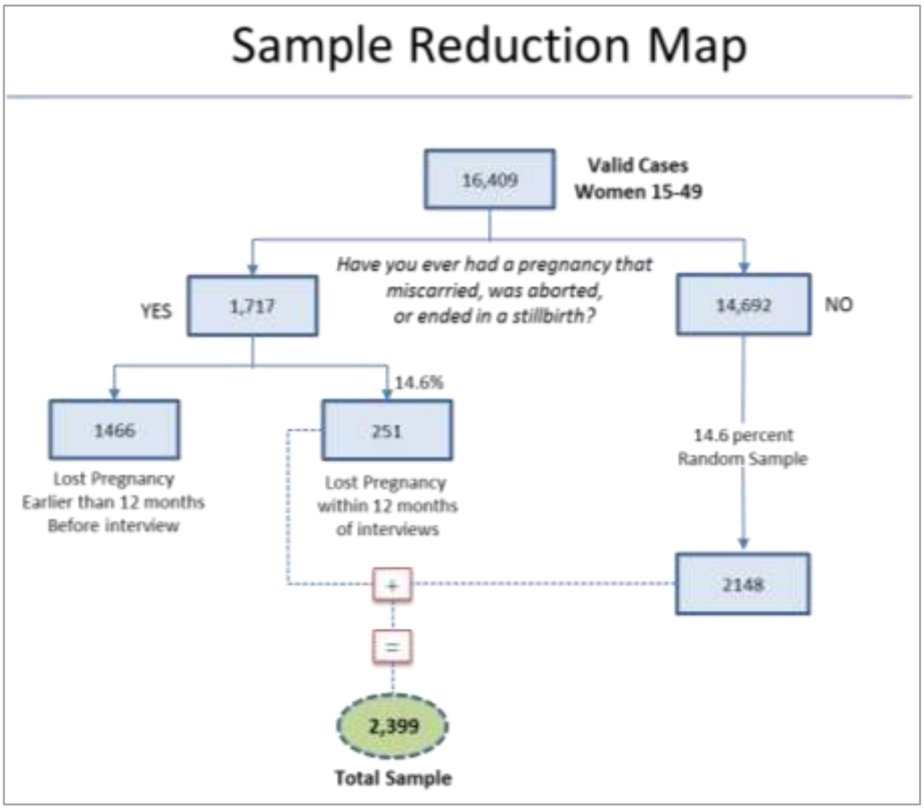

Figure 4: Sample Selection Flow
(Source: ZDHS2013/14)

- **1**: Splitting the SPSS data file into two – one file with cases that reported that they had a pregnancy loss in the past and the other for those that had not experienced a pregnancy loss before the interview (1,717 vs 14,692 respectively).

- **2**: To align reported maternal socio-demographic characteristics (as at the time of the survey) with the pregnancy losses, this study focused only on those pregnancy losses that were reported to have taken place within 12 months from the month of interview. To calculate the interval of 12 months between the pregnancy loss and the time of interview[2], the following data transformation sub steps were followed:
  (i) Computing a date variable (*InterviewDate*) in the format: MMMYY, from the month (*V006*) and year (V007) of interview [See Annex 1 for the variable labels)

[2] Please note the use of the term “interview” as opposed to “survey” period which covered the period from August 2013 to April 2014.

(ii) Computing a date variable (*PregTerm_Date*) in the format: MMMYY, from the month (*V229*) and year (*V230*) when pregnancy ended (i.e. miscarried, was aborted, or ended in a stillbirth)

(iii) Compute the date difference (in months) between '*InterviewDate'* and '*PregTerm_Date'*.

Note: After selecting cases with pregnancy losses within 12 months of the interview, this procedure yielded a total of 251 cases representing 0.1462 of the subsample (1,717).

- **3**: In order to compensate for this reduction (in 2), the subpopulation of women (14,692) who had not experienced a pregnancy loss was also reduced to 2148 by the same factor of 0.1462. This was done using a random sampling procedure in SPSS.

- **4**: The two data files in 2 and 3 were then remerged, ending up with a working sample of 2399 cases.

3.5.2 Model Preparation, Building and Inspection

To determine socioeconomic and demographic characteristics of mothers that were risk factors for pregnancy losses, this study fitted a Multivariate Binary Logistic Regression Model to the data (2399 cases) using the Statistical Package for Social Sciences, version 20 (SPSS20). In broad terms, data analysis covered: Model Preparation, Model Building and Model Evaluation. These three stages were necessary so as to conform to the requirements of a Binary Logistic Regression analysis before Model Presentation could be done (Chapter 4). In order to ensure that only those variables of statistical relevance (to logistic regression modelling) and those of clinical importance to this study, were included in the final model (but at the same time achieve parsimony), an 'ENTER' method was used to select variables for model building. The subsections that follow outline steps that were followed during model preparation, building and inspection.

3.5.2.1 *Step 1*: Univariate Analysis

To determine the socio demographic variables that were risk factors, univariate logistic regression models were run on the following (18) independent variables: Type of residence; marital status; contraceptive use; provider during ANC; STI Symptoms; whether used any IPT; Religion; Province; Education; literacy level; Wealth Index; Age of the respondent; Age at first child; Body Mass Index; Total children ever borne; Timing of first ANC visit; Number of ANC visits from the most recent birth; days drank alcohol in the week before interview. Using a cut-off point of p-value <0.25 and relevance of each variable to the study, thirteen (13) variables were selected for *Step 2*.

Variables that were selected through this step were [3] : Age (AGE); Education (EDUCN); Children ever born (TCEB); Gestation age at first ANC (GA_ANC1); Body Mass Index (BMI); Family Planning use (FPUSE); Marital status (MARITAL); Literacy (LITERACY); STI Symptoms in 12 months before survey (STI_12MTH); Age at first child (AGE-@CHILD1); Province (PROVINCE); Residence (RURURB) and; Use of IPT in the last pregnancy (IPT_ANC).

Note: For a detailed process for this step, please refer to Annex 3A.

3.5.2.2 *Step 2*: Selection of variables for Multivariate Analysis

It has been observed by researchers that depending solely on the univariate analysis in selecting variables for multivariate analysis usually poses a problem: the approach tends to ignore the possibility that a variable that shows a weak association at this stage may actually become an important predictor of outcome (or vice versa) when taken together with other variables (Hosmer and Lemeshow, 2000). It is for this reason that on this step, a full model with all the (13) variables (selected in step 1) was built, and then from it, smaller models were constructed by dropping one variable from the full model – a step at a time. Using the likelihood ratio test (α=0.05) criteria and automatic inclusion of variables of study interest, the following variables were shortlisted inclusion in the Logistic Model: AGE; EDUCN; TCEB; BMI; STI_12MTH; AGE_@CHLID1; FPUSE and MARITAL.

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[3] The word in brackets is the short name for each of the variables.

Note: For detailed description of the selection process under this step, refer to Annex 3B

3.5.2.3 *Step 3*: Verifying the importance of each variable included in the Model

After fitting the multivariate model (as show in Table 33), the importance of each variable in the model, was verified by examining the Wald statistic for each variable and comparing the coefficient of each variable in the multivariate model to its value in the Univariate Logistic Model for that variable. The relevance of each of the eight variables was still observed when the multivariate model was compared with univariate models for each variable. All the variables were retained for inclusion in the final model.

For details on the process, refer to Annex 3C

3.5.2.4 *Step 4*: Inspection of Variables in the 'Preliminary Main Effects' Model

The model in Table 33 had two continuous variables, namely AGE, and TCEB. Whilst logistic regression does not require the dependent and independent variables to be related linearly as linear regression does, it however assumes that the independent variables on an interval or ratio scale are linearly related to the log odds of the outcome variable. Interpretation of the coefficient of a continuous variable, therefore depends on the units in which the variable is stored in the dataset and whether the slope is constant across all values. After testing for linearity, the scale for TCEB and AGE were changed to ordinal.

For details on the tests conducted, refer to Annex 3D.

3.5.2.5 *Step 5*: Checking for Interactions among Variables

To assess for possible interactions among the main effects variables, a 2 by 2 variable paired approach was applied. Since there were six statistically significant variables selected from step 3, the possible number of 2 x 2 combinations was (${}_nC_r={}_6C_2$). This produced a total of 28 combinations. It was noted from the analysis that there were no viable interactions among variables that required inclusion in the model

See Annex 3E for details on how the testing for interaction was undertaken.

3.5.3 Model Inspection

Once the model building process was successfully completed, the Preliminary Final Model was subjected to a number of tests in order to assess how effectively the model described the outcome variable (pregnancy loss). The model diagnostics for logistic regression model that were performed included the Hosmer & Lemeshow test, classification accuracy (using the ROC curve), inspecting the model for numeric issues (which included complete separation tests, null-frequency cells, collinearity and influential cases) and sample size adequacy issues. *See Annex 3F for the testing procedures.*

Having satisfied these tests, the final step was model interpretation as presented in Chapter 4.

3.6 Limitation of the Study

The main limitation for this study was that it was not possible to distinguish induced from spontaneous losses of pregnancies from the dataset because of the way the original question was phrased in the ZDHS. However, regardless of whether the pregnancy was induced or spontaneous, it is an event of reproductive health concern that may be indicative of service provision gaps for either family planning or antenatal care. The other challenge faced was the absence of question on the ZDHS questionnaire that explicitly asked a question like: “Have you ever been pregnant?” This question would have assisted in fine-tuning the sample so that only women, who were at risk of losing a pregnancy were included in the study. However, this limitation many have only affected the general rate of loss as the deflation in the rates can be assumed to have been fairly distributed across all maternal factors considered in the study.

3.7 Ethical Considerations

This study relied wholly on secondary data from the ZDHS of 2013-14 and therefore, the study did not need an approval on ethical grounds. The same ethical considerations made during the primary data collection and processing (to de-identify individual cases) covered this analysis.

Chapter 4: STUDY FINDINGS

4.1 Characteristics of the Sample

Background characteristics of respondents are presented in Table 1. Variables presented in the table were chosen on the basis of the outcome of the process of selecting variables that were clinically relevant to the study or were statistically significant at the stage of preparing the multivariate binomial logistic regression model. Main study variables were: Age, education, children ever born and Body Mass Index. Others, included, family planning use, marital status, Symptoms of sexually transmitted infections, and the age of the mother at first child.

Table 1: Background Characteristics of Cases
Distribution of women by selected maternal characteristics and whether they had experienced a pregnancy loss in the 12 months before the interview, ZDHS 2013/14

Background Characteristic	Statistic			Number		
	No	Yes	Total	No	Yes	Total
Age (median)	26.0	28.0	26.0	2148	251	2,399
Residence (%)						
Rural	50.8	55.8	51.3	1091	140	1231
Urban	49.2	44.2	48.7	1057	111	1168
Education level (%)						
No Education	7.3	10.4	7.6	157	26	183
Primary	44.0	52.2	44.9	945	131	1,076
Secondary	42.5	31.1	41.3	911	78	989
Higher	6.2	6.4	6.2	133	16	149
Total Children Ever born (mean)	3.0	3.0	3.0	2148	251	2,399
Body Mass Index (%)						
Underweight	9.8	6.4	9.5	548	46	594
Normal	66.9	71.3	67.4	522	72	594
Overweight	15.3	15.9	15.3	520	73	593
Obese	7.0	4.8	6.8	537	56	593
Missing	1.0	1.6	1.0	21	4	25
Age at first child (in years) (%)						
11-16	22.4	29.7	23.2	352	57	409
17-19	45.9	47.4	46.0	720	91	811
20+	31.7	22.9	30.8	498	44	542
Not Applicable	_	_	_	578	59	637
STI Symptoms in the last 12 months (%)						
No	95.2	90.4	94.7	2045	227	2,272
Yes	3.9	8.4	4.3	83	21	104
Not Sure	0.9	1.2	1.0	20	3	23
Family Planning Use (%)						
Currently using	34.7	24.7	33.7	746	62	808
Used since last birth	9.1	29.9	11.3	195	75	270
Used before last birth	9.7	6.4	9.3	208	16	224
Never used	46.5	39.0	45.7	999	98	1,097
Marital status (%)						
Never in union	32.8	10.0	30.4	704	25	729
Married	54.3	79.3	56.9	1166	199	1,365
Living with partner	0.7	1.2	0.8	15	3	18
Separated/Divorced/Widowed	12.2	9.6	12.0	263	24	287
Total	**89.5**	**10.5**	_	2148	251	2,399

Source: Zambia Demographic and Health Survey, 2013/14

4.1.1 Maternal Age

The subsample of those who had experienced a pregnancy loss in the 12 months before the interview, was slightly older than those who hadn't; those who had experienced a pregnancy loss were, on average about two years older.

4.1.2 Children Ever Born

There was no difference in the history of the number of children ever borne between the two groups. The median number of children ever born in each subgroup was 3 children.

4.1.3 Education

Most of the respondents had been to school with only about 8 percent reporting that they had never been to school. The majority of respondents who had some education had either obtained a primary (44.9%) or secondary (41.3%) education. Those who had not lost a pregnancy in the 12 months before the interview were slightly more educated than those who had not. About 49% had a secondary education or higher as compared to those who had lost a pregnancy (37.5%). Conversely, one was about 1.2 times more likely to find respondents who had a primary education among those who had lost a pregnancy over those who hadn't.

4.1.4 Body Mass Index

About 7 in every 10 respondents had normal weight (BMI =18.5-24.9kg/m^2) with only 15% overweight (25.0 -29.9 kg/m^2, about 10% underweight (<18.5 kg/m^2) and less than 10 percent were obese (>30 kg/m^2). Either weight, height or both were missing in about 1 percent of the cases hence BMI could not be computed. There weren't notable differences in BMIs between the two groups.

4.1.5 Age at first child

About one third of those who had a child in the past, had their first child at the age of 20 or older while a quarter did so before they were 17 years of age. Majority of respondents (46%) had their first child from 17 to 19 years. Those who lost a pregnancy were more likely to have had their first child earlier.

4.1.6 STI Symptoms

During the ZDHS of 2013/14, women were asked to state whether they had suffered from a sexually transmitted infection (STI) or experienced STI-related symptoms in the 12 months before the interview. About 4 percent of the study respondents had either experienced STI symptoms or suffered from STIs. This varied between the two groups with those who had lost a pregnancy more likely to have experienced a loss.

4.1.7 Family Planning Use

About a third of respondents in the study sample were using a method of family planning at the time of the interview and about a tenth had done so since the last birth and before the last birth respectively. Those who had never used a family planning method constituted about 46 percent of the sample. The pattern of use, varied between the two groups.

4.1.8 Marital Status

About 6 in every 10 respondents were married with less than one percent living with a partner. A third reported that they had never been in a union while 12 percent were married before. Those who had not experienced a pregnancy loss were about 3 times more likely (32.8% vs 10.0%) to have never been married and 1.5 times less likely to be married (54.3% vs 79.3%) as compared to those who had lost a pregnancy.

4.2 Study of Findings

4.2.1 Objective 1: *To determine socio-demographic characteristics of mothers that are risk factors to pregnancy loss*

Study Question: ***What socio-demographic characteristics of mothers are risk factors for pregnancy losses?***

About one in every 10 respondents in the 2013/14 Zambia Demographic and Health Survey reported that they had experienced a pregnancy loss at some time in the previous 12 months before the interview. Patterns of pregnancy loss varied with age, number of children ever born, exposure to STI/symptoms, age at first child, family planning use and marital status. Education level of the mother did not relate with pregnancy losses when used with other factors. However, some characteristics, within themselves depicted levels of variation by rural/urban residences. Conversely, Body Mass Index did not appear to strongly affect the risk of pregnancy loss.

Since a pregnancy loss is always preceded by a conception, it may be argued therefore that the risk of losing a pregnancy is likely to be positively related to the risk of exposure to falling pregnant as those who are more likely to fall pregnant are equally likely to have higher chances of experiencing pregnant losses that those subgroups with a low prevalence of pregnancy. Where this association was suspected, an attempt was made to check the validity of this assumption by including the information on the prevalence of pregnancy.

As explained in section 3.5, the process of selecting variables that are presented in this chapter involved ensuring that the requirements for building a logistic regression model were satisfied so that only those variables that met the inclusion criteria were retained for further analysis. At the end of model inspection, eight variables were retained as presented in Table 2.

4.2.1.1 Current Age of the Mother

As shown by Table 2, having a pregnancy at ages older than 19 years, increased twofold the odds of losing that pregnancy. This pattern persisted even after controlling for other maternal characteristics. Having a child around the age of 20-29 years, increased the odds of a pregnancy loss by 153 percent (OR=2.53; 95% CI 1.50-4.29). Advanced maternal age was therefore found to be associated with pregnancy losses with the highest risk recorded at the age band 30-34 years, when this group was compared to those aged below 20 years (OR=2.79; 95% CI 1.45-5.35).

When individual age groups were compared, Figure 5 shows that, the rate of losing a pregnancy increased with age of the woman from 15 to 29 years and declined with increasing age from 29 to 39 years. At 40-44, the rate increased to the levels similar to those aged 20-24. The sudden increase in the rate between ages 35-39 and 40-44 was influenced largely by the urban population as shown in the section that follows. It is however not clear what factors were at play in raising the risk at the age of 40-44 over those aged 35-39.

Table 2: Unadjusted and adjusted odds ratios (OR) and 95 % confidence intervals (CI(95) of having experienced a pregnancy loss in the 12 months before 2013/14 ZDHS

Maternal Characteristic	Unadjusted (univariate) Models			Adjusted Models					
				Model 1			Model 2		
	B	OR	CI (95)	B	OR	CI (95)	B	OR	CI (95)
Age									
<20 years	--	1.00	--	--	1.00	--	--	1.00	--
20-29	0.88	2.40	(1.61, 3.59)	1.35	3.86	(2.37, 6.27)	0.93	2.53	(1.50, 4.29)
30-34	0.79	2.21	(1.38, 3.54)	1.60	4.94	(2.68, 9.11)	1.02	2.79	(1.45, 5.35)
35+	0.62	1.87	(1.87, 1.20)	1.46	4.32	(2.31, 8.07)	0.92	2.51	(1.28, 4.92)
Education									
No Education	--	1.00	--	--	1.00	--	--	1.00	--
Primary	-0.18	0.84	(0.53, 1.32)	-0.09	0.92	(0.57, 1.47)	-0.08	0.92	(0.57, 1.5)
Secondary	-0.66	0.52	(0.32, 0.83)	-0.71	0.49	(0.29, 0.83)	-0.40	0.67	(0.39, 1.16)
Higher	-0.32	0.73	(0.37, 1.41)	-0.58	0.56	(0.27, 1.16)	-0.42	0.66	(0.3, 1.46)
Children Ever Born									
0	--	1.00	--	--	1.00	--	--	1.00	--
1	0.23	1.26	(0.82, 1.91)	0.07	1.07	(0.62, 1.85)	-0.93	0.40	(0.21, 0.74)
2	0.24	1.27	(0.82, 1.95)	-0.30	0.74	(0.42, 1.32)	-1.49	0.23	(0.12, 0.44)
3	0.10	1.10	(0.68, 1.80)	-0.58	0.56	(0.30, 1.04)	-1.79	0.17	(0.08, 0.34)
4	0.11	1.12	(0.67, 1.85)	-0.74	0.48	(0.25, 0.91)	-1.94	0.14	(0.07, 0.30)
5+	0.18	1.20	(0.83, 1.74)	-0.81	0.45	(0.25, 0.81)	-1.94	0.14	(0.07, 0.28)
Body Mass Index									
Obese	--	1.00	--	--	1.00	--	--	1.00	--
Underweight	-0.54	0.95	(0.44, 2.06)	0.06	1.06	(0.48, 2.38)	0.37	1.44	(0.63, 3.32)
Normal	0.44	1.56	(0.85, 2.86)	0.51	1.67	(0.89, 3.15)	0.60	1.82	(0.94, 3.52)
Overweight	-0.42	0.52	(0.78, 2.99)	0.48	1.61	(0.81, 3.21)	0.50	1.66	(0.81, 3.38)
STI Symptoms									
No	--	1.00	--	--	1.00	--	--	1.00	--
Yes	0.82	2.28	(1.39, 3.75)	0.75	2.12	(1.27, 3.55)	0.85	2.33	(1.35, 4.02)
Not Sure	0.30	1.35	(0.40, 4.58)	0.13	1.14	(0.33, 3.96)	0.45	1.57	(0.42, 5.87)
Age at first child									
11-16	--	1.00	--	--	1.00	--	--	1.00	--
17-19 Years	-0.25	0.78	(0.55, 1.11)	-0.33	0.72	(0.5, 1.04)	-0.38	0.68	(0.47, 1.00)
20+ Years	-0.61	0.55	(0.36, 0.83)	-0.76	0.47	(0.3, 0.74)	-0.78	0.46	(0.29, 0.73)
Family Planning									
Never used before	--	1.00	--				--	1.00	--
Currently using	-0.17	0.85	(0.61, 1.18)				-0.41	0.66	(0.45, 0.98)
Used before	0.83	2.30	(1.69, 3.13)				0.62	1.86	(1.28, 2.68)
Marital Status									
Never been in a union	--	1.00	--				--	1.00	–
Married	1.57	4.81	(3.14-7.36)				2.57	13.03	(7.37, 23.05)
Living with partner	1.72	5.63	(1.53-20.71)				2.84	17.04	(4.24, 68.45)
In a union before	0.94	2.57	(1.44-4.58)				1.69	5.42	(2.68, 10.97)
Constant	--	--	--	-3.64	0.26	--	-5.70	0.00	

	Model 1	Model 2
-2LL:	1535.377	1401.104
	χ^2 (20) = 72.586, p <.001	χ^2 (25) = 206.8, p <.001
Nagelkerke R^2:	6.1%	16.9%
Hosmer & Lemeshow Test:	P=0.478	P=0.170

Source: Zambia Demographic and Health Survey, 2013/14

a) Age and rural/urban residence

According to Figure 5, the rate of pregnancy loss was generally higher for women from rural areas than their urban counterparts, except for those aged 25-29. The highest rates for both rural and urban women were also reported at ages 25-29, but the rate for rural women remained high until age 40-44, while that of urban women declined by about 50 percent for the same age range.

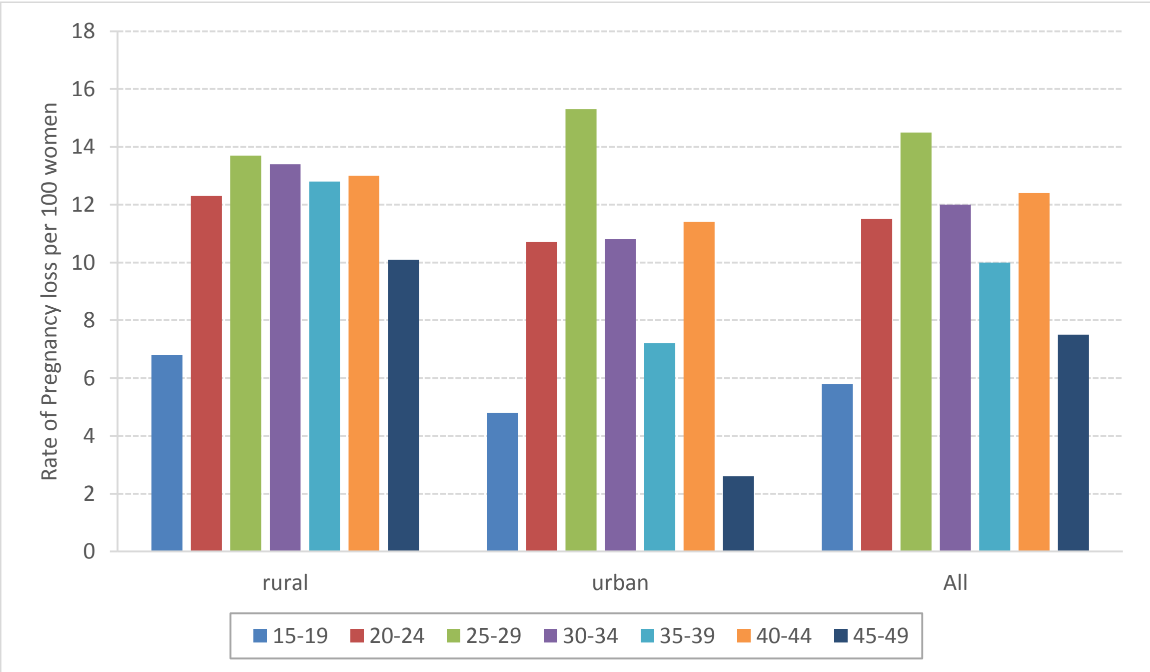

Figure 5: Rate of pregnancy loss by age and residence of the mother (Source: ZDHS, 2013/14)

b) Age and Education

As shown in Figure 6, the change in the rate of pregnancy loss with age was not consistent across all education categories.

