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THE IMPACT OF MATERNAL HIV STATUS ON MATERNAL AND CHILD MORTALITY IN LESOTHO

TS'EPANG SEOTLA (2015195973)

Supervisor:
DR MORNE SJOLANDER

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Department of Mathematical Statistics and Actuarial Science

Faculty of Natural and Agricultural Sciences

University of the Free State

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Declaration

"I, **Ts'epang Seotla**, declare that the Master's Degree research dissertation or interrelated, publishable manuscripts/published articles, or coursework Master's Degree mini-dissertation that I herewith submit for the Master's Degree qualification **M.Sc. (Statistics)** at the University of the Free State is my independent work, and that I have not previously submitted it for a qualification at another institution of higher education." I further declare that all sources cited or quoted are indicated and acknowledged by means of a comprehensive list of references. Copyright hereby cedes to the University of the Free State.

TS'EPANG SEOTLA

Name Surname

Acknowledgement

First, I would like to thank God for seeing me through and protecting me throughout my studies. Lord, You are righteous and may You continue to guide me...

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I SOLEMNLY WOULD LIKE TO THANK YOU ALL AND MAY THE LORD BLESS YOU

Abstract

In Lesotho and many other developing countries, statistics on maternal and child mortality, because of the HIV status of the mother, are increasing day by day, regardless of the efforts made by the authorities to reduce and control them. Because of the critical contribution mortality makes to the growth rates of a nation, it is important to understand its impacts on the population. This study seeks to contribute to such an understanding by providing an assessment of child and maternal mortality because of the HIV status of the mother in Lesotho. It utilised data from the 2014 Lesotho Demographic and Health Survey and the 2011 Lesotho Demographic Survey.

The study shows a slight increase in the number of child deaths, as well as the deaths of their mothers, because of HIV. This is due to the upsurge in the number of mother-to-child HIV transmissions, which have resulted from women refusing to test for HIV during pregnancy. The study also shows that women with higher education levels are infected more with HIV than those with no education; with women of a younger age dominating in this regard. Moreover, it indicates that maternal and child mortality, as a result of HIV, are mostly influenced by the age of the mother, her place of residence and her education attainment, although these are not the only contributing factors.

The study depicts that depending on the place of residence (urban or rural residence) of a woman in Lesotho, the chances of death, due to a positive HIV status in women living in the rural areas, are high. The results show no significant evidence to indicate that marital status affects child and maternal mortality, but they reflect that married and people living with partner are more at risk of HIV. When it comes to education attainment, **t**he research shows that **28.7% of** women with secondary education are at risk of dying because of HIV **status of the mother, and for those with no education, 18.6% are at risk of dying**. Moreover, it shows that women in the age groups 25-29 are more at risk of being affected by the mortality (child or maternal), as a result of their HIV status.

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Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
BOS	Bureau of Statistics
CHAL	Christian Health Association of Lesotho
CMH	Cochran Mental Haenszel
CMR	Child Mortality Ratio
COP	Lesotho Country Operational Plan
Df	Degrees of Freedom
EA	Enumeration Area
EGPAF	Elizabeth Glaser Paediatric AIDS Foundation
FNCO	Food and Nutrition Coordinating Office
GF	Global Fund
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
LDHS	Lesotho Demographic and Health Survey
LDS	Lesotho Demographic Survey
LFS	Labour Force Survey
LTR	Lifetime Risk
MDG	Millennium Development Goals
MMR	Maternal Mortality Ratio
MOH	Ministry of Health
MOHSW	Ministry of Health and Social Welfare
MUAC	Mid-Upper-Arm Circumference
OR	Odds Ratio
PEPFAR	United States President’s Emergency Plan for AIDS Relief
PHC	Population and Housing Census
PMTCT	Prevention of Mother-to-Child Treatment
RC	Reference Category
SADC	Southern African Development Community
SDG	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences

TB	Tuberculosis
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV and AIDS
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFPA	United Nations Population Fund
UNICEF	United Nations Children’s Fund
USAID	United States Agency for International Development
WHO	World Health Organisation

Chapter 1 - Introduction to the study

1.1 Introduction

In this chapter, we will introduce what the research study on the impact of maternal HIV status on maternal and child mortality will be based upon. The discussions focus on the subject area for the study, the background, the justification and the problem statement.

1.2 Subject Area

The subject area of this dissertation is health demography. The core aim of this study is to find if there is an association between maternal and child mortality, because of the Human Immunodeficiency Virus (HIV) status of the mother.

This introductory section summarises the existing and up-to-date understanding and background information about the topic. The section will provide the basic theories of the topic, such as maternal mortality, child mortality and the HIV status of the mother and explains the basics accompanied by each of the concepts provided.

1.3 Background to the study

In Lesotho, child and maternal mortality are the two measures that are mostly affected by the Human Immunodeficiency Virus (HIV) status of the mother. “HIV is a gradually replicating retrovirus that causes the Acquired Immunodeficiency Syndrome (AIDS)” (UNESCO, 2004). AIDS is an illness in humans whereby the immune system gradually fails, allowing life-threatening opportunistic contagions and cancers to flourish (UNESCO, 2004). AIDS is a global disease, which has a huge impact on society, both as an illness and as a cause for discrimination (UNESCO, 2004). It is vigorously spreading throughout the globe.