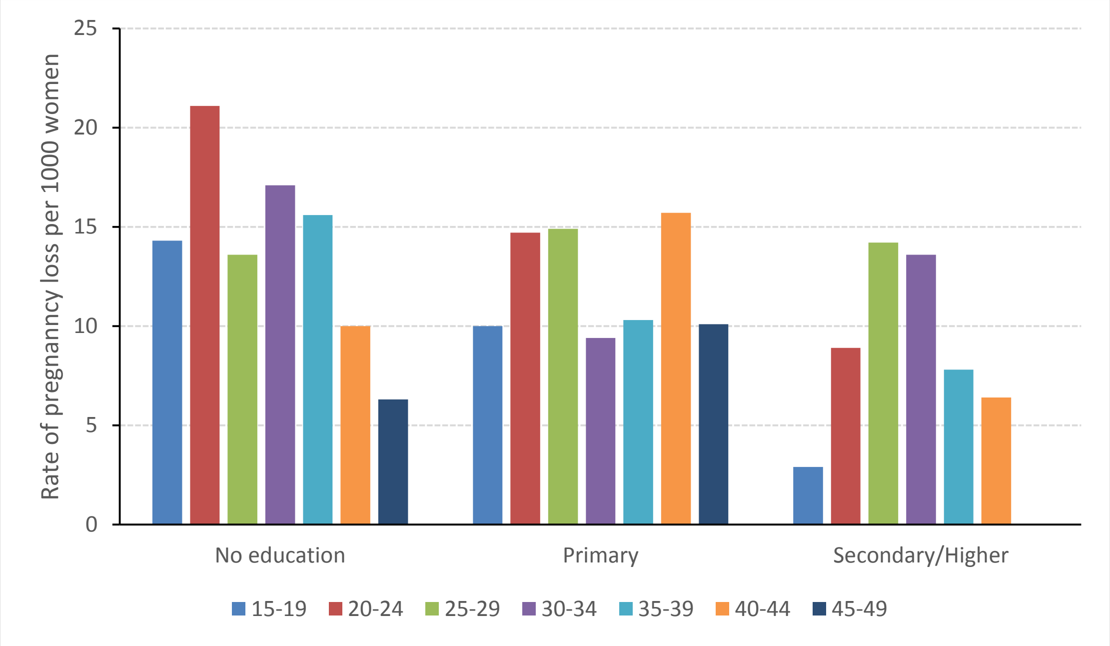

Figure 6: Rate of pregnancy loss by age and education of the mother (Source: ZDHS, 2013/14)

The rate increased with the age of the mother from 15 to 24 across all education levels but this pattern was extended to age 29 for those who had a secondary or higher level of education. For those who had no education or had a secondary/higher education, the risk of experiencing a pregnancy loss reduced with increasing age from 30 years onwards.

The increase in the rate, after age 34 for those with a primary education does not follow the pattern depicted by the other two education level categories - other factors may be influencing this pattern (See section 4.2.1.2 on education of the mother).

c) Age and number of children ever borne

Figure 7 shows the pattern of pregnancy losses by age of the mother and the number of children ever born. For women who had one live birth, the risk of losing a pregnancy, increased with age. Compared with those aged 15-19, women who were aged 30-34 were about three times more likely (25.7% vs 8.2%) to lose a pregnancy while those aged 25-29 and 20-24 were twice and 1.3 times more likely, respectively. This pattern may be related to the age at first child and the resulting spacing since the last birth (Agustin Conde-Agudelo et al., 2006). For women who were aged 15-19 and with one live birth, it is likely that this live birth was born in recent past (within the last five years) while women aged 35-39 years with only one live birth, are more likely to have had this live birth many years ago, hence a wider gap between two pregnancies – which is also considered as a risk factor.

The pattern among those with no previous history of a live birth was similar to those with one birth in the past except for the aged group (25-29) which was higher than the older ages. This may partially be explained by Table 6, which shows that women from this age group were more likely to initiate contraception promptly after pregnancy loss than they were to fall pregnant again; an indication that they may not have been ready for the pregnancy they lost, in the first place.

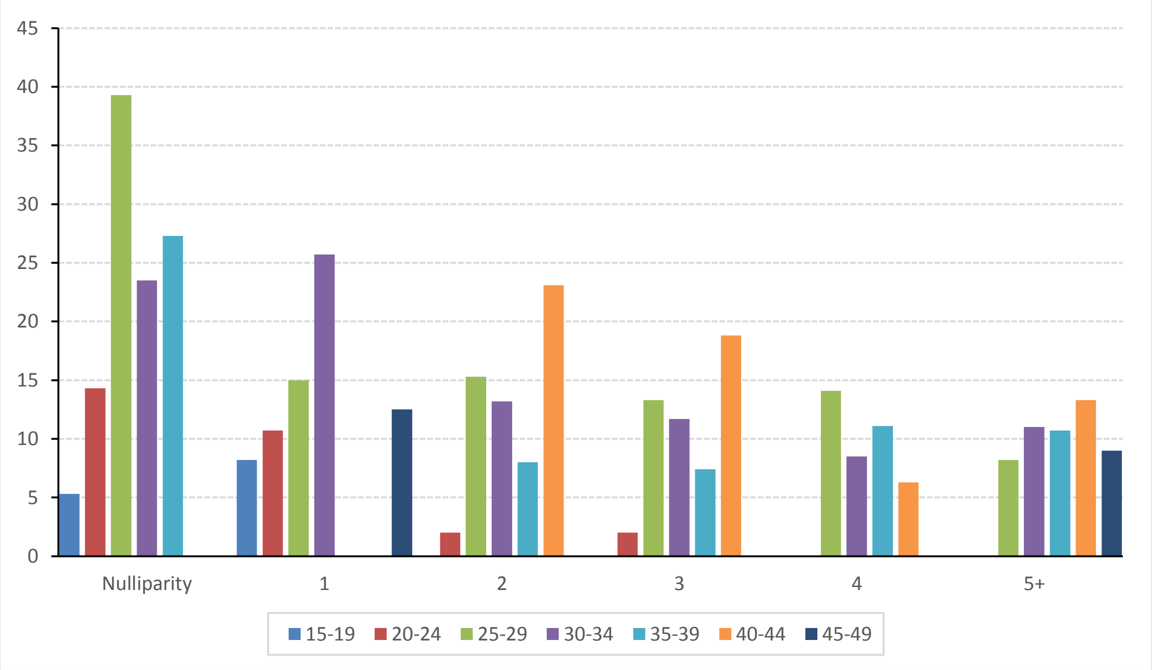

Figure 7: Rate of pregnancy loss by age and children ever borne (Source: ZDHS, 2013/14)

The ZDHS question on pregnancy loss did not separate spontaneous from induced loss, this high propensity in this age band to quickly take up family planning after the reported loss with a very low proportion choosing to fall pregnant again points to the possibility of a high prevalence of induced losses hence the distortion in the pattern of loss among null parity women (See Table 6). This theory may be supported by the fact around 25 and 26 years, women who have attained for higher education are just settling down or still looking for career opportunities - and this point in life getting pregnant may be undesirable to many.

d) Current age and age at first child

Figure 8, presents information on the pattern of pregnancy loss according to the age of the mother segregated by age at first child. The rate of pregnancy loss among those who had their first child at 17 years or later, decreased with increasing age of the mother from the age of 25 to 39 years (for those who had their first child from 17-19) and reduced with age from 25 until 44 years (for those who had their first child from 20 years onwards). However, for those who had their first child earlier than 17 years of age, the benefit of reduced risk of pregnancy loss with age, sets in later in age (from 30 years onwards).

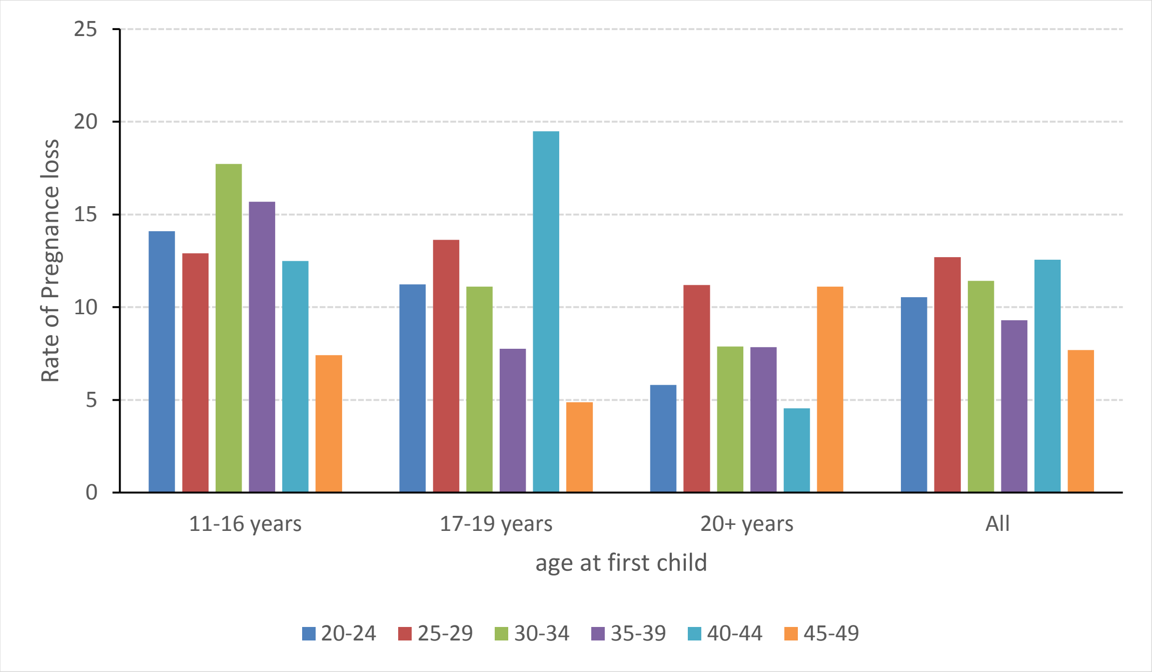

Figure 8: Rate of pregnancy loss, current age of the mother and age at first child (Source: ZDHS, 2013/14)

The current age of the mother may not be a primary factor in determining the risk of losing a pregnancy but the observed differences across ages may partly be explained through the childbearing initiation history. Among women who were aged 20-24 years, the risk of losing a pregnancy reduced with increasing age at initiation of childbearing. Those who started before age 17 had a rate of 14.1% followed by those who started at 17-19 and the lowest was among those who started from 20 years or older. There appears to be an interplay between age at first child, current number of children ever born and current age. See Figure 15 in Section 4.2.1.3.

It is not clear as to what the probable reasons might be for the spike in the rate of loss at 40-44 and 45-49 years among those who had started their childbearing from 17 to 19 years and 20+ years respectively. What is common in both groups however, is that the spike occurred after 20 years of being in child bearing.

e) Age and STI Symptoms

The 2013/14 ZDHS had included three questions to assess the prevalence of sexually transmitted infections in the female population aged 15-49 years. Women were asked if in the last 12 months they had: a disease which was gotten through sexual contact; experienced a bad smelling abnormal genital discharge or genital sores or ulcers. Syphilis in pregnancy is a known pathological condition that contributes to stillbirths (see conceptual framework in Figure 2). To understand how the risk of pregnancy loss by age varies in the absence or presence of STIs, Figure 9 compares the rate of pregnancy loss between those who had experienced at least one of the three conditions and those who hadn't, segregated by age of the mother.

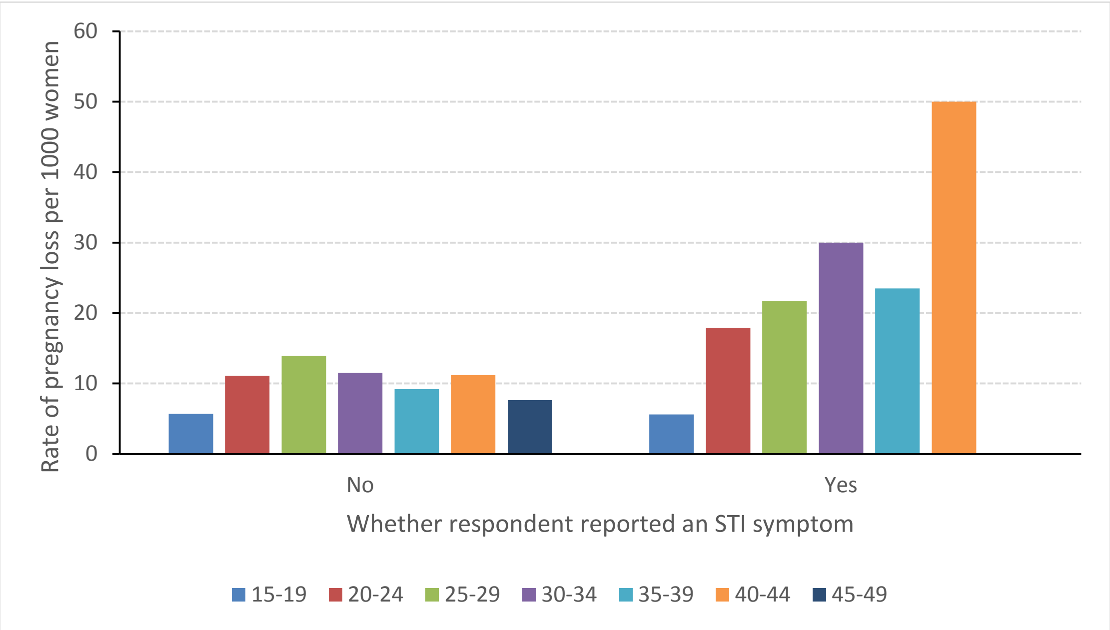

Figure 9: Rate of pregnancy loss, current age of the mother and whether experienced STI Symptoms (Source: ZDHS, 2013/14)

In the absence of self-reported STI symptoms, the risk of losing a pregnancy increased with age from 15-19 until the age group 25-29 and started reducing with increasing age until the age group 35-39. However, in the presence of STI symptoms, the risk increased with age from 15-19 until the age group until the age 30-34.

Generally, from the age of 20 years and onwards, the risk of losing a pregnancy was higher amongst those who had reported having experienced a pregnancy loss than those who had not. It was as high as 4.5 times among those aged 40-44, 2.6 times in those aged 30-39 and about 1.6 times in those aged 20-29. The older the woman was therefore, the higher the risk of losing a pregnancy as a result of possible STIs.

f) Age and Marital Status

Figure 10 presents the rates of pregnancy loss by age, controlling for type of marital unions. By the age of 35 years, all women included in this study, had been in some union of a sort either at the time of interview or before.

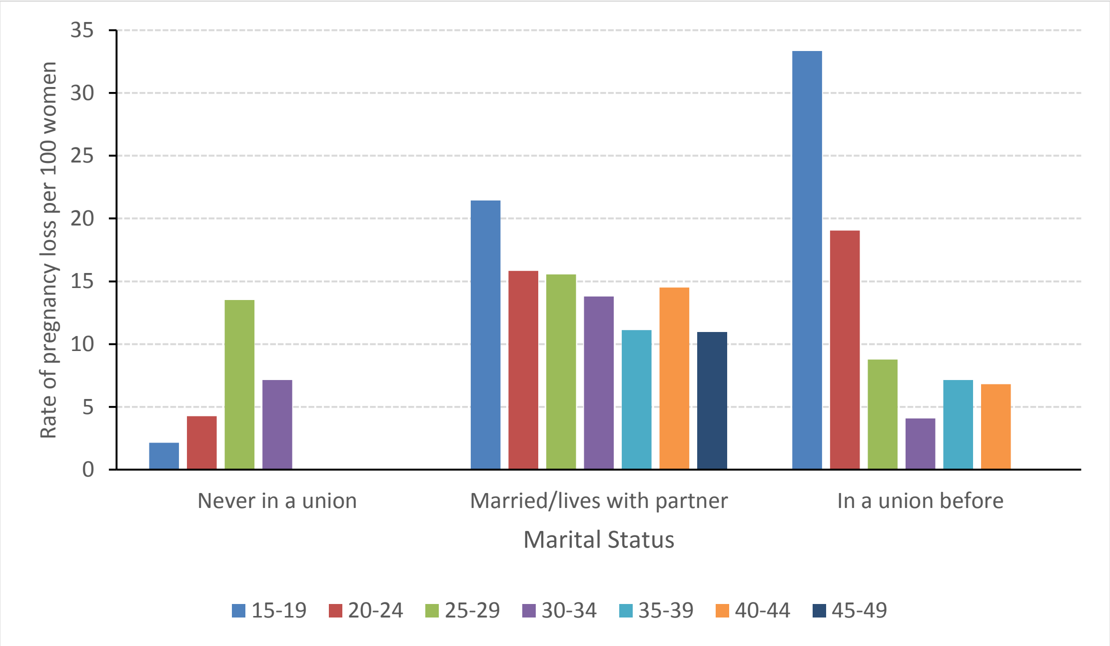

Figure 10: Rate of pregnancy loss by maternal age and marital status (Source: ZDHS, 2013/14)

Among those who had never been married, the risk of losing a pregnancy increased with age, while in those who were currently married/living with a partner or were married before, the rates of pregnancy loss decreased with increasing age. For those who were never married, the risk of pregnancy loss increased from about 2 percent among those aged 15-19 to about 14 percent for those aged 25-29. Conversely, the highest rates were reported in the age group 15-19 for those who were either married/living with a partner or were married before.

4.2.1.2 Education of the Mother

As shown in Table 2, the risk of losing a pregnancy reduced with the increasing level of education attained. Before controlling for other maternal characteristics, the odds of losing a pregnancy among those with secondary education was significantly lower than in those with no education. Those with a secondary education were 48 percent less likely to lose a pregnancy than those with no education (OR=0.52; 95% CI, 0.32, 083). This pattern persisted even after controlling for age, children ever born, BMI, exposure to STIs and age at first child (OR=0.49; 95% CI, 0.29-0.83). However, after considering marital status and family planning the association between secondary education and no education was no longer statistically significant (OR=0.67; 95% CI, 0.39-1.16).

a) Education by Rural/Urban Residence

Figure 11 shows that in rural areas, the rate of pregnancy loss reduced with the increasing level of education until secondary education. However, pregnancy losses in the urban area, did not vary with education as did in the rural areas. In urban areas, the highest rate of pregnancy loss was recorded amongst those with a primary education (12.3%) followed by higher education (10.9%) and secondary (7.9%). Unlike in rural areas, women in urban areas with no education were less likely to experience a pregnancy loss than those with some education

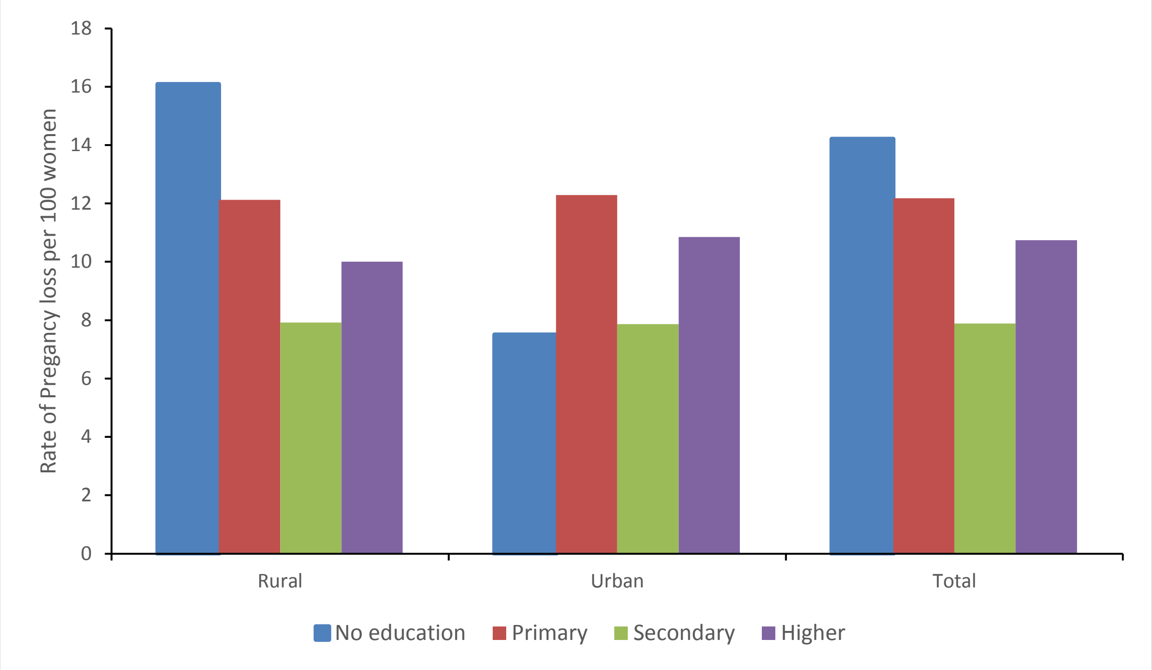

Figure 11: Rate of pregnancy loss by education and rural/urban residence (Source: ZDHS, 2013/14)

The difference in rate of pregnancy loss between rural and urban areas was predominantly in those with no education. A woman with no education from rural areas was twice more likely to lose a pregnancy than a woman in urban areas with no education. There was no difference between rural and urban in the risk of pregnancy losses for those with a primary, secondary or higher education.

b) Education and Age and first child

Figure 12 shows the rate of pregnancy loss by education and the age at which the mother had the first child. Age at first child appeared to influence the pattern of pregnancy loss by education level in women who started their child bearing after 19 years. The higher the education level of the mother, the lower the risk of losing a pregnancy among those women who had their first child after 19 years of age. This is probably due to the fact that women who started child bearing after 20 years were also likely to have spent more years in school and that once they started childbearing they were ready for motherhood. Women who had their first child before 20 years of age were more likely to have attained either secondary or higher education after their first child. This may explain the observed distortions, in the relationship between education level and pregnancy loss.

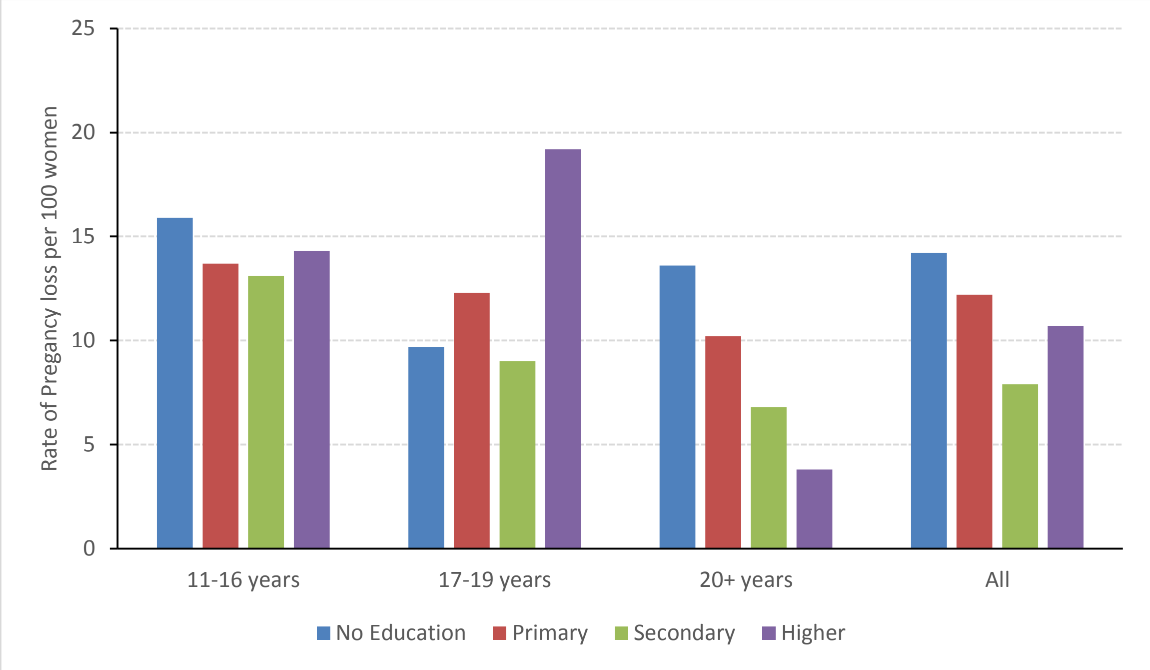

Figure 12: Rate of pregnancy loss by education and age at first child (Source: ZDHS, 2013/14)

It can be argued from the observations made from the data presented in the Figure 12 that the current level of education of the mother, may be not have much influence on determining the risk of pregnancy loss if the women also has a history of early initiation of motherhood. Therefore, whereas increased education level of the mother may reduce the risk of losing a pregnancy, much more important is the age at which the mother had the first child.

c) Education and history of STI symptoms

Table 3, presents data on pregnancy losses by education level of the mother, taking into account whether a woman had, in the 12 months before the interview, experienced any symptoms related to Sexually Transmitted Infections (STI). As indicated by Table 2 and Table 3, having experienced STI symptoms in the 12 months before the interview increased twofold, the risk of losing a pregnancy (OR=2.29; 95% CI,1.34-3.93). According to Table 3, women with a primary education or higher, who had experienced STI symptoms were at higher risks of losing a pregnancy than those who did not.

Table 3: Rate of pregnancy loss by education and experience of STI-related symptoms in the last year				
Level of Education	*Rate of pregnancy (per 100 women)*			*Ratios of rates for 'Yes' to 'No' STI symptoms in the 12 months before survey*
	All	*Whether experience STI Symptoms 12 months before interview*		
		Yes	*No*	
All	10.5	20.0	10.0	2.0
No education	14.2	11.1	14.7	0.8
Primary	12.2	20.0	11.7	1.7
Secondary	7.9	17.5	7.6	2.3
Higher	10.7	60.0	8.4	7.1

Source: Zambia Demographic and Health Survey, 2013/14

Women with primary or secondary level of education who had experienced STI symptoms, were about twice likely to lose a pregnancy than those who did not. The highest difference in rates of pregnancy losses was recorded amongst women of higher education; those who reported having suffered from STI symptoms were 7 times more likely to lose a pregnancy than those who did not. However, the pattern is different among women who had no education; the risk was higher in those who had not reported having had STIs than those who did. Since these were self-reported, it is possible that women with no education may have underreported their experience with STI symptoms.

d) Education and Marital Status

Table 4 shows the rate of pregnancy loss by education and marital status of the woman. Among women who had never married, the risk of pregnancy loss increased with the level of education. 'Never married' women with a higher level of education were about twice likely to lose a pregnancy than those with a similar marital status who had a primary education. Similarly, among those who were married before, women who had a primary education were about 4 times more likely to lose a pregnancy than those with no education. Conversely, married women with a secondary education, were less likely to experience a pregnancy loss than those with either a primary education or no education.

Table 4: Rate of pregnancy loss by education and marital status					
Marital Status	*Rate of pregnancy (per 100 women)*				
	All	*Level of Education*			
		No Education	*Primary*	*Secondary*	*Higher*
All	10.5	14.2	12.2	7.9	10.7
Never married	3.4	0.0	2.1	3.9	4.3
Married	14.6	18.7	14.8	12.6	15.9
Lives with partner	16.7	0.0	20.0	16.7	--
Previously married	8.4	2.6	11.6	7.4	0.0

Source: Zambia Demographic and Health Survey, 2013/14

Women who were living with a partner at the time of the interview had generally the highest risk of losing a pregnancy of all marital categories. About 1 in every 5 women with a primary education, or a secondary education, who were leaving with a partner had experienced a pregnancy loss at some point in the 12 months before ZDHS 2013/14.

4.2.1.3 Total number of children ever born (TCEB)

In this study, the number of children ever born was used as a proxy for parity. Since the frequencies in younger women tend towards 'zero' as the number children ever born increases, it was for this reason that TCEB was truncated at five children ever born, and higher parities were cumulated into 5 to create a category '5+'. Therefore, in the sections that follow, TCEB has been presented as an ordinal variable, as indicated in Table 2.

When women, who did not have previous births, were compared with those with higher parities, their risks of losing a pregnancy did not significantly differ from those with higher parities before other maternal characteristics were considered. After taking age, education, BMI, STI symptoms and age at first child into consideration (Model 1, in Table 2), those with 4 or more children were significantly less likely to lose a pregnancy than those without a previous birth. Women who had four children ever born were about 52 percent less likely (OR=0.48; 95%CI, 0.25-0.91), and those who had five or more children 55 percent less likely (OR=0.45; 95%CI, 0.25-0.81) to lose a pregnancy than those without a previous birth.

When family planning and marital status were also considered (Model 2, in Table 2), the odds of losing a pregnancy reduced with increasing parity and the association was significant at all levels of parity. For example, those who had one previous birth, were about 60 percent less likely (OR=0.40; 95% CI, 0.21, 0.74) and those with 5 births or more in the past, 86 percent less likely (OR=0.14; 95% CI, 0.07-0.28) to lose a pregnant than null parity mothers.

a) TCEB and rural/urban residence

As shown in Figure 13, when TCEB was stratified by rural/urban residence, a pattern emerged for women who were from rural areas. The chances of losing a pregnancy increased with the increasing number of children ever born up to the second child. After the second child, the risk reduced but started increasing with TCEB again until the fifth child or more. It is not clear from the data why the pattern is the way it is.

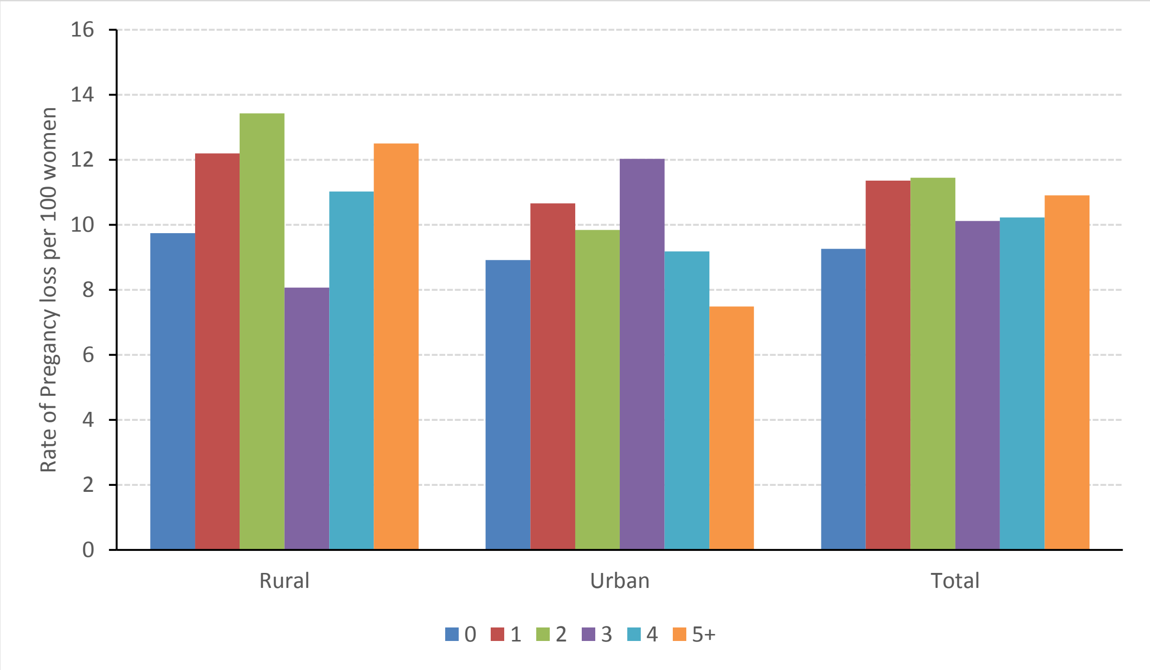

Figure 13: Rate of pregnancy loss, number of children ever borne and rural/urban residence (Source: ZDHS, 2013/14)

When rural and urban residences were compared, from the third child onwards, the risk of pregnancy loss between rural and urban are inverted. In rural areas, the risk increased with increasing parity from the third child while in urban areas it reduced with increasing parity. Other factors may be at play beyond rural and urban residences.

b) TCEB and education

Figure 14 shows the rates of pregnancy loss by number of children ever born and education of the mother. There was no consistent pattern in the risk of losing a pregnancy by the number of children ever born across levels of education. The pattern depicted by women who had a secondary education is almost a reverse to the one observed among those with no education. Among women with no education, up to the third child, the risk of losing a pregnancy decreased with the increasing number of children ever born, while among those with secondary education, the risk increased with increasing TCEB up to the second child.

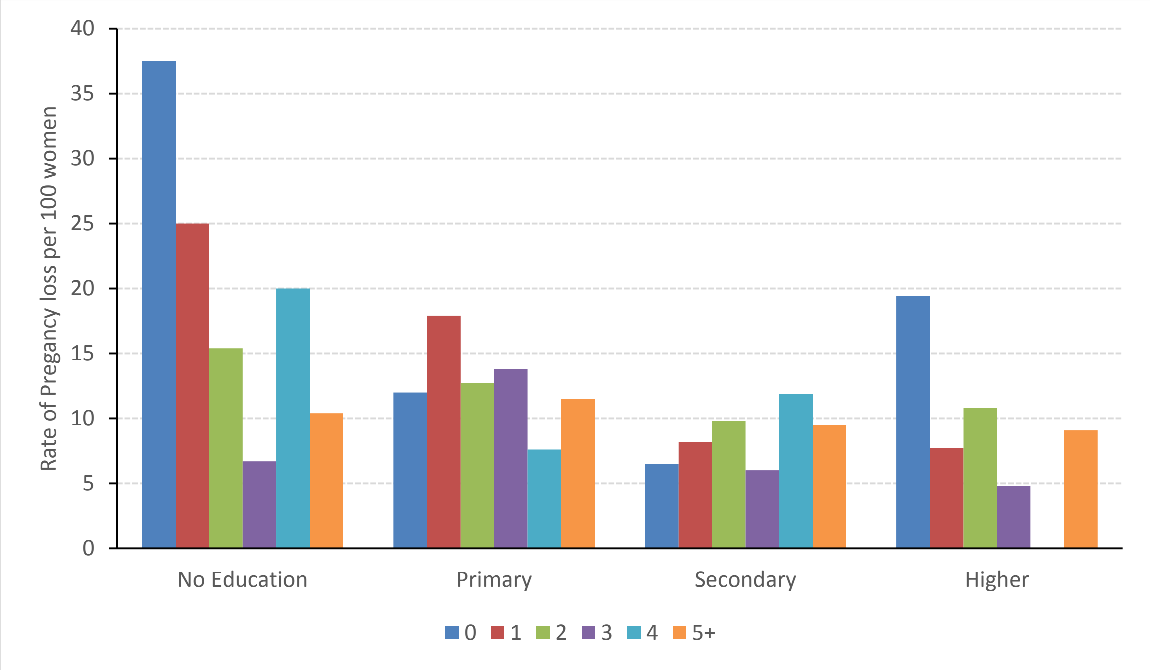

Figure 14: Rate of pregnancy loss, number of children ever borne and education (Source: ZDHS, 2013/14)

From 'no child' to the third child, women who had no education generally had a higher risk of pregnancy loss than their counterparts with the same number of children who were from higher education brackets. Women had no child and no education, had the highest risk of pregnancy loss; they were nearly 4 times more likely than the general population in the sample (37.5% vs 10.5%).

c) TCEB and Age at first child

Figure 15 shows the rate of pregnancy loss by children ever born and the age at first child. The pattern of loss by number of children ever born, among those who initiated childbearing before from 17-19 years, is not very clear (see also Figure 12). However, there are some similarities between those who initiated children bearing before 17 years and those who did so after 19 years old, except that for those who started before 17 years, the lowest risk was recorded one child later (4 children) than those who started after 19 years (at the 3^{rd} child).

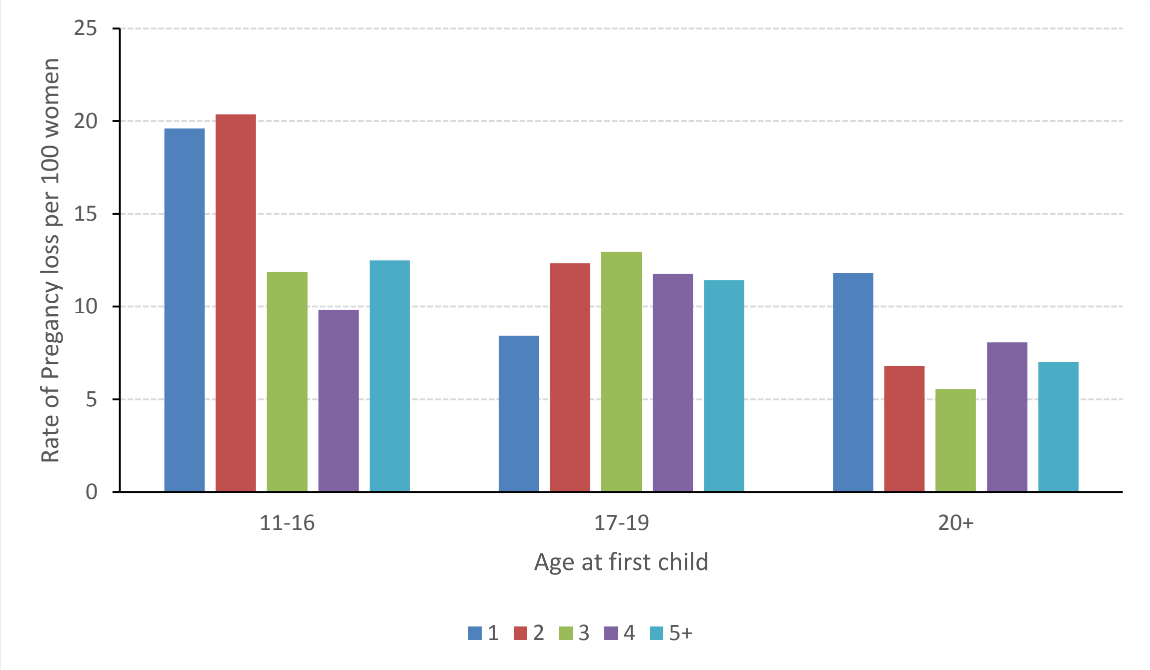

Figure 15: Rate of pregnancy loss, number of children ever borne and age at first child (Source: ZDHS, 2013/14)

The pattern depicted by those who initiated child bearing before 17 years and those after 19 years have some similarity with the one showed by those who were in a marital union or were in a union before, respectively, (Figure 16).

d) TCEB and Marital Status

Figure 16 shows the rate of pregnancy losses by TCEB within each type of marital union. Among women who had never been married before, there was no discernible pattern in the rate of pregnancy loses by number of children ever born. This is largely due to the fact that those who have never been married are more likely to be young. In this study, about 82% percent of all those aged 15-19 years were never married and out of all those who were not married, about 64 percent were aged 15-19. This may explain why the pattern in this group is different from the other two, due to differences in the exposure to pregnancy and longevity of this exposure.

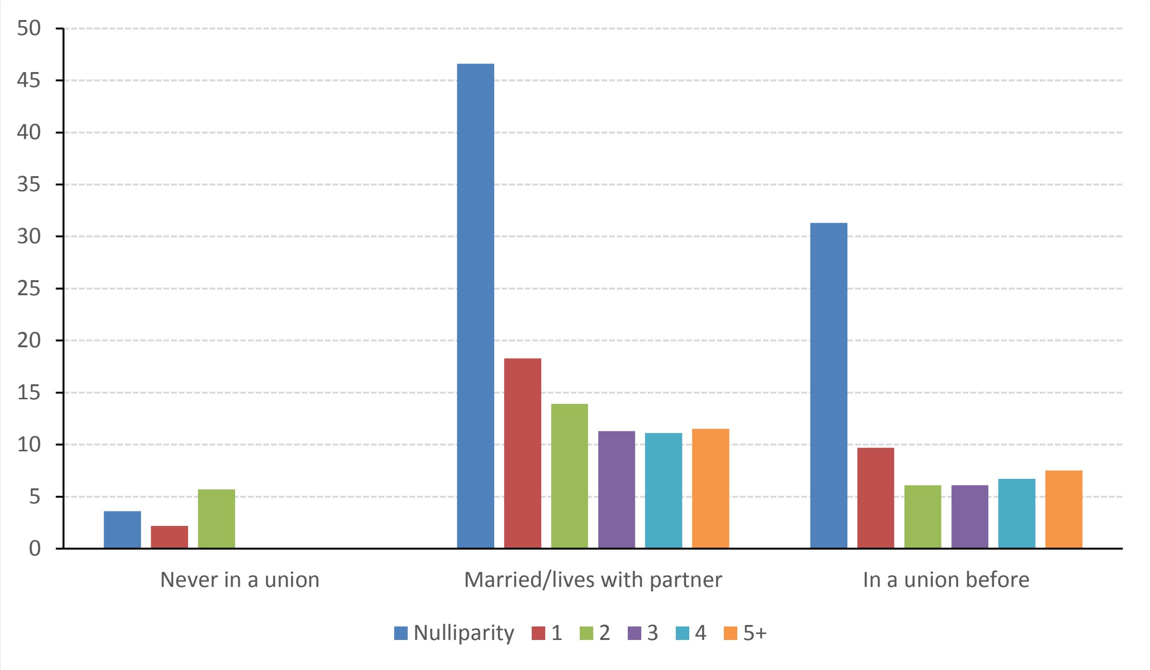

Figure 16: Rate of pregnancy loss, number of children ever borne and marital status (Source: ZDHS, 2013/14)

Among women who were currently in a union or were married in the past, the risk of pregnancy loss reduced with the number of children ever born. In both groups, the risk for those with no previous birth was more than twice, as compared to those with a previous live birth. The risk was lowest around the third and fourth child and increased gradually from the fourth child onwards.

4.2.1.4 Body Mass Index

Even after controlling for other maternal characteristics, at 95% confidence level, the odds of losing a pregnancy in those who were obese was not significantly different from those who were either underweight (OR=1.44, 95% CI, 0.63-3.32); normal weight (OR=1.82, 95% CI, 0.94-3.52) or overweight (OR=1.66, 95% CI, 0.81-3.38) as shown in Table 2. Education and age of the mother were considered in assessing whether BMI varied with each of these characteristics as shown in the sections that follow.

a) Body Mass Index and age of the mother

As shown in Figure 17, the pattern of pregnancy loss was not consistent across ages for all BMI categories. Nonetheless, being underweight at age 35-39, was associated with a greater risk of losing a pregnancy than being underweight at any other age category (between 15 and 34). Underweight women, who were aged 35-39 were 5 times and 4 times more likely to lose a pregnancy than underweight women aged 15-19 and 30-34 respectively.

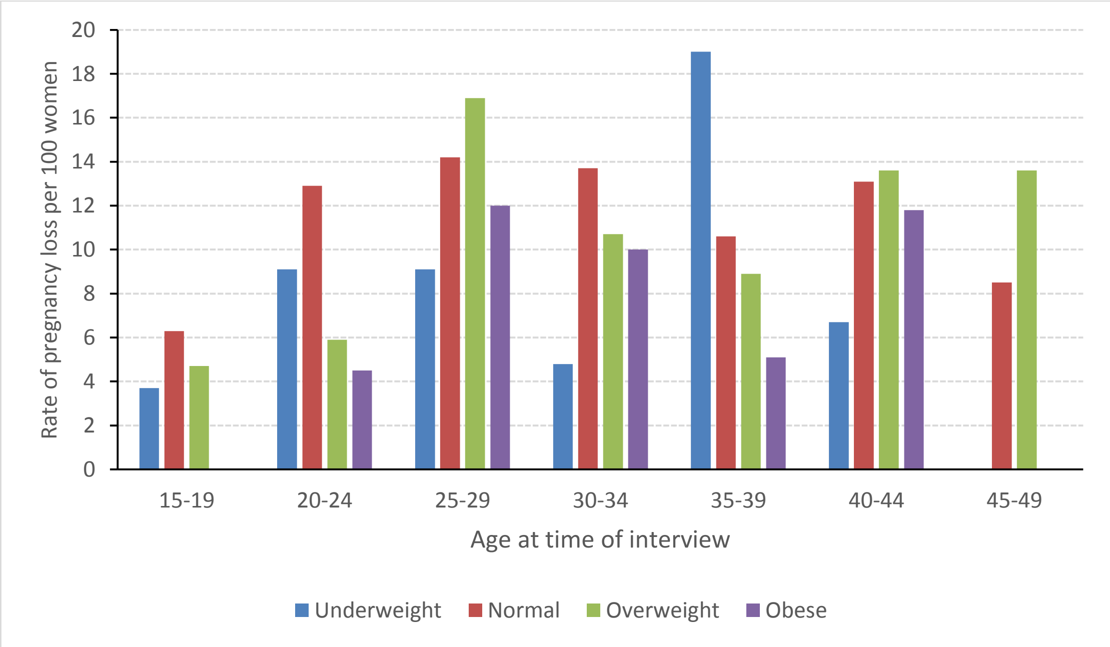

Figure 17: Rate of pregnancy loss, BMI and age of the mother
(Source: ZDHS, 2013/14)

Being overweight was more of a risk in women aged 25-29, 40-44 and 45-49 while being underweight was more of a risk in the 35-39 than in any other age groups. From the chart above, it is clear that even after considering individual age groups, age could not reveal any pattern associated with BMI and pregnancy losses.

b) Body Mass Index and education

Figure 18 shows the rates of pregnancy loss by BMI distributed according to education levels of the mother.

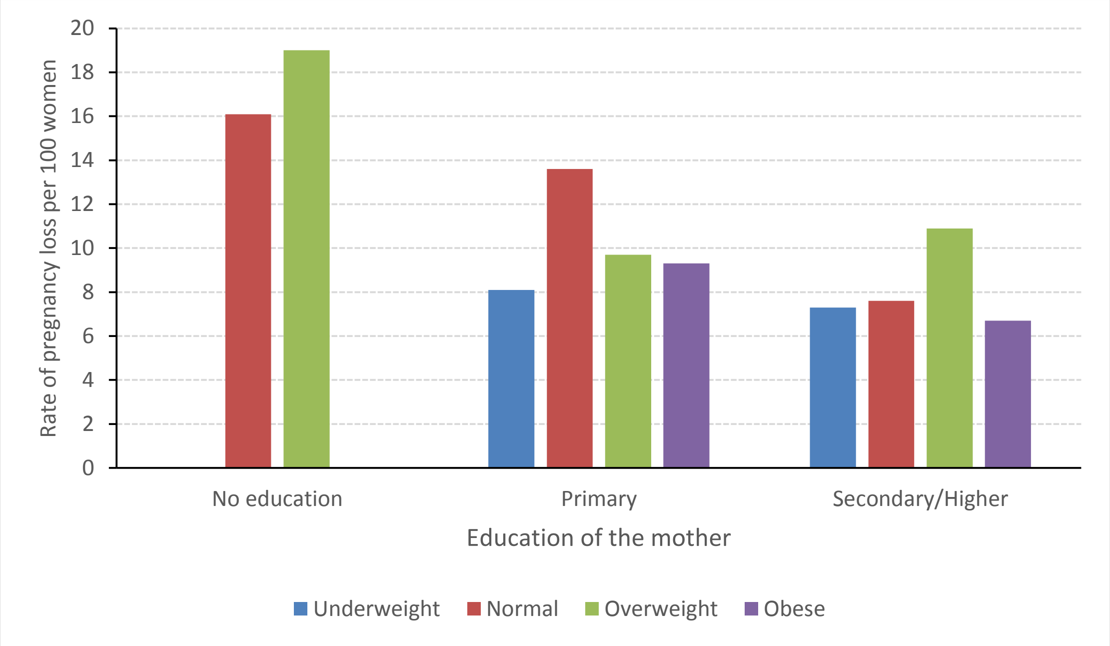

Figure 18: Rate of pregnancy loss, BMI and education of the mother (Source: ZDHS, 2013/14)

Even after controlling for education, pregnancy loss did not vary with Body Mass Index. However, the risk of losing a pregnancy among those who were overweight, was more pronounced in those with no education than any other education category.

4.2.1.5 Patterns of Contraceptive Use and Falling Pregnant after Pregnancy Loss

According to Table 2, women who were using a family planning at the time of interview were about 15 percent less likely to lose a pregnancy than those who had never used a family planning method (OR=0.66; 95% CI, 0.45-0.98) while those who had used a method before but were not at time of interview, were about twice likely to lose a pregnancy (OR=1.86, CI, 1.28-2.68). However, when family planning was considered on its own, the odds of losing a pregnancy in those who were currently using a method did not differ significantly from those who had never used a method (OR=0.85, 95% CI, 061-1.18).

To understand the reported family planning use, this study looked at the pattern of use in the year before the interview. In the ZDHS of 2013/14, women who had indicated they were using family planning method at the time of the survey, were also asked to state the month and year when they started using the reported method. This information was used in this study to determine how long it took for women who had lost a pregnancy and were on a method at the time of interview, for them to start using a reported method.

a) Timing of starting FP or falling pregnant again

According to Table 5, out of the 251 respondents who reported having had lost a pregnancy in the 12 months before the survey, 24.7% were already on a family planning method and 20.4% were pregnant again by the time of the interview. Collectively, about 45 percent of those who had lost a pregnancy in the 12 months before the interview, were either on family planning or pregnant again at the time of the interview and the rest (55%) were neither on any FP method nor pregnant.

Table 5: Percentage distribution of respondents by patterns of FP Practice after the loss of a pregnancy

Family planning use at the time of interview	*Percent according to the timing of initiation of FP after pregnancy loss*					*Count*
	Started FP within 3 months	*Started FP within 4-11 months*	*Pregnant again within 3 months*	*Pregnant again 4-12 months*	*Not on FP since pregnancy loss*	
Currently using	82.3	17.7	-	-	0.0	62
Used since last birth	-	-	17.3	18.7	64.0	75
Used before last birth	-	-	6.2	6.2	87.5	16
Never used	-	-	10.2	12.2	77.6	98
Total	**20.3**	**4.4**	**9.6**	**10.8**	**55.0**	**251**

Source: Zambia Demographic and Health Survey, 2013/14

About 8 in 10 women (82.3%) who started using family planning after a pregnancy loss did so within 3 months (11.3% immediately; 41.9% within a month; 19.4% within 2 months; 9.7% after 2 months but before the third month) and the rest did so from 4 to 11 months. On the other hand, about 1 in every 5 women who had lost a pregnancy, became pregnant within 12 months of pregnancy loss. Of these, about 10 percent were already pregnant by the third month. Overall, those who were pregnant, were on average 4.42 months pregnant at the time of the interview, implying that women who wanted to fall pregnant again after a pregnancy loss, half of them would be pregnant again, within four months of losing a pregnancy.

b) Family planning use, falling pregnant again and maternal age

Table 6 shows the pattern of timing the decisions on conception by women after losing a pregnancy according to age of the woman. The desire to fall pregnant again after a pregnancy loss was higher in younger women aged 15-19 (33.4%) than was to start family planning (15.2%). However, from the age of 25 years, women preferred to start family planning over getting pregnant again.

Table 6: Percentage distribution of respondents by patterns of FP Practice after the loss of a pregnancy

Age group	*Percent according to the timing of initiation of FP after pregnancy loss*					Count
	Started FP within 3 months	*Started FP within 4-11 months*	*Pregnant again within 3 months*	*Pregnant again 4-12 months*	*Not on FP since pregnancy loss*	
15-19	15.2	0.0	15.2	18.2	51.5	33
20-24	14.8	5.6	11.1	9.3	59.3	54
25-29	29.5	3.3	9.8	4.9	52.5	61
30-34	22.7	6.8	6.8	20.5	43.2	44
35-39	17.9	10.7	14.3	10.7	46.4	28
40-44	17.4	0.0	0.0	4.3	78.3	23
45-49	12.5	0.0	0.0	0.0	87.5	8
Total	**20.3**	**4.4**	**9.6**	**10.8**	**55.0**	**251**

Source: Zambia Demographic and Health Survey, 2013/14

Generally, women from all age groups were more likely to promptly (within 3 months) initiate family planning than promptly fall pregnant again. Family planning counselling and services has been identified as part of the package that should be provided to every woman who has undergone an abortion. Since the Zambian Law does not provide for elective abortions (by individuals), both induced and spontaneous abortions take place quietly at home. However, those that end up complicated, women usually end up at health facilities, and mostly, these cases end up being reported as spontaneous (Likwa and other, 2009). The World Health Organisation (WHO), recommends that

> *'Any sexually active woman of reproductive age…, may have a spontaneous or induced abortion at some time during her lifetime. Three primary traits unite women who seek abortion (whether clandestine or legally sanctioned): 1) they are sexually active; 2) they have demonstrated their determination not to have a child at the time the pregnancy occurred; and 3) they face the distinct possibility of another unwanted pregnancy. ….. As a guiding principle, it is important to ensure that women who have experienced abortion are treated with …. unbiased attitude used with any other family planning client'.* (WHO, 1997)

With this in mind the higher percentage among women who initiated family planning immediately after pregnancy loss may not be surprising. However, the higher proportions showed by the age groups 25-29 (29.5%) and 30-34 (22.7%) may not be explained by the general post-abortive service offered by the health care delivery system. Whereas those aged 30-34 who started family planning immediately after pregnancy loss (22.7%) were later likely to fall pregnant before the end of the year

(20.5%), this was not the case with those aged 25-29. Women who lost pregnancies in this age group were twice more likely to remain on family planning than were to get pregnant again an indication that the pregnancy the lost may not have been planned for after all. Compare with Figure 7.

c) Family planning use, falling pregnant again and education

Table 7 shows the percentage of respondents by timing of initiating on family planning or falling pregnant again, distributed by education of the mother. The table reveals that the higher the education level the more likely one was to choose family planning over falling pregnant again. Women with higher education were 4 times more likely to prefer family planning than falling pregnant again. While those with a secondary or a primary education was 1.5 and 1.3 times respectively, more likely to prefer family planning over falling pregnant with 12 months of the previous pregnancy loss; those with no education would rather fall pregnant than start family planning (34.6% vs 7.6%). This becomes pronounced when the timing of starting family planning was considered. Those with a primary education or higher were more than 4 times likely to start family planning within three months of pregnancy loss than those with no education.

Table 7: Percentage distribution of respondents by patterns of FP Practice after the loss of a pregnancy

Family planning use at the time of interview	*Percent according to the timing of initiation of FP after pregnancy loss*					*Count*
	Started FP within 3 months	*Started FP within 4-11 months*	*Pregnant again within 3 months*	*Pregnant again 4-12 months*	*Not on FP since pregnancy loss*	
No education	3.8	3.8	19.2	15.4	57.7	26
Primary	22.1	3.1	7.6	12.2	55.0	131
Secondary	23.1	6.4	10.3	9.0	51.3	78
Higher	18.8	6.3	6.3	0.0	68.8	16
Total	**20.3**	**4.4**	**9.6**	**10.8**	**55.0**	**251**

Source: Zambia Demographic and Health Survey, 2013/14

Although women with no education were more likely not to receive a postnatal check-up in their most recent births before the 2013/14 ZDHS, the differences between education levels were not as wide as shown in Table 7. The proportion of women who had not sought postnatal services were as follows: no education=42.9%; primary=33.0%; secondary=18.3% and higher=4.9% (CSO, 2014). In view of this, the pattern presented in Table 7 goes beyond availability of and access to post-abortion family planning services.

d) Family planning use, falling pregnant again and marital status

Table 8 shows the percentage distribution of women who had lost a pregnancy by marital status, family planning and pregnancy status at the time of interview. Women who were previously in marital union, were more likely (29%) to start family planning within 3 months after losing a pregnancy than those who were married/living with a partner (19%) or those who had never been married (20%). Whereas the need for family planning after pregnancy loss was more urgent among formerly married women than was the need to fall pregnant again (29.2% vs 8.3%), among married women, the need for family planning was just as important as was falling pregnant again (23.8% vs 22.8%). The urgency to start family planning was more pronounced in women who had never married. All women who were never married who started using family planning after pregnancy loss, did so with 2 months.

Table 8: Percentage distribution of respondents by patterns of FP Practice and pregnancy status, after the loss of a pregnancy

	Percent according to the timing of initiation of FP after pregnancy loss					
Family planning use at the time of interview	*Started FP within 3 months*	*Started FP within 4-11 months*	*Pregnant again within 3 months*	*Pregnant again 4-12 months*	*Not on FP since pregnancy loss*	*Count*
Never in union	20.0	-	4.0	-	76.0	25
Married/Living with partner	19.3	4.5	10.4	12.4	53.5	202
Separated/Divorced/Widowed	29.2	8.3	8.3	8.3	45.8	24
Total	**20.3**	**4.4**	**9.6**	**10.8**	**55.0**	**251**

Source: Zambia Demographic and Health Survey, 2013/14

The lowest proportion of women who had lost a pregnancy and fell pregnant again was recorded among women who had never been in a union (4%) compared to those who were married/living with a partner (22.8%) or were once married (16.6%). Never married women were about 6 times and 4 times less likely to fall pregnant within 12 months of losing a pregnancy than those who were married/living with a partner or married before, respectively. When they chose to fall pregnant again, they did so within three months of a pregnancy loss.

4.2.1.6 Gestation age at loss of pregnancy

A total of 251 women out of 2399 in this study (10.5%) reported that they had experienced a pregnancy loss in the 12 months before the interview. Table 9 presents data on the distribution of women by timing of pregnancy loss, rural/urban residence and whether she had experienced STI symptoms. Nearly half (47.2%) of all the reported losses took place within the first 3 months of conception, one-third (31.0%) did so from the 4th to the 6th month and the rest (about 22%) in the last three months of the pregnancy. There were differences in the distribution of losses by gestation of pregnancies by rural/residence and exposure to STIs.

Table 9: Percentage distribution of according to gestation at pregnancy loss, rural/urban residence and whether she had experienced STI Symptoms

Gestation at loss	*Percent according to rural/urban residence and Whether the woman reported having had experienced STI symptoms*						*All*		
	Rural			*Urban*					
	No	*Yes*	*Total*	*No*	*Yes*	*Total*	*No*	*Yes*	*Total*
1st Trimester	44.0	40.0	43.9	48.4	68.8	51.4	45.8	61.9	47.2
2nd Trimester	28.4	40.0	28.8	35.5	25.0	33.9	31.3	28.6	31.0
3rd Trimester	27.6	20.0	27.3	16.1	6.3	14.7	22.9	9.5	21.8
Count (all)	134	5	139	93	16	109	227	21	248

Source: Zambia Demographic and Health Survey, 2013/14

a) Gestation at loss and rural/urban residence

As indicated in Table 9, whereas the majority of pregnancies in both rural and urban areas were lost during the first trimester (43.9% and 51.4%, respectively), there were differences in proportions between the two regions. A woman in the urban area was about twice less likely to loss a pregnancy in the third trimester than a rural counterpart (14.7% vs 27.3%). However, urban women were about 17 percent more likely (51.4% vs 43.9%) to lose a pregnancy in the first and second (33.9% vs 28.8%) trimesters respectively, than their rural counter parts.

b) Gestation at loss and exposure to STIs

Distribution of pregnancy losses by gestation at loss also varied with whether a woman had reported STI symptoms in the 12 months before the survey. As shown in Table 9, in both cases, majority of the losses took place in the first trimester (45.8% and 61.9%). However, those who had reported STI symptoms were less likely to carry their pregnancies beyond the first trimester. In the absence of STIs, for women who were at risk of losing a pregnancy, about 23 in every 100 women (22.9%) were likely to carry their pregnancy through the second trimester while only 10 women (9.5%) would do so among those who were exposed to STIs.

When rural/urban residence was considered, it was clear that the problem of early termination of pregnancy due to STIs was more pronounced in urban that was in rural areas. In urban areas, those who had experienced STI symptoms, about 69 percent lost their pregnancies within the 1st trimester while those in rural areas who had reported STIs, their losses were evenly distributed across the first 6 months. By the third trimester, less than 10 percent of the women in urban areas who were exposed to STIs would still be at risk of losing a pregnancy. This difference may be due to gaps in service provision between the two areas. It is a requirement that once STI is detected during antenatal, the woman is asked to bring her partner for testing and treatment. With the involvement of traditional leadership in such matters, women in rural areas are more likely to bring their partners than in urban areas, thereby increasing the risk of reinfection.

c) Gestation at loss and Age of the respondent

Figure 19 presents the percentage distribution of pregnancy losses by gestation at the time of loss and the age of the mother. According to this chart, there was no consistent pattern in the distribution of losses by age across the three trimesters. However, a pattern by age is evident among those who had lost their pregnancies in the third trimester. Between age 15 and 44, the older the woman got, the less likely she was to lose a pregnancy in the third trimester.

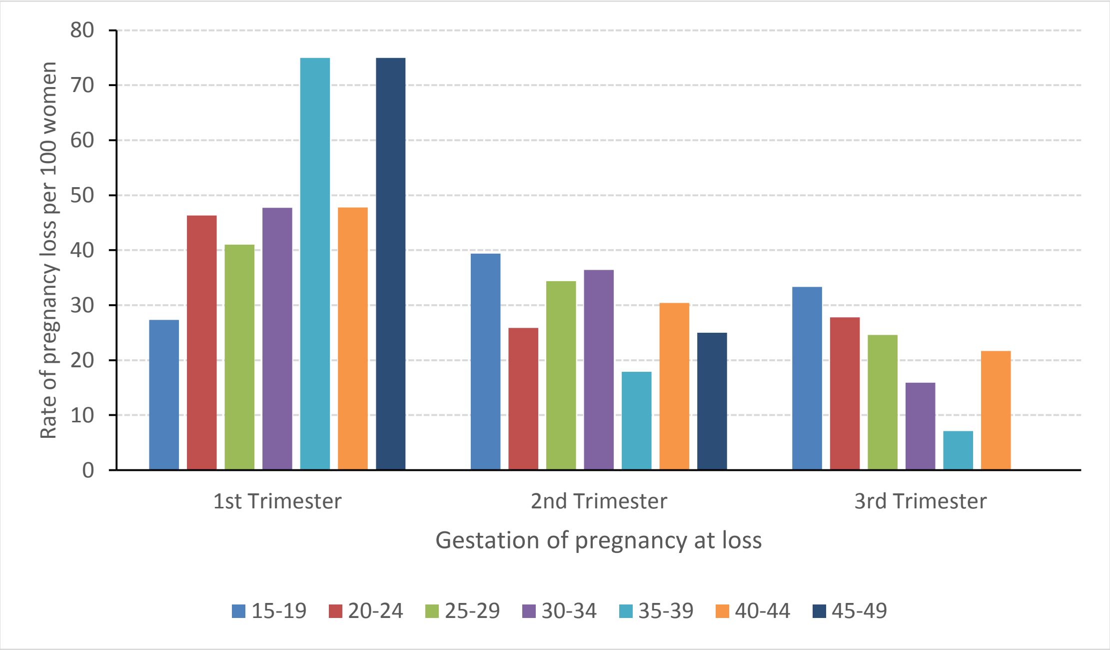

Figure 19: Timing of pregnancy loss and the age of respondent
(Source: ZDHS, 2013/14)

d) Gestation age and education

According to the 2013/14 ZDHS Final Report, 'The use of antenatal care services from a skilled provider is strongly related to mother's level of education. Women with more than a secondary education are more likely to receive antenatal care from a skilled provider (99 percent) than women with no education (91 percent)'. Following from this finding, is that at each given gestation age of the pregnancy, a higher proportion of women with a secondary or higher education is expected to have interfaced with the health care delivery system than those with primary or no education and therefore would have been provided needed prenatal care services.

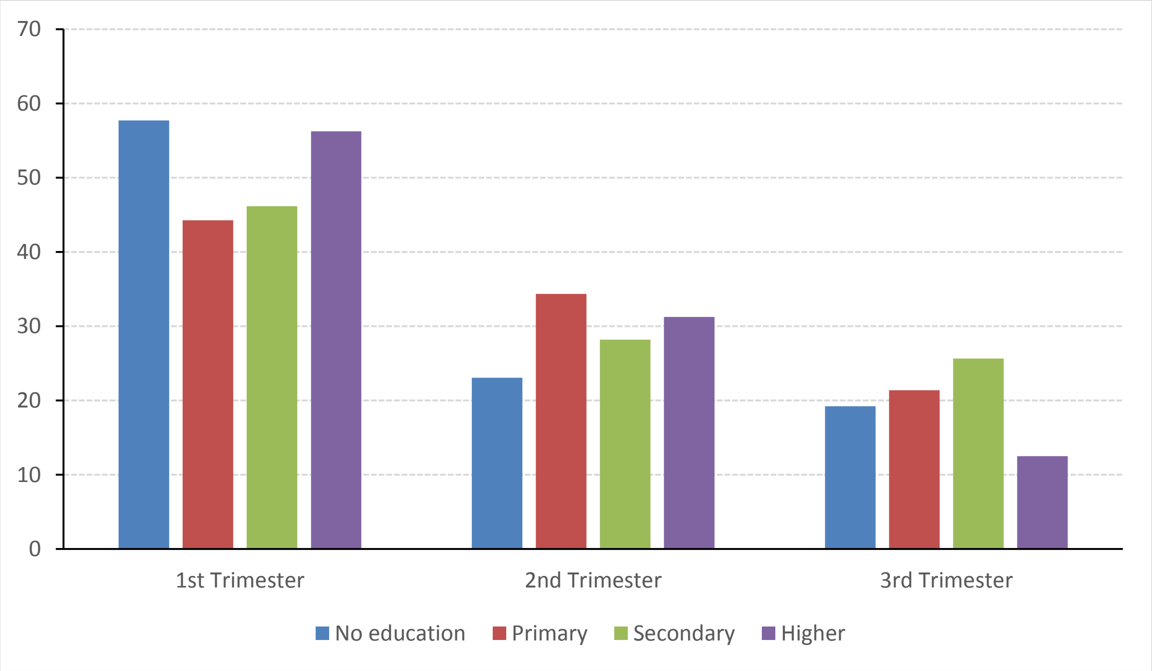

Figure 20: Education and gestation age at termination pregnancy (Source: ZDHS, 2013/14)

The information shown in Figure 20 does not seem to conform to the expectation that a higher proportion of women with no or limited education should lose pregnancies in the first trimester than those with secondary education or higher. It appears from this figure that there were just as high pregnancy losses in those with less than secondary education as was in those with more than secondary education during any pregnancy trimester. As-a-matter-of-fact, risks tended to increase with the level of education from primary to higher education in the 1st trimester and from no education to secondary education in the 3rd trimester. This suggests that education alone and its effects of predisposing women to antenatal services may not influence the levels of pregnancy losses.

e) Gestation age and marital status

Table 10 shows the percentage distribution of women who had reported losing a pregnancy in the 12 months before the survey, by marital status according to timing of loss. There were variations in the timing of pregnancy loses by marital status of women. Nearly half (48.5%) of married women or those living with a partner, who had lost a pregnancy did so in the first trimester, compared to 44.0% those who were never married and those who were either separated, divorced or widowed (37.5%).

Table 10: Percentage distribution of respondents who reported a pregnancy loss in the 12 months before the interviewer, by gestation at the time of termination and marital status

Gestation	*Gestation at time of losing a pregnancy*			*Ratio of rates for never married to…*	
	Never Married	*Married/lives with partner*	*Married in the past*	*Married/ lives with partner*	*Married in the past*
1st Trimester	44.0	48.5	37.5	0.91	1.17
2nd Trimester	24.0	29.7	50.0	0.81	0.48
3rd Trimester	32.0	21.8	12.5	1.47	2.56

Source: Zambia Demographic and Health Survey, 2013/14

It was more common among those who had never been married to lose their pregnancies in the third trimester than those who were either married/living with a partner or were previously in a marital union. They were 1.5 and twice more likely to lose a pregnancy in the third trimester than those who were married/living with a partner or married in the past, respectively. Those who had never been in a union were mostly in the age group 15-19. This conforms to the pattern in Figure 19 which shows that the risk of losing a pregnancy in the third trimester reduced with increasing age.

As shown in Table 11, the majority of women who were married or living with a partner, when they lost a pregnancy, they tended to do so earlier in the pregnancy and the proportion reduced with age of the pregnancy. This is not the case with those who were never married or those who were married before. Among those who were never married, nearly 8 percent more women had lost their pregnancies in the third trimester than in the second trimester. Similarly, more women among those who had been in a union before reported losing their pregnancies in the second trimester (50%) than in the first trimester (37.5%). Stillbirth rate is known to reduce with gestation of pregnancy until the 36th week (PPH, 2014). The pattern shown among those who were in a marital union is similar to this expectation and the other marital categories are probably distortions due to induced pregnancy loses.

f) Gestation age at loss of a pregnancy and Timing of starting FP or falling pregnant again

Table 11, presents information on the timing of starting FP and falling pregnant again by gestation at pregnancy loss. Women who lost their pregnancies in the first trimester, were more (by 3 percent) likely to fall pregnant again than starting a family planning method, within 12 months of losing a pregnancy. On the other hand, those who lost their pregnancies in the second or third trimesters were more likely to start family planning than falling pregnant again; they were about 2.5 times more likely to start family planning than falling pregnant again.

Table 11: Percentage distribution of respondents according to patterns of FP Practice and pregnancy status after the loss of a pregnancy

Family planning use at the time of interview	*Percent according to the timing of initiation of FP after pregnancy loss*					*Count*
	Started FP within 3 months	*Started FP within 4-11 months*	*Pregnant again within 3 months*	*Pregnant again 4-12 months*	*Not on FP since pregnancy loss*	
1st Trimester	16.9	3.4	12.7	10.2	56.8	118
2nd Trimester	19.2	3.8	7.7	12.8	56.4	78
3rd Trimester	29.1	7.3	5.5	9.1	49.1	55
Total	20.3	4.4	9.6	10.8	55.0	251

Source: Zambia Demographic and Health Survey, 2013/14

On the timing of starting a family planning method or falling pregnant again, women who lost their pregnancies in the first trimester, were about twice more likely (12.7 vs 5.5) to fall pregnant within three months of losing a pregnancy than those who did so in the third trimester. Conversely, those who lost their pregnancies in the third trimester, were also about twice more likely (29.1 vs 16.9) to get on a family planning method than those who did so in the first trimester.

4.2.2 Objective 2: *To assess the relative importance of socioeconomic and demographic characteristics of mothers in determining the risk of losing a pregnancy*

Study Question: ***What is the relative importance of each maternal socio-demographic characteristic in determining the risk of pregnancy loss in the population?***

4.2.2.1 Ranking of Predictors

As shown in Table 2, eight variables (age, education, children ever born, Body Mass Index, STI symptoms, age at first child, family planning use and marital status) were included in the final Logistic Regression Model (Model2) resulting in a total of 25 design variables. The following design variables were significant at α=0.05:

1) Age of the mother (*reference = those aged <20 years*)
   - 20-29
   - 30-34
   - 35+
2) Number of children ever born (*reference = 'zero number of children ever born')*
   - All parity levels (from 1 to 5+)

3) STI Symptoms (*reference = No)*
4) Age at first child (*reference = 11-16 years)*
   - 20+ years
5) Family planning (*reference = never used before*)
   - Currently using
   - Used before
6) Marital Status (*reference= never married*)
   - Married
   - Living with partner
   - In a marital union, before

The ranking criteria used in identifying the relative importance of each variable was the odds ratio. This method of ranking was chosen on the premise that all the 15 design variables listed were measure on the same scale. Using information from Table 2, Table 12 presents the order of importance for each variable in determining the risk of losing pregnancy.

Table 12: Relative importance of predictors in explaining the risk of pregnancy loss

Order	Design variable name	Coefficient	Odds Ratio
1	MARITAL_with Partner	2.84	17.04
2	MARITAL_Married	2.57	13.03
3	MARITAL_Married before	1.69	5.42
4	Age_30-34	1.02	2.79
5	Age_20-29	0.93	2.53
6	Age_35+	0.92	2.51
7	STI_12MTH (yes)	0.85	2.33
8	FPUSE_Used before	0.62	1.86
9	FPUSE_Currently using	-0.41	0.66
10	AGE_@CHILD1 (20+ years)	-0.78	0.46
11	TCEB_1	-0.93	0.40
12	TCEB_2	-1.49	0.23
13	TCEB_3	-1.79	0.17
14	TCEB_4	-1.94	0.14
15	TCEB_5+	-1.94	0.14
	Constant	-5.70	--

The table attempts to answer the study question: "*What is the relative importance of each maternal socio-demographic characteristic in determining the risk of pregnancy loss in the population?"* According to the table, marital status (with its design variables) provided the strongest association with pregnancy loss after all other variables were taken into account. Therefore, being in a cohabiting relationship was the strongest factor that contributed to the risk of losing a pregnancy while increased number of children ever born beyond two children was weakest.

4.2.2.2 The Logistic Regression Equation for the study

a) Definition of the equation

The design variables presented (in Table 12) were the predictors that were found to be statistically significant in predicting the probability of losing a pregnancy. The final interest was to be able to predict the probability of losing a pregnancy, given the age, marital status, exposure to STIs, family planning use, age at first child and number of children ever born.

Setting $\beta i = 1, 2, 3 \ldots 23$

Where βi corresponds to coefficients (from Model 2 in Table 2) as follows:

β_0 = -5.70
β_1 = 20-29; β_2 = 30-34; β_3 = 35+ (Age group)
β_4 = primary; β_5 = secondary; β_6 = higher (Education)
β_7 = 1; β_8 = 2; β_9 = 3; β_{10} = 4; β_{11} = 5 (Total number of children ever born)
β_{12} = underweight; β_{13} = normal; β_{14} = overweight (Body Mass Index)
β_{15} = yes; β_{16} = not sure/unknown (Experienced STI symptoms)
β_{17} = 17-19; β_{18} = 20+ years (Age at first child)
β_{19} = currently using; β_{20} = used before (Family Planning)
β_{21} = married; β_{22} = living with a partner; β_{23} = in a union before (Marital Status)

The predictive equation for a logistic regression model for the probability of losing a pregnancy takes form:

$$y = \frac{e^{\beta_0 + \beta_i x_i}}{1 + e^{\beta_0 + \beta_i x_i}}$$

Noting that each set: β_1 through β_3; β_4 through β_6; β_7 through β_{11}; β_{12} through β_{14}; β_{15} through β_{16}; β_{17} through β_{18}; β_{19} through β_{20}; and β_{21} through β_{23}, can only take one value at a time.

b) Testing the predictive equation

To test the model, coefficients from Table 2, were used, assuming two women with the same maternal characteristics but differed only on marital status. One was living with a partner while the other was divorced/widowed/separated.

To test the equation, the following values were assumed: age=20-29; education=higher; TCEB=3; BMI=underweight; exposure to STIs=Yes; Age at first child=17-19; Family Planning=used before.

The predictive equation for a woman who was leaving with a partner therefore was:

$$y = \frac{e^{(-5.70+0.93-0.42-1.79+0.37+0.85-0.38+0.62+2.84)}}{1 + e^{(-5.70+0.93-0.42-1.79+0.37+0.85-0.38+0.62+2.84)}}$$

$$y = \frac{e^{(-2.68)}}{1 + e^{(-2.68)}}$$

$$y = \frac{0.06416}{1 + 0.06416}$$

$$= \mathbf{0.060 \text{ or } 6.03 \text{ percent}}$$

While the predictive equation for a woman who was divorced/widowed/separated was:

$$y = \frac{e^{(-5.70+0.93-0.42-1.79+0.37+0.85-0.38+0.62+1.69)}}{1 + e^{(-5.70+0.93-0.42-1.79+0.37+0.85-0.38+0.62+1.69)}}$$

$$y = \frac{e^{(-3.83)}}{1 + e^{(-3.83)}}$$

$$y = \frac{0.02171}{1 + 0.02171}$$

$$= \mathbf{0.02125 \text{ or } 2.12 \text{ percent}}$$

It follows from the two scenarios that being in a cohabiting relationship increased the probability of losing a pregnancy over those who were married in the past by 4 percent, when other maternal characteristics are held equal.

Chapter 5: DISCUSSION OF FINDINGS

In this study, the rate of pregnancy loss was 10.5 per 100 women of child bearing age (15-49 years). When disaggregated into gestation age at loss, the rate of loss after 28 weeks of gestation was 2.3% of women aged 15-49 years. Others studies that have studied the levels of stillbirths (which is the pregnancy loss after 28 weeks of gestation) at community level, have found similar results. In a meta-analysis of studies that reported pregnancy-related conditions that included stillbirths, Lale et al. (2006) found that the prevalence rate of stillbirths at community level was typically less than 1% in developed economies and could exceed 3% in developing countries.

Most of the studies done on this subject were in health facility settings whereby obstetric records were reviewed retrospectively and therefore may not be comparable to the method used in this study. However, in communities were institutional deliveries are almost universal, the rates obtained at facility level should be a reflection of the rates at the community. For example, in a retrospective review of records of women who sought antenatal and delivery services in Lusaka district, between February 2006 and March 2009, Stringer et al. (2011) found that the crude stillbirth rate for Lusaka was 21.0 per 1000 live birth (2.1%). Lusaka district being predominantly urban with a rate of nearly 90 percent institutional deliveries, this rate is similar to the one obtained in this report. The Zambia Ministry of Health has been collecting routine information on the number of stillbirths that take place in health facilities. In 2015, a total of 8838 stillbirths and 441,956 live births were reported countrywide representing a crude stillbirth rate of 19.9 per 1000 live births, (95% CI; 19.98-19.99). The rate obtained in this study, therefore is close to those found through other methods in the country.

5.1.1 Maternal Age

Results from this study have shown that the risk of losing a pregnancy, increased with advancing maternal age between 15 and 29 years and reduced with increasing age between 29 and 39 years. When compared with those aged 20-24, women who were aged 25-29 and those age 30-34, had higher odds of losing a pregnancy by 30% and 5%, respectively. This pattern persisted even after controlling for other factors (as shown in the models in Table 2). This finding of advancing maternal age as a risk factor to pregnancy loss has been reported in other studies (Stringer et al., 2011; Reddy et al., 2006; Bhatiyar et al., 2008). However, there are some deviations observed in this study. Whereas for some time, it has been established in other studies (Raymond et al., 1994; Fretts et al., 1995) that risk of pregnancy loss was the lowest in the age group 20-24 with higher risks dispersed to either ends of the age distribution, the pattern in this study has not been exactly as in other studies. While the risk of was lower among those aged 20-24 than in those aged 25-34, it was higher than the age group 15-19. This difference may be explained by a slight variation in the methods used. The rates from this study were based on the general population while these other studies predominantly focused on women who had sought intrapartum services.

5.1.2 Education of the mother

Education of the mother, on its own (univariate analysis) showed a statistically significant association with the risk of pregnancy loss. However, when other factors were considered, education was not as important but was explained through other variables. (See Table 2). Before considering other factors, the odds of experiencing a pregnancy loss among those with a secondary education was 48 percent lower than those with no education (OR=0.52; 95% CI: 0.32-0.83). Although not significant when other factors were considered the pattern was the same. Reducing risk of losing a pregnancy with advancing education level, has also been reported in other studies. Globally, it has been observed that stillbirth rates were inversely correlated with the wealth and development of nations, especially with factors such secondary education (Frøen, 2011). Others studies have also found that foetal mortality inversely changed with education of the mother especially in the age groups 20-34 and 35-49 (Hoyer, 1996) and that mortality was higher among offspring of mothers with less than 12 years of education than those with 14+ years, regardless of age, parity and marital status (Chen, et al., 1998).

Access to prenatal care services is known to reduce the risk of losing pregnancies. Women who initiate prenatal care service in the third trimester are known to be at higher risk of stillbirths than those who do early (Vogel et al., 2013). This is related to increased opportunities in those who do so early to have any risk factor (as shown in Figure 2) identified and attended to, early in the pregnancy. It appeared from this study that the benefits of advanced levels of education, which may be responsible for influencing the reduction in pregnancy loss, seem to be more pronounced in rural than urban areas [Figure 11]. Access to antenatal services in urban areas may not discriminate against those with lower education as would in rural areas. For every next level of education one attains, the closer to the administrative centre (in that district/province) that person is likely to be, and the closer to an area with concentrated health facilities. It may be argued therefore that if all women had equal access to pre-conception, prenatal and intrapartum health services, education of the mother may not matter much. However, education works as a ‘vehicle’ that brings women closer to where health services are in easier reach.

5.1.3 Children ever born

Prior pregnancies have been known to affect the risk of pregnancy loss. In this study, Total Number of Children Ever borne was used a proxy variable for the number of prior pregnancies, as there was no specific question in the ZDHS that asked about prior pregnancies (including those that did not result into a live birth). Findings showed that, number of children ever born was an important factor in determining the risk of pregnancy loss (Table 2).

Other studies have reported a lack of the association between children ever born and pregnancy loss. Avachat et al. (2015) found that despite the recorded higher rates of stillbirths (38.3%) among nulliparity women, there was no significant association with the occurrence of stillbirths. Similarly, Savvas et al. (2004) reported that although para 2 reduced the risk of foetal death, when included with other factors in analysing the risk of foetal death, parity on its own did not show a strong relationship. Comparable results were also reported by Froen (2001) where it was found that ‘zero’ parity was not associated with sudden unexplained foetal deaths.

In this study, however, after analysing children ever born against education and age at first child, a pattern emerged. Among women with no education, nulliparity was associated with very high risk of losing a pregnancy as compared to those with smaller numbers of children ever born [Figure 14]. In a study conducted by Huang et al. (2000), found that nulliparity and multiparity of 3 or more were associated with unexplained foetal deaths. This pattern is similar to the pattern depicted in the women with no education in this study.

5.1.4 Timing of first child

Timing of the first child was found to be an important determinant of pregnancy loss. Women who started their childbearing at 20 years or older, were 56 percent less likely to experience a pregnancy loss than those who started earlier than 17 years of age (OR=0.46; 95% CI: 0.30 – 0.74). This factor also seemed to explain the inverse relationship between education and pregnancy loss. [Figure 8].

According to the ZDHS of 2013/14, there was a two-year difference in the median age at first child between those who had secondary education (20.0) and those with no education (18.4). From the same report, it was reported that for women who were aged 15-19 in the rural areas, 36.4% of them already had started childbearing compared to 20% in the urban areas; 53.2 percent among those with no education compared to 23.1% of those with a secondary education. This shows an intricate relationship between starting childbearing early and advancing in education. As for the direction of causation, that is beyond the scope of this study. What is evident however, is that women who start childbearing late, are also likely to advance in their education and once that happened, they are equally more likely to access reproductive health services thereby reducing the risk pregnancy loss.

5.1.5 Body Mass Index

Body Mass Index was summarised into four main classifications recommended by the World Health Organisation thus: Underweight (BMI<18.5); Normal (BMI =18.5-24.9); Overweight (25.0-29.9) and Obese (BMI<30). In this study, BMI was not found to be statistically significant, both at univariate and multivariate levels of analysis. This finding is in contrast with the one observed in a study done in Lusaka District Health Facilities by Stringer et al. (2011), where they found that, when compared to BMI of lower than 19.8 at first antenatal visit, BMI of greater than 26 was significantly associated with stillbirths, after adjusting for other factors (OR=1.8; 95% CI: 1.4–2.3). Similar studies (Aune, 2014; Khashan and Kenny, 2009) also found an association between BMI and the risk of stillbirths. The results obtained in this study may be as result of the timing of taking measurements. In these other studies, weight (and height) of the woman was recorded at during pregnancy, while in this study the measurements were taken after the loss of pregnancy had already taken place.

5.1.6 Access to antenatal services

According to the ZDHS 2013/14 (CS0, 2014), women were asked about the last birth and how old the pregnancy was at the time of making first antenatal visit to a health facility. About 24 percent did so in the first trimester, 70 percent in the second trimester, 5.6% in the third trimester while 0.4 percent did not make any visit or information was not available. From this, it means therefore that by the time a woman lost a pregnancy in the third trimester, there was 94% chance of having interfaced at least once with the health delivery system for antenatal care and if any, risk factors would have been identified. Results from the same survey also show that timing of the first antenatal visit before the third trimester was homogenous across all age groups of women (range = 92.5% to 94%). The pattern shown in Figure 19, where a higher proportion of younger women were losing pregnancies in the third trimester than older ones, despite the high first antenatal attendance rate by the end of the second trimester (for all ages), goes beyond general accessibility to health care services.

5.1.7 Exposure to Sexually Transmitted Diseases

Self-reported STI-related symptoms was the only pathological variable that was included in the analysis. It was found that the possibility of having had experienced one or more STI-related symptoms was the third-most important variable (after marital status and age) in explaining the variability in pregnancy losses. Women who reported having experienced STI symptoms in the 12 months before the survey had higher odds of having lost a pregnancy (OR=2.29; 95% CI: 1.34-3.93). The risk of STIs was observed to be a major contributing factor to the losses that took place earlier in the pregnancy. About 2 women who were not exposed to STI symptoms, for every one 1 woman, who reported STI symptoms, were able to carry their pregnancies beyond the second trimester (Table 9). The study also found that a higher proportion of urban women who were exposed to STIs lost their pregnancies in the first trimester than their rural counterparts.

This finding may suggest discrepancies in the health care delivery system between rural and urban settings. WHO recommends that every pregnant woman be tested for syphilis in the first trimester and again later in the third trimester (WHO, 2002). According to the ZDHS2013/14, there was no significant difference in the timing of the 1st ANC visit between rural and urban women. The higher proportion of pregnancy losses in the first trimester among urban women (with STIs) may be attributed to the possibility that a higher proportion was exposed to the symptoms before pregnancy while those in rural areas are likely to have continued been exposed to STIs while pregnant.

The ZDHS2013/14 report (Table 9.3) shows that whereas 57.7% of women in urban areas who sought ANC services in the most recent birth (in the five years before the survey) had their urine samples taken, only 31.5% in rural areas had urine samples taken. It is more likely that urban women who came for the first antenatal care visit with an STI, were screened and treated than those from rural areas. It is equally more likely that infections that took place during pregnancy were attended to in more women from urban that rural areas. Higher rates of pregnancy losses in the first trimester among those in urban compared to those in rural areas cannot be attributed to coverage of syphilis testing.

5.1.8 Family planning and Current Marital Status

Patterns of family planning use was included in this study as a proxy measure of service demand gaps for delaying or postponing a pregnancy. The study found out that 1 in every 4 (62 out 251) women, who had lost a pregnancy, were already on family planning at the time of the interview and half of these started family planning within a month of losing a pregnancy. Timing of initiation of family planning varied with marital status. Majority of women who were in marital unions chose to fall pregnant again than did initiate on family planning while those who were separated/divorced/widowed preferred more to initiate family planning than falling pregnant again. Promptness in initiating family planning after losing a pregnancy may be indicative of unplanned conceptions.

Chapter 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Pathological factors that determine the risk of intra-uterine foetal deaths have been an interest of study for years. The World Health Organisation and its partners have since been defining and refining packages of care that were aimed at reducing the risk of losing pregnancy. Focused antenatal care (FANC) is one of those strategies that aims, among other things, at identifying and treating already established diseases; early detection of complications and other potential problems; and provision of prophylaxis and treatment of pregnancy-threatening complications such as anaemia, malaria, sexually transmitted (including HIV) and urinary tract infection, including tetanus. **Unfortunately, a woman has to interface with the health care delivery system in the first place, for these factors to be identified and managed**.

As shown in **Figure 1**, by the time women were interfacing with the health care delivery system after pregnancy, about 6 percent would have already lost their pregnancies. There are also inherent differences in the risk of losing a pregnancy between rural and urban settings and the timing of the loss by the age of the mother. Some patterns that have emerged in this study defy popularly held views such as the expectation that women in urban areas are more likely to do better due to wider access to health care.

The main focus for this study was to identify distal factors (social demographic) that contributed to increased risk of exposure to pathological conditions (proximate determinants) known to be responsible for pregnancy losses (Figure 2). Findings from this study show that the risk of pregnancy loss was associated with maternal age, rural/urban residence, number of children ever born, and age at first child, pattern of contraceptive use, marital status and history of sexually transmitted diseases.

Type of marital union was found to be the main factor determining the risk of pregnancy loss. Findings also show that, marital status was equally responsible for the variations by age and number of children ever born. Lack of use of family planning was responsible for the majority of terminations among women of middle ages, those with a secondary education or higher and those who had been married before.

Exposure to sexually transmitted infections were found to be mostly responsible for early losses of pregnancies, especially so among women in urban settings. Detection and treatment of STIs in rural areas may be falling behind urban areas. The observed higher proportions of losses in the second and third trimesters among those who reported STIs may suggest that some women are not tested and treatment early enough.

Family planning, sexually transmitted diseases and type of marital union were three main factors identified to be responsible for pregnancy terminations. While STIs are likely to be responsible for spontaneous foetal losses, lack of use of family planning in conjunction with type of marital union and age, may be responsible for induced foetal losses.

6.2 Recommendations

6.2.1 Further Studies

This study has attempted to confirm what is already known about pregnancy losses; but it has equally brought out issues that require further investigations. Outstanding issues that this study recommends further investigations into, include:

1) **Body Mass Index** as a factor in determining the risk of pregnancy loss. Although many studies have reported that excessive leanness and obesity were associated with increased risk of intrauterine foetal death, this study has failed to find that association. It is suspected that the answer to this discrepancy may lie in the data collection methodology; the timing of taking the measurements. **This study recommends further studies in the effect of BMI at different gestation on the risk of stillbirths.**

2) **Differentials in pregnancy losses in the third trimester** has been found, in this study, to be an important factor in determining the levels of risk between rural and urban areas. Access to antenatal services is generally homogeneous between rural and urban areas, yet women in rural areas are about twice likely to lose a pregnancy in the third trimester than their urban counterparts. **This study**

recommends further investigation to determine the causes behind this wide difference.

3) **Women in urban areas were about twice more likely to be screened for syphilis during antenatal than their rural colleagues**, yet they were about twice likely to lose a pregnancy in the event that they suffered from or experienced a STI symptoms, at some point before or during pregnancy. **This study recommends an assessment into syphilis screening practices, specifically into the timing (by gestation) of the first syphilis test.**

6.2.2 Policy Recommendations

Objective #2: To propose public health interventions that can improve the safety of pregnancies in mothers who were at risk.

Access to family planning services by all women who are sexually active (yet were not ready for a pregnancy) and ensuring that all women in the child bearing age had access to screening services for sexually transmitted and urinary tract infections will help in the reduction of spontaneous and induced foetal deaths. For this to work, the Ministry of health should consider extending these services beyond traditional packages of prenatal care.

As the Ministry reorganises its service delivery system especially those that pertain to sexual and reproductive health (SRH), it should consider the following proposals:

1) Compulsory screening for sexually transmitted and urinary tract infections

Currently, a woman has to fall pregnant first, make a visit to a facility, for her to be routinely screened for STIs. The other opportunity for a woman to be screened for STIs is when she sought curative care services which may require screening for STIs. This study shows that by the time a woman made the first visit, it would have probably been late, **it is recommended therefore that when any woman in the child-bearing age made a visit (curative or preventive) to a health facility, she MUST be screened for STIs according to existing protocols**.

2) ***Increase retesting frequency in women who fail to bring partners for joint treatment of STIs***

Existing protocols for screening for syphilis in pregnancy, require that a woman is tested in the first trimester (or at any earliest first antenatal visit) and later in the third trimester (or at delivery if this is the first contact with a health facility). Women who react to syphilis testing are expected to come with their partners so that they are jointly treated to avoid re-infection. Unfortunately, male partners do not usually present themselves for treatment, especially in urban areas. Even though some women quickly respond to treatment, women who test positive early in the pregnancy and are not able to bring their partners, are therefore left to carry the pregnancy for six months before the next test (third trimester). Since it is not possible for every woman to bring a partner, **this study recommends that women who fail to bring their partners should be rested more frequently, before delivery, than those who get treated with their partners**.

3) ***Integration of family planning into other services***

Although family planning has been at the centre of reproductive health services since the Alma Ata conference, for years the service has been provided in a silo. Lately, there have been efforts to integrate it into postnatal care, post abortion care, HIV care and treatment, among other services. Findings from this study point to the fact that women tend to rush for family planning after having had a pregnancy loss (most likely induced). In order to reduce the occurrence of this, **this study recommends that at any opportunity, a woman of childbearing age makes a visit to a health facility, she should be screened for UNMET need for family planning and provided with an appropriate FP method**.

4) ***Strengthen Community-based Family Planning Services***

In the past 4 to 5 years, the Ministry of Health has been scaling up a Community Health Worker Programme. This is a programme that seeks to extend selected health services beyond fixed health structures (health centres/posts) with a focus on health service promotion and prevention. Family planning is one of those health services included in the package. **This study recommends that the role of**

Community Health Assistants (CHAs) be extended to include screening for UNMET need for family planning and provision of family planning methods or referral.

5) ***Introduce and Institutionalise Stillbirth Reviews***

For a number of years now, all health facilities that experience a death in woman as a result of pregnancy, all such cases are notified and a detailed death review is conducted. This should be extended to all stillbirths (from 28 weeks of gestation as per WHO guidelines). Once a case has been reviewed information should be reported through the existing routine system – the DHIS. This will help in aligning interventions at facility and district levels.

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ANNEX 1: LISTING OF STUDY VARIABLES

	On the Questionnaire		On the SPSS data file		
Variables Name	**Question # / label**	**Responses and Codes**	**Variable label - name**	**Values/labels**	**Measurement Scale**
Woman's Questionnaire					
Pregnancy loss [Outcome]	230 - Have you ever had a pregnancy that miscarried, was aborted, or ended in a stillbirth?	Yes........1 No........2	V228 - Ever had a terminated pregnancy	0 = 'No' 1 = 'Yes'	Nominal (dichotomous)
	231 - When did the last such pregnancy end?	Month: ____ ____ Year: ____ ____ ____ ____	V229 - Month V230 Year Transformed into: 'Date pregnancy ended'. Date format: MMMYYYY	DATE	Interval
	233 - How many months pregnant were you when the last such pregnancy ended?	Months: ____ ____	V233 - Months when pregnancy ended	Numeric	Interval
Province [Predictor/ Confounder]	[Front page]	10 Provinces of Zambia	V024 - Region	1='Central' 2='Copperbelt' 3='Eastern' 4='Luapula' 5='Lusaka' 6='Muchinga' 7='Northern' 8='North Western' 9='Southern' 10='Western'	Nominal
Rural/urban [Predictor/ Confounder]	[Front page]	Rural........1 Urban........2	V025 - Type of place of residence	1 = 'Urban' 2 = 'Rural'	Nominal (dichotomous)
Age [Predictor]	103 How old were you at your last birthday?	NUMERIC	V013 - Age in 5-year groups	1='15-19' 2='20-24' 3='25-29' 4='30-34' 5='35-39' 6='40-44' 7='45-49'	Ordinal

	On the Questionnaire		On the SPSS data file		
Variables Name	**Question # / label**	**Responses and Codes**	**Variable label - name**	**Values/labels**	**Measurement Scale**
Education [Predictor]	104 Have you ever attended school?	Yes .... 1 No 2	V106 - Highest educational level	0 = 'No education' 1 = 'Primary' 2 = 'Secondary' 3 = 'Higher'	Ordinal
	105 What is the highest level of school you attended: primary, secondary, or higher?	None .... 0 Primary .... 1 Secondary .... 2 Higher 3			
	106 What is the highest grade you completed at that level?	NUMERIC	V107 - Highest year of education	NUMERIC	Interval
			V149 – Education Attainment	0=No education 1=Incomplete primary 2=Complete primary 3=Incomplete secondary 4=Complete secondary 5=Higher	Ordinal
Literacy [Predictor]	108 Now I would like you to read this sentence to me. INSTRUCTION: SHOW CARD TO RESPONDENR	Cannot read at all .... 1 Able to read only parts of Sentence ...... 2 Able to read whole sentence .... 3 No card with required language .... 4 Blind/visually impaired 5	V155 - Literacy	0 = 'Cannot read at all' 1 = 'Able to read only parts of sentence' 2 = 'Able to read whole sentence' 3 = 'No card with required language' 4 = 'Blind/visually impaired'	Ordinal
Religion [Predictor/ Confounder]	113 What is your religion?	Catholic .... 1 Protestant .... 2 Muslim .... 3 Other 6	V130 - Religion	1 = 'Catholic' 2 = 'Protestant' 3 = 'Muslim' 96 = 'Other'	Nominal
Ethnicity [Predictor/ Confounder]	114 What tribe do you belong to?	MULTIPLE RESPONSES	V131 - Ethnicity	Too many to list	Nominal
Children Ever born. [Predictor]	203 How many sons live with you? And how many daughters live with you? 205 How many sons are alive but do not live with you? And how many daughters are alive but do not live with you?	NUMERIC	V201 - Total children ever born	NUMERIC	Interval

	On the Questionnaire		On the SPSS data file		
Variables Name	**Question # / label**	**Responses and Codes**	**Variable label - name**	**Values/labels**	**Measurement Scale**
	207 How many boys have died? And how many girls have died?				
Timing of 1st ANC Visit	411 How many months pregnant were you when you received antenatal care for this [last birth] pregnancy?	NUMERIC	M13$1 - Timing of 1st antenatal check (months)	NUMERIC	Interval
Number ANC Visits	412 How many times did you receive antenatal care for this [last birth] pregnancy?	NUMERIC	M14$1 - Number of antenatal visits during pregnancy	NUMERIC	Interval
Use of IPT in the last pregnancy					
Any STI Symptoms in the last 12 months	940 Now I would like to ask you some questions about your health the last 12 months. During the last 12 months, have you had disease which you got through sexual contact?	Yes......1 No 2	Transformed into 'STI_12mths' by selecting all cases that responded 'Yes' to either 940, 941 or 942. Note: 941 & 942 where not filters from 940, hence this transformation	0=No 1=Yes	
	941 Sometimes women experience a bad smelling abnormal genital discharge. During the last 12 months, have you had a bad smelling abnormal genital discharge?	Yes......1 No 2			
	942 Sometimes women have a genital sore or ulcer. During the last 12 months, have you had a genital sore or ulcer?	Yes......1 No 2			
Health	408 Did you see anyone	Yes......1	Transformed into another	1=Trained health worker	Nominal

	On the Questionnaire		On the SPSS data file		
Variables Name	**Question # / label**	**Responses and Codes**	**Variable label - name**	**Values/labels**	**Measurement Scale**
Provider during ANC in the last birth	for antenatal care for this [last birth] pregnancy?	No 2	variable: 'PersonSeenANC' by selecting all cases that responded 'Yes' to either 'Doctor', 'Clinical Officer' or 'Nurse/Midwife' and grouping them into 'Trained Health Worker'. 'Traditional Birth Attendant', Community Health Worker' and 'other' were initially retained as independent categories but 'Community Health Worker' and 'other' were merged into one to avoid 'null' frequency cells.	2Traditional Birth Attendant 3=Community Health 4=Worker/Other 5=No one	
	409 Whom did you see? Anyone else	Health Personnel Doctor Clinical officer Nurse/Midwife Other Person Traditional Birth Attendant Community Health Worker Other (Specify)			
Family planning use [Predictor]	303 Are you currently doing something or using any method to delay or avoid getting pregnant?	Yes..1 No 2	V361 - Pattern of [FP] use	1 = 'Currently using' 2 = 'Used since last birth' 3 = 'Used before last birth' 4 = 'Never used'	Nominal
	313 Have you ever used anything or tried in any way to delay or avoid getting pregnant?	Yes..1 No 2			
Marital status [Predictor/ Confounder]	601 Are you currently married or living together with a man as if married?	Yes, currently married..........................1 Yes, living with a man...........................2 No, not in union 3	V501 - Current marital status	0 = 'Never in union' 1 = 'Married' 2 = 'Living with partner' 3 = 'Widowed' 4 = 'Divorced' 5 = 'No longer living together/separated'	Nominal
	602 Have you ever been married or lived together with a man as if married?	Yes, formerly married ....1 Yes, lived with a man ....2 No 3			
	603 What is your marital status now: are you widowed, divorced, or separated?	Widowed..1 Divorced...2 Separated...3			
Employment	810 Have you done any	Yes..1	V731 - Respondent worked in	0 = 'No'	Nominal

	On the Questionnaire		On the SPSS data file		
Variables Name	**Question # / label**	**Responses and Codes**	**Variable label - name**	**Values/labels**	**Measurement Scale**
[Predictor/ Confounder]	work in the last 12 months?	No 2	last 12 months	1 = 'In the past year' 2 = 'Currently working' 3 = 'Have a job, but on leave last 7 days'	
Occupation [Predictor/ Confounder]	811 What is your occupation, that is, what kind of work do you mainly do?	MULTIPLE RESPONSES	V716 - Respondent's occupation	Too many to list	Nominal
Tobacco use [Predictor]	1004 Do you currently smoke cigarettes?	Yes..1 No 2	V463A - Smokes cigarettes	0 = 'No' 1 = 'Yes'	Nominal (dichotomous)
	1005 In the last 24 hours, how many cigarettes did you smoke?	NUMERIC	V464 - Number of cigarettes in last 24 hours	NUMERIC	Ratio
	1007 What (other) type of tobacco do you currently smoke or use?	Pipe ....A Chewing tobacco.................................B Snuff..C Other (specify) ....D	V463B - Smokes pipe	0 = 'No' 1 = 'Yes'	Nominal
			V463C - Uses chewing tobacco	0 = 'No' 1 = 'Yes'	Nominal
			V463D - Uses snuff	0 = 'No' 1 = 'Yes'	Nominal
Alcohol Use	1007A Do you drink alcohol?	Yes..1 No 2	S1007A - Drink alcohol	0 = 'No' 1 = 'Yes'	Nominal
	1007B In the last one week how many days did you drink alcohol?	NUMERIC	S1007B - Number of days drank alcohol in last week	NUMERIC	
Household Questionnaire					
Body mass index	211 Weight [in kilograms]	NUMERIC	V445 - Body Mass Index	Numeric	Interval
	212 Height [in centimetres]	NUMERIC			
Wealth Index	[Computed] – from multiple variables	N/A	V190 - Wealth Index	1 = 'Poorest' 2 = 'Poorer' 3 = 'Middle' 4 = 'Richer' 5 = 'Richest'	Ordinal

Source: Zambia Demographic and Health Survey, 2013/14

ANNEX 2: CODE SHEET FOR SELECTED VARIABLES VIA UNIVARIATE ANALYSIS

Generic Name		On the SPSS data file		Short Name	Parameter Coding
		Values/labels	**Measurement Scale**		
1	Pregnancy loss [Outcome]	0 = 'No' 1 = 'Yes'	Nominal (dichotomous)	PREGLOSS	
2	Province	1='Central' ; 2='Copperbelt'; 3='Eastern'; 4='Luapula'; 5='Lusaka';6='Muchinga' 7='Northern'; 8='North Western' 9='Southern'; **10='Western' (ref)**	Nominal	PROVINCE	DROPPED (**at step 2**)
3	Rural/urban	1 = 'Urban' 2 = 'Rural'	Nominal (dichotomous)	RURURB	DROPPED (**at step 2**)
4	Age	Years	Ratio	AGE	NUMERIC
5	Education	**0 = 'No education'** (ref); 1 = 'Primary' 2 = 'Secondary'; 3 = 'Higher'	Ordinal	EDUCN	EDUCN(1)= 'PRIMARY' EDUCN(2)= 'SECONDARY' EDUCN(3)= 'HIGHER'
6	Literacy Level	**0 = 'Cannot read at all'** (ref) 1 = 'Able to read only parts of sentence' 2 = 'Able to read whole sentence' 3 = 'Could not be assessed'	Ordinal	LITERACY	DROPPED (**at step 2**)
7	Children Ever born	NUMBER	Interval	TCEB	NUMERIC
8	Timing of 1st ANC Visit	MONTHS	Interval	GA-ANC1	DROPPED (**at step 2**)
10	Any STI Symptoms in the last 12 months	**0=No** (ref) 1=Yes	Nominal	STI_12MTH	STI_12MTH(1) = YES
11	Family planning use	1 = 'Currently using' 2 = 'Used since last birth' 3 = 'Used before last birth' **4 = 'Never used'** (ref)	Nominal	FPUSE	FPUSE(1) ='Currently using' FPUSE(2) ='Used since last birth' FPUSE(3) ='Used before last birth'
12	Marital status	**0 = 'Never in union'** (ref) 1 = 'Married' 2 = 'Living with partner' 3 = 'Widowed' 4 = 'Divorced' 5 = 'No longer living together/separated'	Nominal	MARITAL	MARITAL(1) = 'Married' MARITAL(2) = 'Living with partner' MARITAL(3) = 'Widowed' MARITAL(4) = 'Divorced' MARITAL(5) = 'No longer living together/separated'
13	Body mass index	NUMBER	Interval	BMI	NUMERIC
14	Age at first child	Recoded to Categories		AGE_@CHILD1	AGEGRP_CHILD1(1)='11-16' AGEGRP_CHILD1(2)='17-19' AGEGRP_CHILD1(3)='20+'

Source: Zambia Demographic and Health Survey, 2013/14

ANNEX 3A: STEP 1 - UNIVARIATE ANALYSIS

The intention of this study was to determine socio demographic factors that were associated with pregnancy losses. As indicated in Figure 4, a total 251 of the 2399 cases (10.5%) had experienced a pregnancy loss in the 12 months before the interview. In order to select variables for this step (univariate analysis), preliminary dependent variables were first grouped according to their measurement scale as follows[4]:

- **Nominal**: Type of residence (2); marital status (6); contraceptive use (4); provider during ANC (for the most recent birth (5); STI Symptoms (2); whether used any IPT (2); Religion (4); Province (10).
- **Ordinal**: Education (4); literacy level (4); Wealth Index (5).
- **Continuous**: Age of the respondent (35); Age at first child (3); Body Mass Index[5] (1145); Total children ever borne (15); Timing of first ANC visit (9); Number of ANC visits from the most recent birth (11); Days drank alcohol in the week before interview (8).

Note: The number of unique observations for BMI (1145) in a sample of 2371 cases did not provide enough variability. This variable was therefore converted to an ordinal scale using WHO classification.

a) Categorical variables

For all categorical and continuous variables with fewer number of integers, a univariate analysis using contingency tables was performed. The results of this procedure are presented as Tables B1.1 through B1.14. These are contingency tables of the dependent variable (No, Yes) versus the *k* levels of each independent variable with a chi-square value, the degrees of freedom and the p-value of the likelihood ratio.

Note: This likelihood ratio was chosen due to its equivalency with the likelihood ratio statistic produced via a logistic regression analysis.

Table 13: Percentage distribution of study units by religion and whether they had experienced a pregnancy termination in the	Table 14: Percentage distribution of study units by literacy level and whether they had experienced a pregnancy termination in

[4] The number in brackets after each variable, represent the number of categories in each variable or the number of unique integers for continuous variables

[5] Original data had this variable converted to the 100th unit. For example, 23.94 would be stored as 2394.

12 months before the interview

Religion	Ever had a terminated pregnancy		Count
	No	Yes	
Catholic	90.5	9.5	420
Protestant	89.3	10.7	1944
Muslim	100.0	0.0	7
Other	90.9	9.1	22
Total	2143	250	2393

$X^2_{(3)}$ =2.114; p=.549

Source: Zambia Demographic and Health Survey, 2013/14

the 12 months before the interview

Literacy	Ever had a terminated pregnancy		Count
	No	Yes	
Cannot read at all	85.9	14.1	751
Able to read only parts of sentence	88.8	11.2	215
Able to read whole sentence	91.6	8.4	1413
No card with required language	100.0	0.0	6
Blind/visually impaired	50.0	50.0	2
Total	89.5	10.5	2387

$X^2_{(4)}$ =19.837; p=.001

Source: Zambia Demographic and Health Survey, 2013/14

Table 15: Percentage distribution of study units by Wealth Index and whether they had experienced a pregnancy termination in the 12 months before the interview

Wealth Index	Ever had a terminated pregnancy		Count
	No	Yes	
Poorest	88.9	11.1	406
Poorer	88.9	11.1	443
Middle	87.9	12.1	486
Richer	89.5	10.1	507
Richest	91.6	8.4	557
Total	89.5	10.5	2399

$X^2_{(4)}$ =4.407; p=.354

Source: Zambia Demographic and Health Survey, 2013/14

Table 16: Percentage distribution of study units by province of residence and whether they had experienced a pregnancy termination in the 12 months before the interview

Province	Ever had a terminated pregnancy		Count
	No	Yes	
Central	90.8	9.2	206
Copperbelt	85.1	14.9	222
Eastern	91.7	8.3	327
Luapula	90.0	8.6	229
Lusaka	91.4	10.0	269
Muchinga	89.6	10.4	202
Northern	85.5	14.5	234
North Western	86.8	13.2	234
Southern	91.3	8.7	264
Western	92.0	8.0	212
Total	89.5	10.5	2399

$X^2_{(9)}$ = 15.351; p=.082

Source: Zambia Demographic and Health Survey, 2013/14

Table 17: Percentage distribution of study units by family planning use and whether they had experienced a pregnancy termination in the 12 months before the interview

Contraceptive use	Ever had a terminated pregnancy		Count
	No	Yes	
Currently using	92.3	7.7	808
Used since last birth	72.2	27.8	270
Used before last birth	92.9	7.1	224
Never used	91.1	8.9	1097
Total	89.5	10.5	2399

$X^2_{(3)}$ = 75.769; p=.000

Source: Zambia Demographic and Health Survey, 2013/14

Table 18: Percentage distribution of study units by marital status and whether they had experienced a pregnancy termination in the 12 months before the interview

Marital Status	Ever had a terminated pregnancy		Count
	No	Yes	
Never in a union	96.6	3.4	729
Married	85.4	14.6	1365
Living with a partner	83.3	16.7	18
Widowed	96.6	3.4	89
Divorced	89.5	10.5	153
No longer living together/separated	88.9	11.1	45
Total	89.5	10.5	2399

$X^2{}_{(5)} = 79.965; p=.000$

Source: Zambia Demographic and Health Survey, 2013/14

Table 19: Percentage distribution of study units by whether an IPT was used during antenatal and whether they had experienced a pregnancy termination in the 12 months before the interview

Whether used IPT	Ever had a terminated pregnancy		Count
	No	Yes	
No	93.0	7.0	100
Yes	89.4	10.6	1241
Total	89.7	10.3	1341

$X^2{}_{(2)} = 1.617; p=.446$

Source: Zambia Demographic and Health Survey, 2013/14

Table 20: Percentage distribution of study units by timing of 1st ANC visit and whether they had experienced a pregnancy termination in the 12 months before the interview

Timing of 1st ANC visit	Ever had a terminated pregnancy		Count
	No	Yes	
Month 1	100	0.0	7
Month 2	95.0	5.0	40
Month 3	87.3	12.7	267
Month 4	89.1	10.9	422
Month 5	90.5	9.5	305
Month 6	90.5	9.5	201
Month 7	92.7	7.3	55
Month 8	92.3	7.7	13
Month 9	100	0.0	2
Total	89.7	10.3	1312

$X^2{}_{(8)} = 6.313; p=.708$

Source: Zambia Demographic and Health Survey, 2013/14

Table 21: Percentage distribution of study units by number of ANC visits during pregnancy for last birth before the interview and whether they had experienced a pregnancy termination in the 12 months before the interview

Number of ANC visits	Ever had a terminated pregnancy		Count
	No	Yes	
None	95.2	4.8	21
1	94.3	5.7	35
2	92.3	7.7	117
3	91.3	8.7	435
4	87.8	12.3	400
5+	88.7	11.3	319
Total	89.8	10.2	1327

$X^2{}_{(5)} = 5.796; p=.327$

Source: Zambia Demographic and Health Survey, 2013/14

Table 22: Percentage distribution of study units by type of provider seen during pregnancy for last birth before the interview and whether they had experienced a pregnancy termination in the 12 months before the interview

Provider during ANC	Ever had a terminated pregnancy		Count
	No	Yes	
Trained health worker	89.9	10.1	1234
Traditional birth attendant	80.6	19.4	36
Community Health Worker	86.1	13.9	36
Other	100.0	0	12
None	95.2	4.8	21
Total	89.7	10.2	1339

$X^2{}_{(4)} = 6.618; p=.157$

Source: Zambia Demographic and Health Survey, 2013/14

Table 23: Percentage distribution of study units by whether a respondent has experienced STI symptoms in 12 months before the survey and whether they had experienced a pregnancy termination in the 12 months before the interview

Whether responded had STI symptoms in 12 months before survey	Ever had a terminated pregnancy		Count
	No	Yes	
No	90.0	10.0	2272
Yes	79.8	20.2	104
Total	89.6	10.4	2376

$X^2{}_{(1)} = 9.063; p=.003$

Source: Zambia Demographic and Health Survey, 2013/14

Table 24: Percentage distribution of study units by age at first child and whether they had experienced a pregnancy termination in the 12 months before the interview

Age at first child	Ever had a terminated pregnancy		Count
	No	Yes	
11-16 Years	86.1	13.9	409
17-19 Years	88.8	11.2	811
20+ Years	91.9	8.1	842
Total	1570	192	1762

$X^2{}_{(2)} = 8.381; p=.015$

Source: Zambia Demographic and Health Survey, 2013/14

Table 13 to Table 24 were produced for two purposes:

(i) *To assess the level of association between the dependent variable and each independent variable so that only variables with moderate association with the dependent variable were retained for further analyses.*

Using the recommendation by Mickey and Greenland (1989), all variables with a *p*-value < 0.25 were nominated for inclusion in multivariate analysis beside those already selected in the study as focus variables. As shown in Table 25, this procedure yielded the following variables:

- Using the *p*-value <0.25 cut-off point: Nine variables qualified: literacy; contraceptive use; current marital status; 'self-reported' STI symptoms in the 12 months before the survey; highest education attained; province of residence; type of residence; ANC provider during the previous birth; and use of IPT during the previous pregnancy.
- Other variables of known clinical importance: Although timing of 1st ANC visit did not meet the criteria; it was the only variable which provided a proxy measure for health-seeking behaviour during the antenatal period; for this reason, it was retained for inclusion into the multivariate model. (See Table 25 below).

Table 25: Summary of Likelihood Ratio Tests

	Independent variables	Chi-square	df	p-value
1	Contraceptive use	75.769	3	.000
2	Marital Status	79.965	5	.000
3	Literacy	19.105	4	.001
4	STI symptoms in the last 12 months	9.063	1	.003
5	Highest Education	13.114	3	.004
6	Province	15.351	9	.082
7	Type of Residence	2.041	1	.153
8	Provider during ANC	6.618	4	.157
9	Use of IPT in the last pregnancy	1.400	1	.237
10	Number of ANC visits	5.796	5	.327
11	Wealth Index	4.407	4	.534
12	Religion	2.114	3	.543
13	Timing of 1st ANC visit	6.273	8	.617
14	Body Mass Index	9.496	3	.023

Source: Zambia Demographic and Health Survey, 2013/14

(ii) To inspect the selected variables for cells with 'zero' frequencies so that necessary adjustments to the categories could be done to those variables before including them in a logistic regression analysis model.

Out of the categorical variables selected via a *p*-value < 0.25 or through clinical relevance, the following had at least one cell with a 'null' frequency: literacy (Table 14), timing of first ANC visit (Table 20) and Provider during ANC (Table 22). The following corrective measures were undertaken, to make the three variables suitable for logistic regression:

- **Literacy** - the categories 'no card with required language' and 'Blind/visually impaired' were collapsed into one category labelled 'Could not be assessed'. The revised outputs are presented in Table 26 below.

Table 26: Percentage distribution of study units by level of literacy and whether they had experienced a pregnancy termination in the 12 months before the interview

Literacy	**Ever had a terminated pregnancy**		Count
	No	Yes	
Cannot read at all	85.9	14.1	751
Able to read only parts of sentence	88.8	11.2	215
Able to read whole sentence	91.6	8.4	1413
Could not be assessed	87.5	12.5	8
Total	89.5	10.5	2387

$X^2_{(4)}$ =19.105; p=.001

Source: Zambia Demographic and Health Survey, 2013/14

- **Timing of first ANC visit -** The nine categories in Table 20 were collapsed into three categories thus: Month 1, month 2 and month 3 collapsed into one category and labelled 'Trimester 1'; Months 4, month 5 and month 6 collapsed into 'Trimester 2'and Month 7, month 8 and month 9 into 'Trimester 3'. The revised outputs are shown in Table 27 below.

Table 27: Percentage distribution of study units by age of the pregnancy at 1st ANC visit in last birth before the interview and whether they had experienced a pregnancy termination in the 12 months before the interview			
Timing of 1st ANC visit	**Ever had a terminated pregnancy**		Count
	No	Yes	
Trimester 1	88.5	11.5	314
Trimester 2	89.9	10.1	928
Trimester 3	92.9	7.1	70
Total	89.7	10.3	1312

$X^2_{(2)}$ = 1.313; p=.519

Source: Zambia Demographic and Health Survey, 2013/14

- **Provider during ANC** - The 'other' category was merged with 'Community Health Worker'. This transformation changed the *p*-value from 0.157 to 0.262, thereby disqualifying (*p>0.25)* this variable from inclusion in the multivariate analysis. The revised outputs are shown in Table B2.3 in below.

Table 28: Percentage distribution of study units by type of provider seen during pregnancy for last birth before the interview and whether they had experienced a pregnancy termination in the 12 months before the interview			
Provider during ANC	**Ever had a terminated pregnancy**		Count
	No	Yes	
Trained health worker	89.9	10.1	1234
Traditional birth attendant	80.6	19.4	36
Community Health Worker/Other	89.6	10.4	48
None	95.2	4.8	21
Total	89.7	10.4	1339

$X^2_{(3)}$ = 3.995; p=.262

Source: Zambia Demographic and Health Survey, 2013/14

b) Continuous variables

As indicated earlier, the following variables were considered to be on interval or ratio scale (with too many integers to be considered under contingency table analysis above): Age, age at first child, Total children ever born and number of days drank alcohol in the week before interview. A univariate logistic regression model (using 'ever had terminated a pregnancy' as a dependent variable) was fitted to the data for each of these individual independent variables. Table 29 presents the estimates for the models.

Table 29: Univariate Logistic Regression – Variables in the Equations outputs

Maternal Characteristic	**Statistics**					
	B	S.E.	Wald	df	Sig.	Exp(B)
Age of respondent	.015	.007	3.970	1	.046	1.015
Age at first child	-.054	.026	4.200	1	.040	0.948
Total number of children ever born	.024	.024	.997	1	.318	1.024
Days drank alcohol in the last month	-.021	.116	.032	1	.858	.979

Source: Zambia Demographic and Health Survey, 2013/14

Applying the same criteria of *p<0.25*, the current age of the respondent and the age of the respondent and age at first child were selected as candidates for inclusion in the multivariate analysis. The number of children ever born was retained despite not meeting the criterion because it was a proxy measure of previous pregnancies – which is a variable of interest. From the literature, number of prior pregnancies is known to be associated with the risk of pregnancy loss. Although, on its own, this variable did not perform well as predictors of pregnancy loss (as shown in Table 29), it was retained due to clinical relevance. This strategy was chosen to reduce the risk of building a model that would have otherwise been biological implausible (Greenland, 1989).

Note: Age at first child was converted to an ordinal scale, because it was noted that women who had not yet had a child would also be included in at multivariate level, as keeping it as a continuous variable was going to reduce the overall sample.

c) Univariate Logistic Regression

Thirteen variables were retained at the univariate analysis level and their logistic regression outputs are summarised in Table 30, below.

Table 30: Univariate Logistic Regression Models on Selected Predictors of Pregnancy Loss (N=2399)									
VARIABLE		**Coeff.**	**Std Err.**	**Wald**	**df**	**Sig.**	**OR**	**95% CI for OR**	
								Lower	**Upper**
AGE		0.015	0.007	3.97	1	0.046	1.015	1.00	1.029
Education *(ref = 'No Education')*	**EDUCN**			12.896	3	0.012			
	Primary	-0.178	0.231	0.591	1	0.442	0.837	0.532	1.317
	Secondary	-0.660	0.242	7.407	1	0.006	0.517	0.322	0.831
	Higher	-0.320	0.339	0.889	1	0.346	0.726	0.374	1.411
Children ever borne		0.024	0.024	0.997	1	0.318	1.024	0.977	1.074
Gestation Age at first ANC Visit *(ref = 'Trimester 1')*	**GA_ANC1**			1.307	3	0.727			
	Trimester 2	-0.139	0.208	0.446	1	0.504	0.870	0.579	1.308
	Trimester 3	-0.521	0.497	1.099	1	0.294	0.594	0.224	1.573
	Missing	-0.081	0.203	0.158	1	0.691	0.923	0.620	1.372
Body Mass Index *(ref = 'obese')*	**BMI**			5.850	4	0.211			
	Underweight	-0.054	0.397	0.018	1	0.893	0.948	0.436	2.062
	Normal	0.442	0.310	2.030	1	0.154	1.556	0.847	2.858
	Overweight	0.422	0.344	1.506	1	0.220	1.524	0.777	2.989
	No Stated	0.868	0.623	1.941	1	0.164	2.381	0.703	8.067
Family Planning Use *(ref = 'Never used')*	**FPUSE**			40.733	2	0.000			
	Currently using	-0.166	0.169	0.959	1	0.328	0.847	0.608	1.181
	Used before	-0.834	0.157	28.169	1	0.000	0.434	0.319	0.591
Marital Status *(ref = 'Never in union')*	**MARITAL**			56.158	3	0.000			
	Married	1.57	0.217	52.100	1	0.000	4.806	3.138	7.361
	Living with Partner	1.728	0.664	6.768	1	0.009	5.632	1.532	20.711
	In a union before	0.944	0.295	10.252	1	0.001	2.57	1.442	4.579
Literacy *(ref = 'Cannot read at all')*	**LITERACY**			16.788	3	0.002			
	Able to read only parts of the sentence	-0.268	0.241	1.245	1	0.265	0.765	0.477	1.225
	Able to read whole sentence	-0.581	0.142	16.718	1	0.000	0.56	0.424	0.739
	Could not be assessed	-0.14	1.074	0.017	1	0.896	0.869	0.106	7.137
	Missing	-0.592	1.05	0.318	1	0.573	0.553	0.071	4.329
STI Symptoms in 12 months before Survey? *(ref = 'No')*	**STI_12MTH**			10.661	2	0.005			
	Yes	0.824	0.254	10.514	1	0.001	2.279	1.385	3.751
	Not Sure	0.301	0.623	0.233	1	0.629	1.351	0.398	4.583
Age at first child *(ref = '11-16')*	**AGE_@CHILD1**			9.793	3	0.02			
	17-19 Years	-0.248	0.181	1.874	1	0.171	0.781	0.547	1.113
	20+ Years	-0.606	0.212	8.135	1	0.004	0.546	0.36	0.827
	Missing/NA	-0.461	0.198	5.451	1	0.020	0.63	0.428	0.929
Province *(ref = 'Western')*	**PROVINCE**			15.704	9	0.073			
	Central	0.153	0.349	0.192	1	0.661	1.165	0.588	2.311
	Copperbelt	0.695	0.316	4.846	1	0.028	2.003	1.079	3.717
	Eastern	0.032	0.323	0.01	1	0.921	1.032	0.548	1.944
	Luapula	0.247	0.335	0.545	1	0.460	1.281	0.664	2.47
	Lusaka	0.07	0.334	0.044	1	0.834	1.072	0.557	2.063
	Muchinga	0.286	0.342	0.698	1	0.404	1.331	0.681	2.603
	Northern	0.668	0.314	4.534	1	0.033	1.95	1.055	3.606
	Northwestern	0.561	0.318	3.107	1	0.078	1.752	0.939	3.267
	Southern	0.090	0.334	0.073	1	0.786	1.095	0.569	2.107
Residence (ref=rural)	RURURB	0.200	0.134	2.23	1	0.135	0.818	0.629	1.065
Use of IPT in the last pregnancy? *(ref = 'No')*	IPT_ANC			1.323	2	0.516			
	Yes	0.45	0.403	1.248	1	0.264	1.568	0.712	3.452
	Missing	0.463	0.404	1.31	1	0.252	1.589	0.719	3.509

Source: Zambia Demographic and Health Survey, 2013/14

ANNEX 3B: STEP 2 - SELECTION OF VARIABLES FOR MULTIVARIATE ANALYSIS – A DETAILED DESCRIPTION

Table 31: Variable Analysis for Nested Multiple Logistic Regression Models for the Variables selected in step 1

		Log likelihood				Nagel-kerke R^2	HL Test	Classification Accuracy
		-2LL	ΔLL	Δdf	P[X²(Δdf)> ΔLL]			
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
MODEL 1 = All 13 Variables	39	1392.91				0.176	0.085	89.8
MODEL 2 = **MODEL 1** less IPT_ ANC	37	1395.14	2.24	2	0.33	0.174	0.307	89.8
MODEL 3 = **MODEL 1** less RURURB	38	1394.80	1.89	1	0.17	0.174	0.041	89.7
MODEL 4 = **MODEL 1** less **PROVINCE**	30	1408.94	16.03	9	0.07	0.163	0.144	90.0
MODEL 5 = **MODEL 1** less **AGEGRP**_CHILD1	36	1414.93	22.02	3	0.00	0.158	0.004	89.5
MODEL 6 = **MODEL 1** less STI_12MTH	37	1402.40	9.49	2	0.01	0.168	0.001	89.7
MODEL 7 = **MODEL 1** less LITERACY	35	1395.92	3.02	4	0.56	0.173	0.083	89.9
MODEL 8 = **MODEL 1** less MARITAL	36	1496.86	103.95	3	0.00	0.093	0.800	89.5
MODEL 9 = **MODEL 1** less FPUSE	37	1425.99	33.09	2	0.00	0.150	0.122	89.9
MODEL 10 = **MODEL 1** less BMI	35	1399.12	6.21	4	0.18	0.171	0.005	89.8
MODEL 11 = **MODEL 1** less GA_ANC1	36	1394.58	1.67	3	0.64	0.174	0.207	89.8
MODEL 12 = **MODEL 1** less TCEB	38	1398.81	5.90	1	0.02	0.171	0.017	90.0
MODEL 13 = **MODEL 1** less EDUCN	35	1393.39	0.48	4	0.98	0.175	0.052	89.8
MODEL 14 = **MODEL 1** less AGE	38	1394.03	1.12	1	0.29	0.175	0.023	89.9

Source: Zambia Demographic and Health Survey, 2013/14

Table 31, is meant to answer the question: '*Does the inclusion of a variable tell us more about the outcome (or response) variable than when the variable is not in the model?'* The table therefore presents a summary of 14 models and for each, the following information was collected:

- the degrees of freedom;
- -2 log likelihood;
- change in the log likelihood between the full model and successive smaller models;
- change in degrees of freedom arising from dropping a specific variable from the full model and;
- the log likelihood ratio test taking the format ($P[\chi^2_{(df)} = LLR; p<.005]$).
- Additional information presented included the pseudo R^2, the Hosmer-Lemeshow Test and classification accuracy.

In Table 31, columns (b), (c), (g), (h) and (i) were computed by the SPSS software; while columns (d), (e) and (f) were derived from columns (b) and (c) as follows:

(i) *Column (d) – Change in Log likelihood*: SPSS output, by default contains only the -2 log likelihood statistic. The change in log likelihood, was obtained by getting the absolute difference between the full model and subsequent smaller models. This computation conforms to the expression:

$$G = -2ln\left[\frac{(likelihood\ without\ the\ variable)}{(likelohood\ with\ the\ variable)}\right]$$

(ii) *Column (e) – Change in degrees of freedom*: This is the difference in the degree of freedom between the full model and the model without a given variable.

(iii) *Column (f) – This is the likelihood ratio test* ($P[\chi^2$ (Δdf)> ΔLL]: Column (d) was used as a critical value and (e) as the degrees of freedom, then compared with the chi-square distribution at α=0.05. To do this, a MS Excel Worksheet Function of the form: '=CHIDIST(x,deg_freedom)' was used in computing the *p*-value at α=0.05.

a) Retention and removal of variables

Once the significance levels arising from the removal of each individual variable from the full model were computed, a decision on the retention or removal of each variable was made thus:

- **Variables Retained.** The following variables were retained due to their statistical relevance to the model (*p-value < 0.05)*: AGE_@CHILD1, STI_12MTH, MARITAL, FPUSE and TCEB. Although the removal of AGE, BMI, and EDUCN indicated that there was no significant effect on the full model, these variables were still retained due to their clinical relevance to this study.

- **Variables Removed**. Conversely, IPT_ANC, RURURB, PROVINCE, LITERACY and GA_ANC1 were removed from the model, pending further investigation as described in (b) below.

b) Refitting the model to the data with retained variables only.

After dropping IPT_ANC, RURURB, PROVINCE, LITERACY, and GA_ANC1, a new model was fitted and its summary statistics are presented as a 'reduced model' in Table 32. Results from the starting model (with 13 variables) have also been reproduced.

Table 32: Comparison of reduced model with the original (larger) model

	Model Coefficients			Model Summary		Hosmer & Lemeshow Test	Classification Accuracy
	χ^2 Value	df	*p-value*	- 2LL	Nagelkerke R^2		
ORIGINAL MODEL	215.058	39	.000	1392.91	0.176	0.085	89.8
REDUCED MODEL	190.409	20	.000	1417.55	0.156	0.226	90.0

Source: Zambia Demographic and Health Survey, 2013/14

As indicated by Table 32, the larger model has a lower amount of unexplained variation as compared to the reduced model (-2LL = 1392.906 vs 1417.554 and pseudo R^2= 17.6% vs 15.6%). However, the change in -2LL is not statistically significant, χ^2 (19) = 24.648, p = .1725. This shows that the reduced model predicts values not significantly different from what has been observed in the data, therefore not much was lost by reducing the number of variables to include in the model for purposes of parsimony. The reduced model was therefore retained for further analysis.

ANNEX 3C: *STEP 3* - VERIFYING THE IMPORTANCE OF EACH VARIABLE INCLUDED IN THE MODEL

Table 33: Results of Fitting a Multivariable Model Containing Variables Selected in Step 2 (=Preliminary Main Effects Model.

VARIABLE	Coeff.	Std Err.	Wald	df	Sig.	OR	95% CI for OR	
							Lower	Upper
AGE	0.026	0.014	3.530	1	0.060	1.026	0.999	1.054
EDUCN			2.044	4	0.728			
Primary	-0.096	0.247	0.151	1	0.698	0.908	0.560	1.475
Secondary	-0.313	0.277	1.277	1	0.259	0.731	0.425	1.259
Higher	-0.303	0.400	0.573	1	0.449	0.739	0.337	1.619
Not stated	-19.015	27967.60	0.000	1	0.999	0.000	0.000	.
TCEB	-0.135	0.048	7.716	1	0.005	0.874	0.795	0.961
BMI			5.405	4	0.248			
Underweight	0.406	0.422	0.928	1	0.335	1.502	0.657	3.434
Normal	0.670	0.335	4.003	1	0.045	1.954	1.014	3.767
Overweight	0.574	0.360	2.538	1	0.111	1.775	0.876	3.596
Missing	1.121	0.674	2.762	1	0.097	3.067	0.818	11.502
STI_12MTH			9.945	2	0.007			
Yes	0.859	0.277	9.633	1	0.002	2.361	1.372	4.062
Not Sure	0.450	0.676	0.444	1	0.505	1.569	0.417	5.907
AGE_@CHILD1			37.937	3	0.000			
17-19 Years	-0.378	0.192	3.868	1	0.049	0.685	0.470	0.999
20+ Years	-0.798	0.241	10.961	1	0.001	0.450	0.281	0.722
Not Applicable	0.912	0.307	8.822	1	0.003	2.489	1.364	4.544
FPUSE			37.067	2	0.000			
Currently Using	-0.391	0.198	3.909	1	0.048	0.676	0.459	0.980
Used before	0.695	0.187	13.759	1	0.000	2.004	1.388	2.680
MARITAL			89.529	3	0.000			
Married	2.634	0.295	79.570	1	0.000	13.923	7.806	24.833
Living with partner	2.795	0.713	15.352	1	0.000	16.355	4.042	66.182
In a union before	1.696	0.369	21.155	1	0.000	5.453	2.647	11.234
Constant	-4.531	0.532	72.668	1	0.000	0.011		

Source: Zambia Demographic and Health Survey, 2013/14

When results from Table 30 and Table 33 were compared, STI_12MTH, AGE_@CHILD1 MARITAL and FPUSE remained with a strong association (*p<0.05*) even after controlling for other variables. On the other hand, TCEB which was not strong at the univariate level, but was retained due to its clinical importance, now posted a stronger association at multivariate level.

However, EDUCN and AGE which were statistically significant at univariate stage, when used together with other variables, posted weaker associations at α=*0.05*. Nonetheless, AGE was still significant at α=*0.10*. The BMI was still not statistically significant, even after controlling for other variables. Although AGE, EDUCN and BMI did not demonstrate to have a strong association at multivariate stage, these variables were retained for further analysis, due to their relevance to this study. Furthermore, as demonstrated Table 31, the removal of AGE, EDUCN or BMI did not significantly change the model.

Since coefficients (coeff.) are the estimates from the model that tell us the relationship between the independent variables and the dependent variable (where the dependent variable is on the logit scale), by indicating the amount change in the predicted log odds of PREGLOSS=1 that would be predicted by a 1 unit change in the independent variable, coefficients for each predictor in Table 30 and Table 33 were also compared. From the two tables, absolute changes in the values of coefficients for all variables were noted. An increase was recorded for AGE, FPUSE (used FP before), MARITAL and STI_12MTH. This means that for these variables, the amount of influence on the predicted log odds increased after controlling for other variables. Conversely, all other variables posted a decline in their coefficients, suggesting that other variables may be at play in explaining the association.

ANNEX 3D: STEP 4 - INSPECTION OF VARIABLES IN THE 'PRELIMINARY MAIN EFFECTS' MODEL

a) Testing AGE

Since the function: **log[p/(1-p)** assumes a linear relationship between the outcome and continuous independence variables, in order to test for linearity with a continuous variable (AGE), the following procedure (from within SPSS) was used:

- ⇨ Obtained quartiles for the variable AGE and the following points were obtained
  25th percentile = 20 years; 50th percentile = 26 years; 75th percentile =34
- ⇨ Created a (new) categorical variable from AGE with quartiles as splitting points as follows:
  (1) 15-20 (2) 21-26 (3) 27-34 (4) 35-49
- ⇨ Run the LOGISTIC REGRESSION Procedure, as in Table 33, but replacing AGE (continuous variable) with the created categorical variable, using 15-20 as the reference category. Part of the results are shown in Table 34 . Mid points for each group were also calculated.

Table 34: Quartile analysis for the variable AGE to determine its linearity with the logit

Quartile	1	2	3	4
Mid-point	17.5	23.5	30.5	42
Frequency	680	528	619	572
Coefficient (B)	0.0	.535	.693	.648
95% CI		(0.529 - 0.541)	(0.686 - 0.700)	(0.641 - 0.655)

From the table, it shows that there was an increase in the coefficients followed by a decline from the 75th percentile. It also showed that the first group was statistically different from the other three but there was an overlap between the third and fourth quartiles. In order to visually inspect the changes in age with coefficients, regression coefficients were plotted against age group mid points as shown in Figure 21.

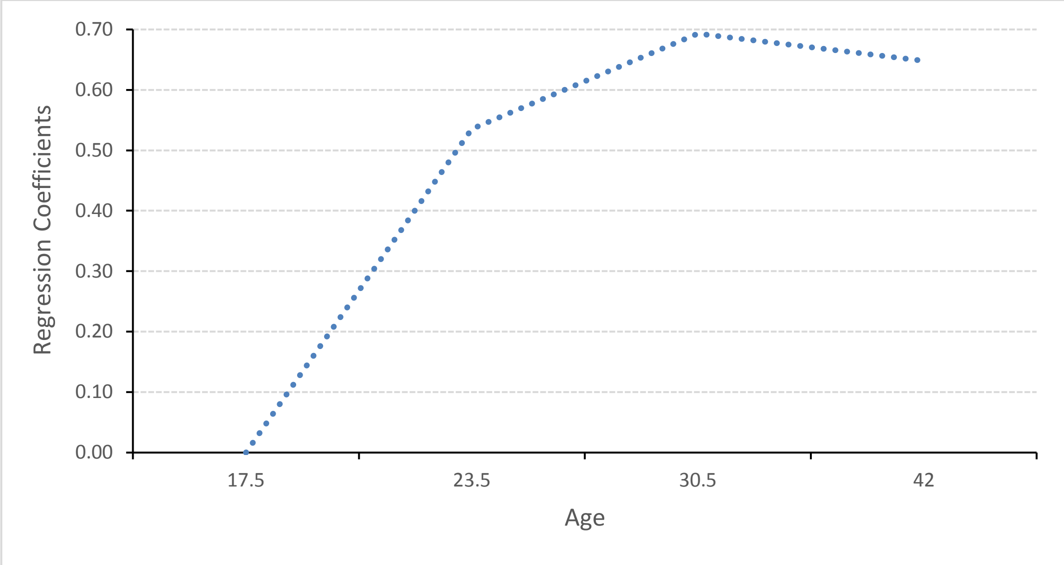


Figure 21: Estimated logistic regression coefficients on approximate quartile mid points of AGE (Source: ZDHS2013/14)

The pattern in Figure 21, does not completely overrule the presence of linearity in the logit for AGE nor does it completely confirm. However, due the observed differences in the gradient of the line between the 3rd and 4th quartiles supported the decision not to use age as a continuous variable as it was going to erroneously assume the same quantity of scale at all ages when the case is different.

b) Testing TCEB

- A different approach was used to determine whether TCEB should be kept as a continuous variable or not. A histogram was produced, and as shown in Figure 21, the distribution was clearly skewed towards lower parities. For this reason, TCEB was converted into a categorical variable by cumulating parities higher than five children into five and labelled as “5+”.

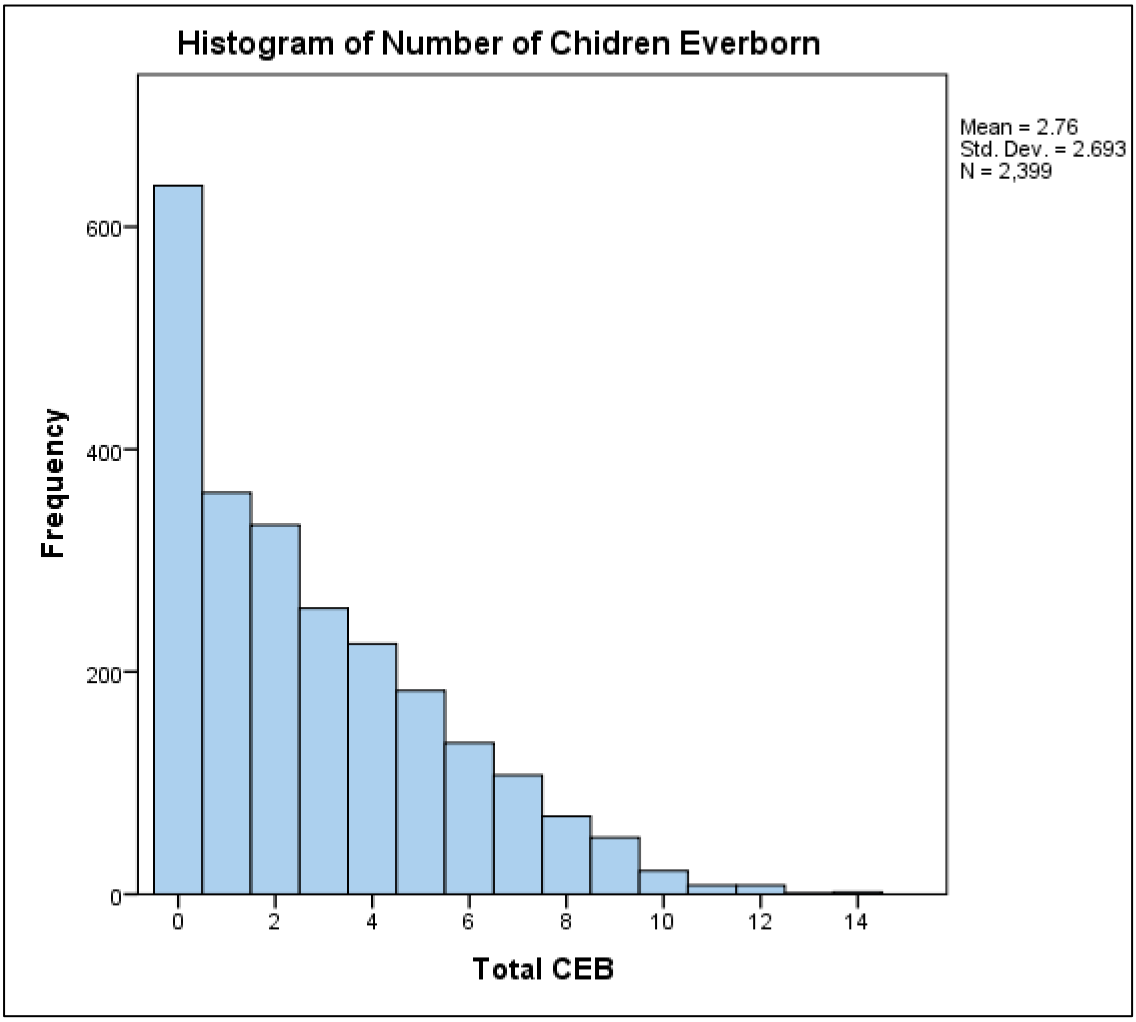


Figure 22: Histogram of the Total Number of Children Ever Born
(Source: ZDHS2013/14)

This decision was based on the observation that at higher parities, there weren't enough numbers to be used in combination with other variables making coefficients not very reliable due to large standard errors.

c) Running the model with adjusted AGE and TCEB

To assess whether there was any improvement to the reduced model (presented in Table 32) after changing the scale for AGE and TCEB from being continuous variables to ordinal, summaries from the two models are presented in Table 35.

Table 35: Comparison of models with AGE and TCEB changed from continuous to categorical variables							
Variables Entered	**Evaluation Statistics**						
	Model Coefficients			Model Summary		Hosmer & Lemeshow Test	Classification Accuracy
	χ² Value	df	*p-value*	- 2LL	Nagelkerke R^2		
REDUCED MODEL (1) [6]	190.409	20	.000	1417.554	0.156	0.226	90.0
REDUCED MODEL (2)[7]	206.800	25	.000	1401.164	0.169	0.170	89.9

Source: Zambia Demographic and Health Survey, 2013/14

From the table, the reduced model with AGE and TCEB scaled as ordinal variables is better than the model with AGE and TCEB as continuous variables as shown by the reduction in -2LL and the increase in the pseudo R^2. The change in -2LL was statistically significant χ^2 (5) = 16.39, p = .006, leading to a conclusion that changing the measurement scale for AGE and TCEB improved the prediction power of the model.

[6] With AGE and TCEB as continuous variables
[7] With AGE and TCEB scaled as categorical variables

ANNEX 3E: *STEP 5* - CHECKING FOR INTERACTIONS AMONG VARIABLES

To assess the influence of each combination on the main effects model, each combination was added one by one to the main effects model and the log-likelihood test statistic computed as shown in Table 36.

Table 36: Log-likelihood, Likelihood Ratio Test Statistic (G), Degrees of Freedom, and p-Value for Selected Interactions and their Effect on the Main Effects Model

INTERACTIONS	Model df	-2 Log-	G	df	Sig.
Main Effects Model	25	1401.164			
AGE by EDUCN	35	1378.916	22.248	10	0.014
AGE by TCEB	38	1384.102	17.062	13	0.196
AGE by BMI_Quartiles	37	1395.883	5.281	12	0.948
AGE by FPUSE	31	1397.658	3.506	6	0.743
AGE by MARITAL	34	1387.008	14.156	9	0.117
AGE by STI_12MTH	31	1397.875	3.289	6	0.772
AGE by AGE_@CHILD1	33	1393.740	7.424	8	0.492
EDUCN by TCEB	41	1391.705	9.459	16	0.893
EDUCN by BMI_Quartiles	38	1379.220	21.944	13	0.056
EDUCN by FPUSE	31	1391.717	9.447	6	0.150
EDUCN by MARITAL	34	1391.106	10.058	9	0.346
EDUCN by STI_12MTH	31	1389.289	11.875	6	0.065
EDUCN by AGE_@CHILD1	35	1392.681	8.483	10	0.582
TCEB by BMI_Quartiles	24	1404.885	3.721	1	0.054
TCEB by FPUSE	35	1379.724	21.440	10	0.018
TCEB by MARITAL	38	1393.217	7.947	13	0.847
TCEB by STI_12MTH	35	1387.373	13.791	10	0.183
TCEB by AGE_@CHILD1	33	1392.795	8.369	8	0.398
BMI_Quartiles by FPUSE	33	1389.406	11.758	8	0.162
BMI_Quartiles by MARITAL	31	1394.825	6.339	6	0.386
BMI_Quartiles by STI_12MTH	24	1401.719	0.555	1	0.456
BMI_Quartiles by AGE_@CHILD1	32	1399.200	1.964	7	0.962
FPUSE by MARITAL	31	1381.647	19.517	6	0.003
FPUSE by STI_12MTH	29	1394.605	6.559	4	0.161
FPUSE by AGE_@CHILD1	31	1382.020	19.144	6	0.004
MARITAL by STI_12MTH	30	1393.920	7.244	5	0.203
MARITAL by AGE_@CHILD1	33	1385.525	15.639	8	0.048
STI_12MTH by AGE_@CHILD1	31	1393.984	7.180	6	0.305

Source: Zambia Demographic and Health Survey, 2013/14

All combinations that had a significant effect (*p<.05)* on the main effects model were identified for possible inclusion. The following combinations posted a significant influence on the main effects model: AGE by EDUCN; TCEB by FPUSE; FPUSE by MARITAL; FPUSE by AGE_@CHILD1 and MARITAL by AGE_@CHILD.

Once the five combinations were identified, the next step was to look at the clinical credibility of each combination. FPUSE by AGE_@CHILD1, and MARITAL by AGE_@CHILD1 were evaluate not to make clinical sense to the study. This is because, it was going to be difficult to relate events that may have taken place at different times in the life of the mother. AGE by EDUCN, TCEB by FPUSE and FPUSE by MARITAL were considered to be plausible combinations and were run as interaction variables together with the main effects variables. Results are presented in Table 37.

Table 37: Results of Fitting a Multivariable Model Containing Variables Selected in Step 2 (Preliminary Main Effects Model and interaction variables

Variable	Coeff.	Std Err.	Wald	df	Sig.	OR	95% CI for OR	
							Lower	Upper
Age			.730	3	.866			
<20 years								
20-29	.925	1.259	.540	1	.462	2.522	.214	29.740
30-34	.875	1.302	.451	1	.502	2.399	.187	30.815
35+	.645	1.270	.258	1	.612	1.906	.158	22.954
Education			4.671	3	.198			
No Education								
Primary	.226	1.209	.035	1	.851	1.254	.117	13.404
Secondary	-.686	1.236	.308	1	.579	.503	.045	5.676
Higher	-17.733	28411.270	.000	1	1.000	.000	0.000	
Children Ever Born			14.293	5	.014			
0								
1	-.618	.400	2.381	1	.123	.539	.246	1.182
2	-1.395	.487	8.224	1	.004	.248	.095	.643
3	-1.373	.554	6.145	1	.013	.253	.086	.750
4	-1.296	.513	6.388	1	.011	.274	.100	.748
5+	-1.414	.439	10.369	1	.001	.243	.103	.575
Body Mass Index			3.127	4	.537			
Obese								
Underweight	.153	.436	.124	1	.725	1.166	.496	2.741
Normal	.447	.347	1.655	1	.198	1.563	.791	3.087
Overweight	.301	.377	.638	1	.424	1.352	.645	2.832
Missing	.805	.714	1.271	1	.260	2.237	.552	9.066
Family Planning			10.616	2	.005			
Never used before								
Currently using	1.643	.584	7.920	1	.005	5.172	1.647	16.246
Used before	1.448	.664	4.753	1	.029	4.253	1.157	15.626
Marital Status			62.303	3	.000			
Never been in a union								
Married	2.729	.362	56.782	1	.000	15.323	7.534	31.165
Living with partner	2.785	1.193	5.452	1	.020	16.202	1.564	167.830
In a union before	1.447	.511	8.015	1	.005	4.252	1.561	11.582
STI Symptoms			7.843	2	.020			
No								
Yes	.804	.287	7.840	1	.005	2.235	1.273	3.923
Not Sure	.105	.687	.023	1	.879	1.110	.289	4.264
Age at first child			10.408	2	.005			
11-16								

Table 37: Results of Fitting a Multivariable Model Containing Variables Selected in Step 2 (Preliminary Main Effects Model and interaction variables

Variable	**Coeff.**	**Std**	**Wald**	**df**	**Sig**	**OR**	**95% CI for OR**	
17-19 Years	-.385	.196	3.836	1	.050	.681	.463	1.000
20+ Years	-.783	.243	10.358	1	.001	.457	.284	.736
TCEB by FPUSE			11.558	10	.316			
TCEB=1 by FPUSE='Currently using'	-1.929	.832	5.376	1	.020	.145	.028	.742
TCEB=1 by FPUSE='Used before'	-.365	.698	.273	1	.601	.694	.177	2.727
TCEB=2 by FPUSE='Currently using'	-.600	.816	.542	1	.462	.549	.111	2.714
TCEB=2 by FPUSE='Used before'	-.361	.762	.225	1	.635	.697	.156	3.104
TCEB=3 by FPUSE='Currently using'	-.886	.865	1.048	1	.306	.412	.076	2.249
TCEB=3 by FPUSE='Used before'	-.953	.848	1.261	1	.261	.386	.073	2.034
TCEB=4 by FPUSE='Currently using'	-1.345	.880	2.339	1	.126	.260	.046	1.461
TCEB=4 by FPUSE='Used before'	-1.036	.837	1.535	1	.215	.355	.069	1.828
TCEB=5 by FPUSE='Currently using'	-1.483	.776	3.656	1	.056	.227	.050	1.038
TCEB=5 by FPUSE='Used before'	-.602	.697	.747	1	.388	.548	.140	2.146
FPUSE by MARITAL			12.980	6	.043			
FPUSE='Currently using' by MARITAL='Married'	-1.273	.808	2.479	1	.115	.280	.057	1.366
FPUSE='Currently using' by MARITAL='Living with partner'	-.466	1.774	.069	1	.793	.627	.019	20.290
FPUSE='Currently using' by MARITAL='In a union before'	.375	.934	.161	1	.688	1.456	.233	9.084
FPUSE='Used before' by MARITAL='Married'	-.397	.738	.290	1	.591	.672	.158	2.857
FPUSE='Used before' by MARITAL='Living with partner'	-.637	1.807	.124	1	.724	.529	.015	18.255
FPUSE='Used before' by MARITAL='In a union before'	-.498	.898	.308	1	.579	.608	.105	3.531
AGE X EDUCN			11.574	9	.238			
AGE_Short(1) by EDUCN(1)	-.437	1.274	.118	1	.731	.646	.053	7.841
AGE_Short(1) by EDUCN(2)	.127	1.305	.010	1	.922	1.136	.088	14.659
AGE_Short(1) by EDUCN(3)	17.763	28411 .270	.000	1	1.00 0	517938 75.998	0.000	
AGE_Short(2) by EDUCN(1)	-.644	1.332	.234	1	.629	.525	.039	7.146
AGE_Short(2) by EDUCN(2)	1.002	1.356	.546	1	.460	2.724	.191	38.843
AGE_Short(2) by EDUCN(3)	-1.452	29000 .566	.000	1	1.00 0	.234	0.000	
AGE_Short(3) by EDUCN(1)	-.043	1.276	.001	1	.973	.957	.078	11.680
AGE_Short(3) by EDUCN(2)	.093	1.363	.005	1	.946	1.097	.076	15.858
AGE_Short(3) by EDUCN(3)	17.576	28411 .270	.000	1	1.00 0	429503 47.311	0.000	

Table 37: Results of Fitting a Multivariable Model Containing Variables Selected in Step 2 (Preliminary Main Effects Model and interaction variables

Variable	Coeff.	Std	Wald	df	Sig	OR	95% CI for OR
Constant	-3.846	1.263	9.265	1	.002	.021	

Source: Zambia Demographic and Health Survey, 2013/14

As shown in Table 37, firstly, TCEB by FPUSE and AGE by EDUCN were neither statistically significant at α=0.05 nor α=0.10. Secondly, the inclusion of the interaction terms between MARITAL with FPUSE increased the Standard Errors of coefficient estimates in the design variables for both FPUSE and MARITAL and consequently broadening the confidence intervals. The three interaction terms were therefore dropped.

After concluding that there wasn't enough ground to include interaction terms to the preliminary main effects model (in Table 33), Table 38 was produced and presented AGE and TCEB as categorical variables. Comparing the two models showed that, whereas there were no major changes to the estimates for all other variables. The model in Table 38 was called 'Preliminary Final Model', pending model diagnostics.

Table 38: Preliminary Final Model - Results of Fitting a Multivariable Model that included adjustment to the number of design variables in the variable 'MARITAL' and changed scale for AGE and TCEB.

Variable	Coeff.	Std Err.	Wald	df	Sig.	OR	95% CI for OR	
							Lower	Upper
Age			12.457	3	0.006			
<20 years								
20-29	0.921	0.267	11.868	1	0.001	2.513	1.488	4.245
30-34	1.020	0.333	9.370	1	0.002	2.772	1.443	5.326
35+	0.916	0.343	7.144	1	0.008	2.499	1.277	4.893
Education			3.891	3	0.273			
No Education								
Primary	-0.082	0.248	0.109	1	0.742	0.921	0.566	1.499
Secondary	-0.402	0.281	2.048	1	0.152	0.669	0.386	1.160
Higher	-0.418	0.403	1.072	1	0.300	0.659	0.299	1.452
Children Ever Born			39.671	5	0.000			
0								
1	-0.917	0.319	8.256	1	0.004	0.400	0.214	0.747
2	-1.477	0.338	19.085	1	0.000	0.228	0.118	0.443
3	-1.779	0.359	24.499	1	0.000	0.169	0.083	0.341
4	-1.930	0.368	27.509	1	0.000	0.145	0.071	0.299
5+	-1.940	0.349	30.923	1	0.000	0.144	0.072	0.285
Body Mass Index			4.322	4	0.364			
Obese								
Underweight	0.367	0.426	0.742	1	0.389	1.443	0.626	3.324
Normal	0.598	0.338	3.140	1	0.076	1.819	0.939	3.525
Overweight	0.507	0.364	1.938	1	0.164	1.660	0.813	3.388
Missing	1.042	0.688	2.296	1	0.130	2.835	0.736	10.913
STI Symptoms			9.503	2	0.009			

Table 38: Preliminary Final Model - Results of Fitting a Multivariable Model that included adjustment to the number of design variables in the variable 'MARITAL' and changed scale for AGE and TCEB.

Variable	**Coeff.**	**Std Err.**	**Wald**	**df**	**Sig.**	**OR**	**95% CI for OR**	
No								
Yes	0.846	0.279	9.187	1	0.002	2.329	1.348	4.024
Not Sure	0.448	0.674	0.441	1	0.507	1.565	0.418	5.863
Age at first child			10.719	2	0.005			
11-16								
17-19 Years	-0.382	0.193	3.928	1	0.047	0.682	0.468	0.996
20+ Years	-0.784	0.240	10.667	1	0.001	0.457	0.285	0.731
Family Planning			32.354	2	0.000			
Never used before								
Currently using	-0.412	0.199	4.297	1	0.038	0.663	0.449	0.978
Used before	0.619	0.188	10.805	1	0.001	1.857	1.284	2.685
Marital Status			85.356	2	0.000			
Never been in a union								
Married/Living with partner	2.570	0.291	78.083	1	0.000	13.067	7.389	23.108
In a union before	1.690	0.359	22.103	1	0.000	5.418	2.679	10.959
Constant	-3.751	0.499	56.395	1	0.000	0.024		

Source: Zambia Demographic and Health Survey, 2013/14

ANNEX 3F: MODEL INSPECTION

1) Summary Measures of Fit

After running the model with the variables in Table 38, the following summary measures were obtained: Hosmer & Lemeshow test and the overall classification accuracy.

a) **Hosmer and Lemeshow Test:** The Hosmer-Lemeshow test for logistic regression is the most commonly used statistic to test 'how well a model fits the data'. Running the model with variables in Table 38, produced Table 39.

Table 39: Contingency Table for Hosmer and Lemeshow Test

		Pregnancy Loss = No		Pregnancy Loss = Yes		Total
		Observed	Expected	Observed	Expected	
Step 1	1	240	244.154	8	3.846	248
	2	232	232.128	8	7.872	240
	3	229	229.601	11	10.399	240
	4	231	227.235	9	12.765	240
	5	231	223.644	9	16.356	240
	6	217	220.877	24	20.123	241
	7	215	215.009	25	24.991	240
	8	206	206.978	34	33.022	240
	9	194	195.024	46	44.976	240
	10	151	151.349	77	76.651	228

χ^2 (8) = 10.197, p = .251,

Source: Zambia Demographic and Health Survey, 2013/14

The value of the Hosmer-Lemeshow goodness-of-fit statistic computed from Table 39, was 10.2 and the corresponding p-value from the chi-square distribution with 8 degrees of freedom was 0.251, which was > 0.05, indicating that the model fitted the data quite well. Comparing observed and expected frequencies also indicated some close agreement in each decile of the risk of pregnancy loss. However, Hosmer and Lemeshow (2000, p. 151), recommend that before one finally accepts that a model fits, an analysis of individual residuals and other diagnostic tests are performed. This was done in the sections that follow (until section 6.2.2b)).

b) **Classification Accuracy and the ROC:** Classification accuracy was used to check how accurately data were described in the model. The area under the Receiver Operating Characteristic Curve (ROC) was used to measure the classification accuracy - probabilities of detecting a true signal (sensitivity) and a false signal (1-specificity) over an entire range of possible cut-off points (0,1). Where sensitivity = (respondents that had experienced a pregnancy loss and were correctly classified thus out all of cases that reported having experienced a pregnancy loss), while specificity = (respondents that had not experienced a pregnancy loss and were correctly classified thus out all of cases that reported not having experienced a pregnancy loss).

Table 40, below displays summary statistics after running ROC curve procedure from SPSS, by plotting sensitivity against 1-specificity across all possible cut-off points in the dataset.

Table 40: Area Under the Curve
Test Result Variable(s): Predicted probability

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.746	.017	.000	.713	.779

The test result variable(s): Predicted probability has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

Source: Zambia Demographic and Health Survey, 2013/14

Hosmer and Lemeshow (2000, p. 162), recommend the following guide as a general decision rule:

- If ROC = 0.5: this suggests no discrimination (just as good as tossing a coin)
- If 0.7 ≤ ROC< 0.8: considered as acceptable discrimination
- If 0.8 ≤ ROC< 0.9: considered as excellent discrimination
- If 0.8 ≥ 0.9: considered as outstanding discrimination (though this is extremely rare)

From Table 40, the area under the curve is .765 with 95% confidence interval (0.713; 0.779) which was significantly different from 0.5 since p-value < .001. A conclusion was made therefore that the logistic regression classified the groups significantly better than would happen by chance.

2) Numeric Issues

After reviewing the Hosmer & Lemeshow Test, and the overall classification accuracy, numeric issues that affect ‘complete separation’ in the dataset, multicollinearity and zero-cell-frequencies were also evaluated.

a) Complete Separation

This is a situation whereby the two groups (PREGLOSS = 1 or 0) can be perfectly identified with a specific group in the independent variable (*e.g. if all those who reported having lost a pregnancy were aged below 30 while those who did not were 30 and above*). When binary logistic procedure is run in SPSS and it detects 'complete separation', a warning is displayed that: '*The parameter covariance matrix cannot be computed. Remaining statistics will be omitted'* and further warns that '…… *a perfect fit is detected'.* None of these messages where encountered in running the preliminary final model. Literature also suggests that complete separation can be empirically detected by inspecting the model parameter estimates; variables with large parameter estimates, typically greater than 5.0 with Wald chi-square statistics that are near Zero (Allison, P.D., 2008) and huge standard errors greater than 2.0 (World Colleges, undated), are potential suspects of complete separation. None of the variables in Table 38 violated this standard.

To visually demonstrate that all the eight main effects variables passed the test of complete separation, Annex 4 presents charts to demonstrate each group (PREGLOSS = 1 or 0) was represented in each dummy variable.

b) Zero cell frequencies

Zero-cell frequencies in categorical variables are known to be partly responsible for complete separation (Hosmer and Lemeshow, 2000, p135-138) in logistic regression models. This problem was dealt with at the univariate analysis stage (in step1) and in step 5. None of the main effects variables had this problem as demonstrated by the figures in Annex 4, which shows that all variables in the model were represented in either group of the outcome variable. Just like for complete separation, zero-cell frequencies are also detectable through SE that are larger than 2.0 which is not present in any of the variables in Table 38.

c) Collinearity

Although collinearity among independent variables is a common phenomenon in multiple regression models, concern is raised if one or more variables in the model has unusually high odds ratios and standard errors, with a Tolerance of 0.1 or less (equivalently variance inflation factor (VIF) of 10 or greater). Tolerance is defined as *an indicator of how much* *collinearity that a regression analysis can tolerate*) while VIF is an indicator of how much of the inflation of the standard error could be caused by collinearity. Table 41, presents summary test statistics for collinearity.

Table 41: Collinearity Diagnostics – Variance Inflation Factor (VIF)

VARIABLE	Dependent Variable and Resulting Variance Inflation Factor (VIF)							
	AGE	EDUCN	TCEB	BMI	FPUSE	MARITAL	STI_12MTH	AGE_@CHILD1
AGE	-	2.42	1.59	2.43	2.48	2.34	2.49	2.46
EDUCN	1.28	-	1.15	1.29	1.29	1.31	1.32	1.32
TCEB	2.55	3.48	-	3.99	3.98	3.98	3.99	2.87
BMI	1.05	1.05	1.08	-	1.08	1.08	1.08	1.08
FPUSE	1.32	1.29	1.32	1.33	-	1.33	1.33	1.24
MARITAL	1.38	1.45	1.46	1.46	1.46	-	1.46	1.36
STI_12MTH	1.01	1.00	1.01	1.01	1.01	1.01	-	1.01
AGE_@CHILD1	2.57	2.60	1.87	2.60	2.42	2.41	2.60	-

Source: Zambia Demographic and Health Survey, 2013/14

To obtain the Tolerance and VIF measures, each independent variable was regressed on the rest of the other variables, using the SPSS PROCEDURE (**Linear Regression=>Statistics=>Collinearity Diagnostics).** The resulting VIF were copied and summarised in **Table 41**. Using the threshold of VIF=2.50, all variables indicated that they were probably correlated with each TCEB, AGE with AGE_@CHILD1, BMI with AGE_@CHILD1 and STI_12MTH with AGE_@CHILD1.

To verify this, a correlation matrix was generated (not shown in full in this paper) and the results showed that TCEB with AGE and AGE_@CHILD1 were the only sets with correlation coefficients of -+ 0.70 or higher, indicating a very strong correlation (TCEB & AGE=0.80; TCEB & AGE_@CHILD1=-0.702). However, both variables were retained in the model as their VIF values were lower than the cut-off point of VIF=10 to indicate a definite presence of collinearity.

d) Influential Cases

Influential cases were designated as those cases with a Cook' distance greater than 1.0 (Hosmer and Lemeshow, 2000, p167-186). To obtain the Cooks Distance values, the preliminary final model (Table 38) was run again and under the SAVE option on the Logistic Regression procedure the 'cook's distance' was selected which created a new variable labelled 'Coo_1. Frequencies for this variable were run. With the output ordered by descending counts; a partial output is presented in Figure 23.

Statistics

Analog of Cook's influence statistics

N	Valid	2397
	Missing	2
Minimum		.00000
Maximum		.55709

Figure 23: Summary for Cook's influence statistic

The output presented in Figure 23 indicated that there were no cases with values greater than 1.0.

3) Sample Adequacy

a) K-Fold Cross Validation

To test the generalisability of the logistic regression model, a k-fold cross-validation technique was applied, using an 80-20 two-fold data partitioning strategy with a single iteration. Eighty (80) percent of the cases were used as the training sample while 20 percent was the holdout sample to predict the target variable in the testing data.

To do this, the following steps were followed:

1) Randomly divided the sample into two sets with the training sample containing 80 percent of the cases and a holdout sample containing the remaining 20 percent. This was achieved by first setting the random seed number (2020 was used) followed by computing a variable that randomly split the data in two parts (of 80-20). The SPSS syntax below was run to accomplish this:

```
SET SEED=2020.
COMPUTE Split=uniform(1)<=0.8.
EXECUTE.
```

2) Derive a logistic regression model using the training sample. The variable 'Split' computed above was used as a selection variable in logistic regression so that only the 80 percent sample was used in running the model.

3) Compared the SPSS Output from the 80 percent model with that from a full dataset as shown below:

⇨ **Tests of Model Coefficients**

Table 42: Test of coefficients between full data and the training sample

Full dataset

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	206.199	23	.000
	Block	206.199	23	.000
	Model	206.199	23	.000

80 percent training sample

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	186.189	23	.000
	Block	186.189	23	.000
	Model	186.189	23	.000

Source: Zambia Demographic and Health Survey, 2013/14

Since in the relationship between independent variables and the dependent variable was statistically significant in the cross-validation analysis (χ^2 (19) = 170.518, p <.001), this supports the interpretation of the model using the full dataset.

⇨ **Relationship between independent variable and dependent variables**

Table 43: Comparisons of statistical significance level for variables between models with full data and the training sample

VARIABLE	**Significance (α=0.05)**	
	Full dataset	**80 percent training sample**
AGE	.006	.004
EDUCN	.273	.219
TCEB	.000	.000
BMI	.364	.563
FPUSE	.000	.000
MARITAL	.000	.000
STI_12MTH	.009	.005
AGE_@CHILD1	.005	.045

Source: Zambia Demographic and Health Survey, 2013/14

From the information presented in Table 43 and Table 44, the significance of the overall relationship and that of individual independent variables follow the same pattern in both the training sample and the full dataset. All variables that were significant at α=0.05 in the full dataset model were also statistically significant in the training sample.

⇨ **Classification Accuracy**

The criteria to support the classification accuracy of the model is an accuracy rate for the holdout sample that is no more than 10% lower than the accuracy rate of the training sample (University of Texas, undated) The accuracy rate of the training sample was 89.9 percent, making the requirement for the holdout sample of equal to 80.9% (0.90 X 89.9%). Since the classification accuracy for the holdout sample was 87.9, the analysis met this criterion and supported the decision to use a full dataset.

Table 44: Classification Tables[a] comparing the training and holdout samples

Observed			Predicted					
			Selected Cases[b]			Unselected Cases[c]		
			Pregnancy Loss		Percentage Correct	Pregnancy Loss		Percentage Correct
			No	Yes		No	Yes	
Step 1	Pregnancy Loss	No	1725	14	99.2	404	3	99.3
		Yes	182	14	7.1	53	2	3.6
	Overall Percentage				89.9			87.9

a. The cut value is .500

b. Selected cases Split 80-20 EQ 1; c. Unselected cases Split 80-20 NE 1

Source: Zambia Demographic and Health Survey, 2013/14

b) Ratio of cases to variables

The recommended minimum ratio of number of cases to the number of variables in a logistic regression model is 10 cases per variable (10:1) and a preferred ratio of 20:1 (University of Texas, undated)

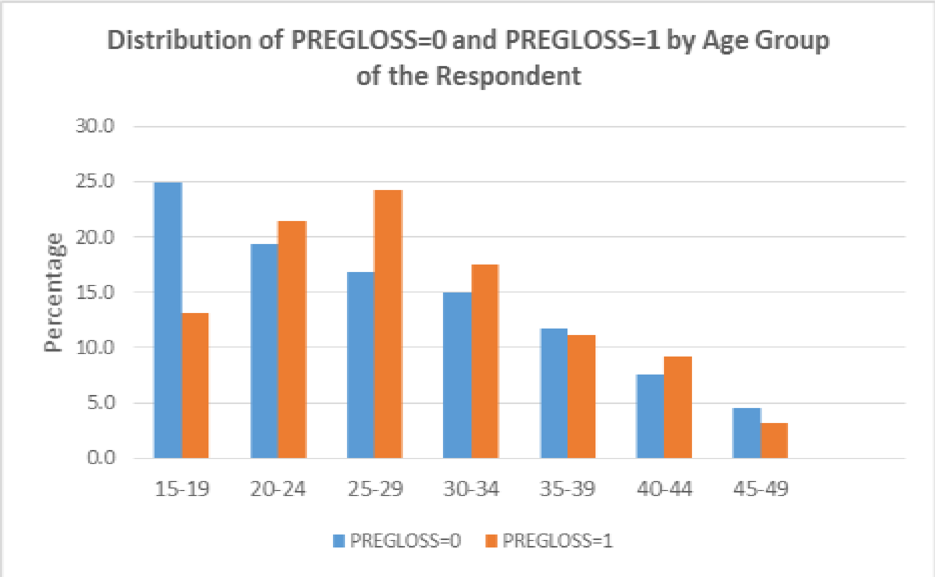
Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	2399	100.0
	Missing Cases	0	.0
	Total	2399	100.0
Unselected Cases		0	.0
Total		2399	100.0

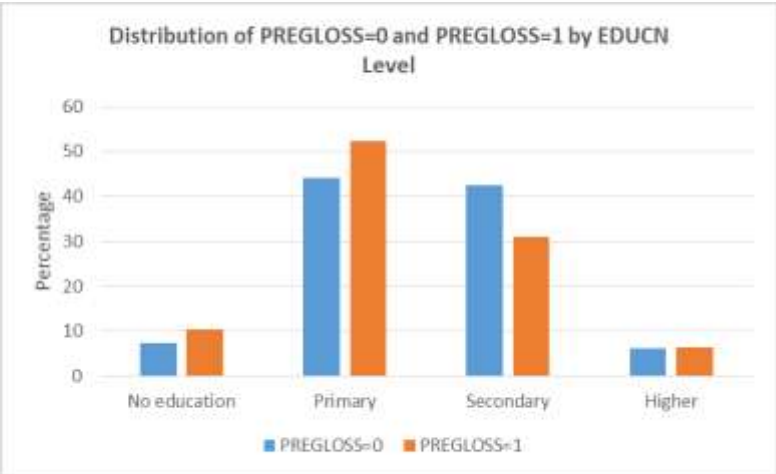
a. If weight is in effect, see classification table for the total number of cases.

From the case-processing summary produced with the logistic regression model, there were 2399 cases shown in the SPSS output above. The preliminary final model in Table 38, has 26 main effects variable. The ratio of cases to variable is 2399/31=77, thereby satisfying both the recommended minimum of 10:1 and the preferred ratio of 20:1.

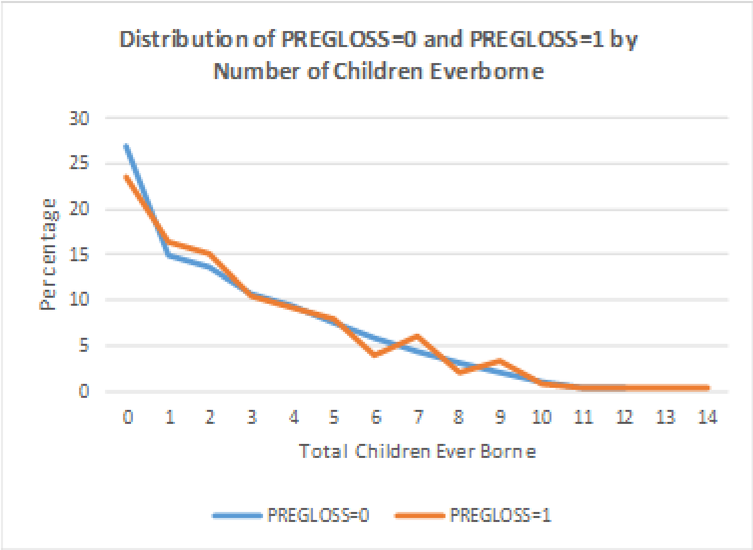
ANNEX 4: GRAPHIC TEST FOR COMPLETE SEPARATION



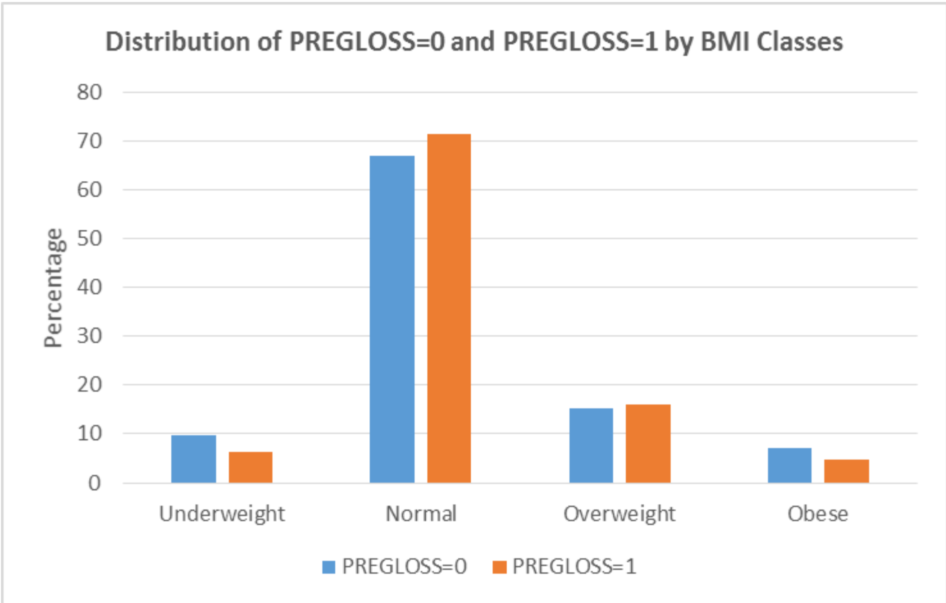
Data Source: The ZDHS 2013/14



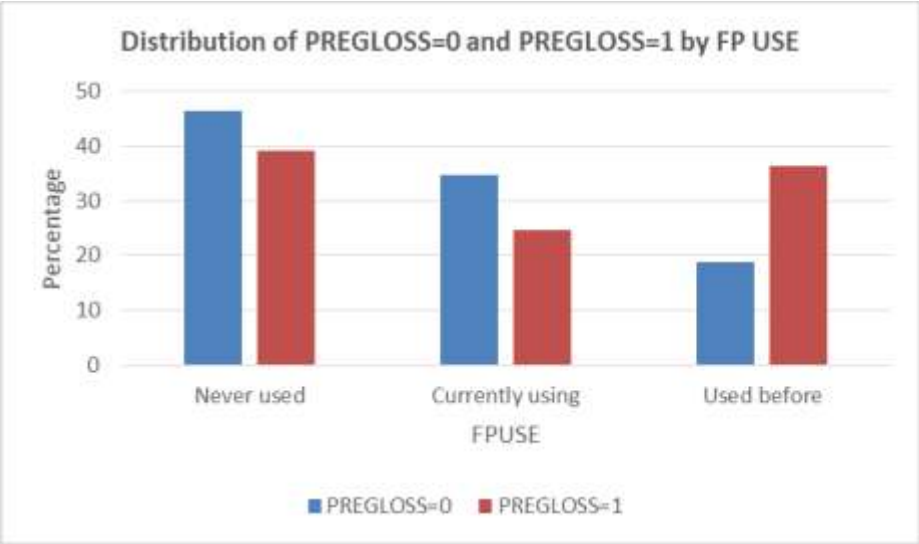
Data Source: The ZDHS 2013/14



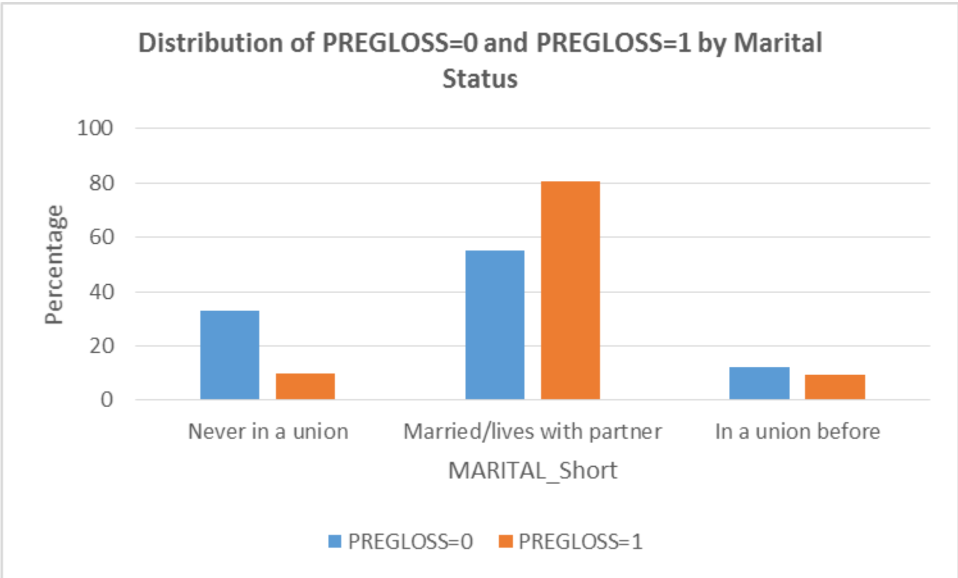
Data Source: The ZDHS 2013/14



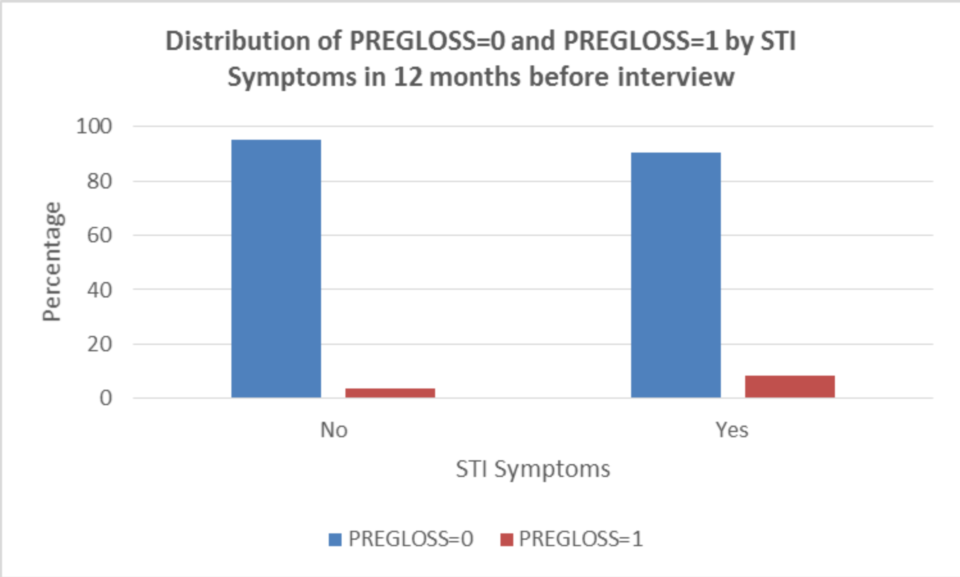
Data Source: The ZDHS 2013/14



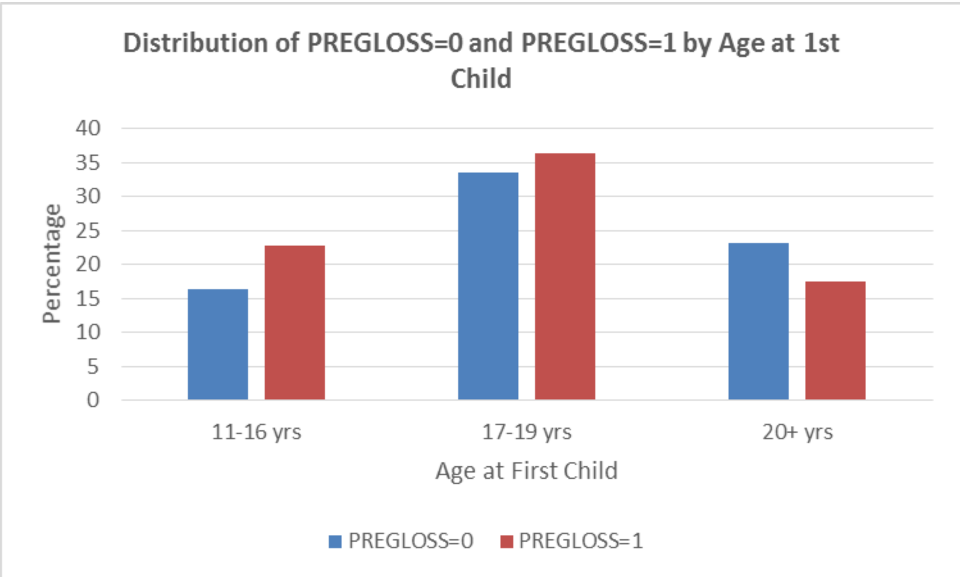
Data Source: The ZDHS 2013/14



Data Source: The ZDHS 2013/14



Data Source: The ZDHS 2013/14



Data Source: The ZDHS 2013/14