The AIDS pandemic is a reality that poses a great threat to the people of Lesotho, and should not be taken lightly considering the overwhelming effect that the spread of HIV infection has on the economic and social development of the country. “According to the Ministry of Health (MOH), efforts to avert and control the transmission of HIV contagion rely on informing people about how the virus is spread and what measures can be taken to prevent its spread”, said Majara Molupe in the informative newspaper (Molupe, 2013). One of the ways in which it is transmitted is through mother-to-child, thus, it is important to study its impacts on maternal and child mortality.

1.3.1 Child Mortality

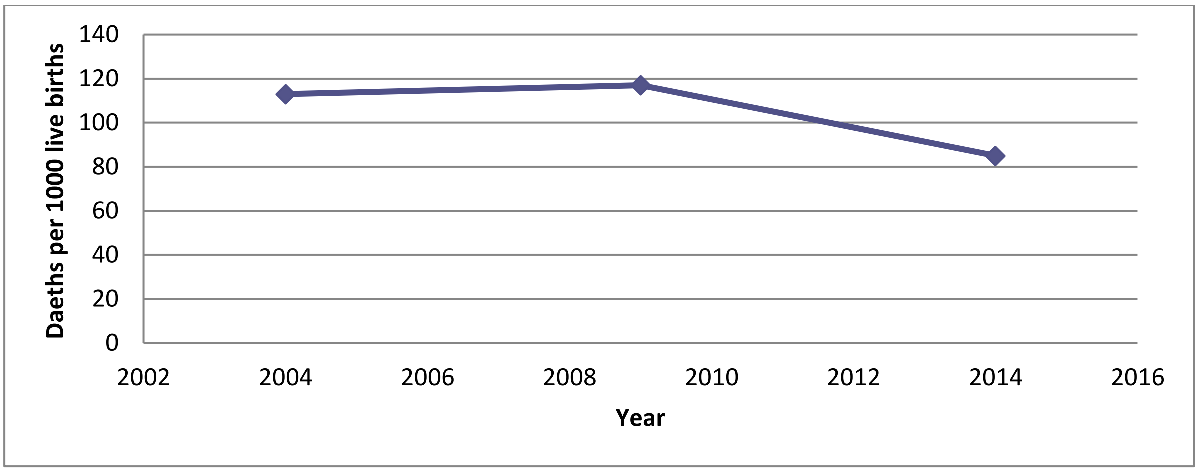
Child mortality, a primary indicator of child health and the overall improvement of any country is inflated by the HIV status of the mother. “Child mortality is the death of infants and children under the age of five” (World Health Organisation, 2018), and it continues to be extremely high in developing countries. This research study looks at it from the perspective of the death of infants and children under the age of five because of the HIV status of the mother.

Taking Lesotho for instance, the child mortality ratio (CMR) was estimated to be 111 deaths per 1000 live births in 2000, and it amplified to 117 deaths per 1000 live births, as per the 2009 Lesotho Demographic and Health Survey (LDHS) in 2009 (Lesotho Government and ORC Macro, 2010). The child mortality rate later decreased to 85 deaths per 1000 live births, which translates into one in every 12 children dying before they reach their fifth birthday. One of the major motives for this increase is the transmission of HIV and AIDS from the mother to the child, which is estimated at 26 percent, and is said to still be increasing thus contributing to an increasing share of mortality (Lesotho Government and ORC Macro, 2010). The child mortality rate is thus calculated as follows:

$$CMR = \frac{\text{Numbers of child deaths}}{\text{Number of live births}} \times 1000 \qquad 1.1$$

The child mortality ratio should have decreased by two-thirds in 2015 according to the Millennium Development Goal (MDG) which states, “Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate” (World Health Organization, 2010). The ratio actually decreased by about three-quarters, which was a great achievement for the country. The ratio was 117 deaths per 1000 live births in 2009 and was reduced to 85 deaths per 1000 live births in 2014 as conveyed in the LDHS 2014 (Lesotho Government and ORC Macro, 2015). The trends of child mortality are given in Figure 1.1.

Figure 1.1: Child Mortality Trends



1.3.2 Maternal Mortality

"The World Health Organisation defines maternal mortality as the death of a woman while pregnant or within 42 days of the termination of pregnancy irrespective of the duration and site of pregnancy, from any cause related to, or aggravated by the pregnancy or its management, but not from accidental or incidental causes" (World Health Organisation, 2018). This research will concentrate on maternal mortality in the case where such a death is only while the individual is pregnant and only due to her HIV status.

Lesotho's Maternal Mortality Ratios (MMR) are among the highest in the Southern African Development Community (SADC) region, with an estimate of 1155 deaths per 100 000 live births in 2009 (Lesotho Government and ORC Macro, 2010). The 2006 population census estimated the maternal mortality to be 939 deaths per 100 000 live births, and the 2011 LDHS estimated it to be 1143 deaths per 100 000 births, for which HIV and AIDS constituted 10 percent and 27.5 percent of the deaths for census and LDS respectively (MOHSW, 2012). The maternal mortality ratio is then calculated as follows:

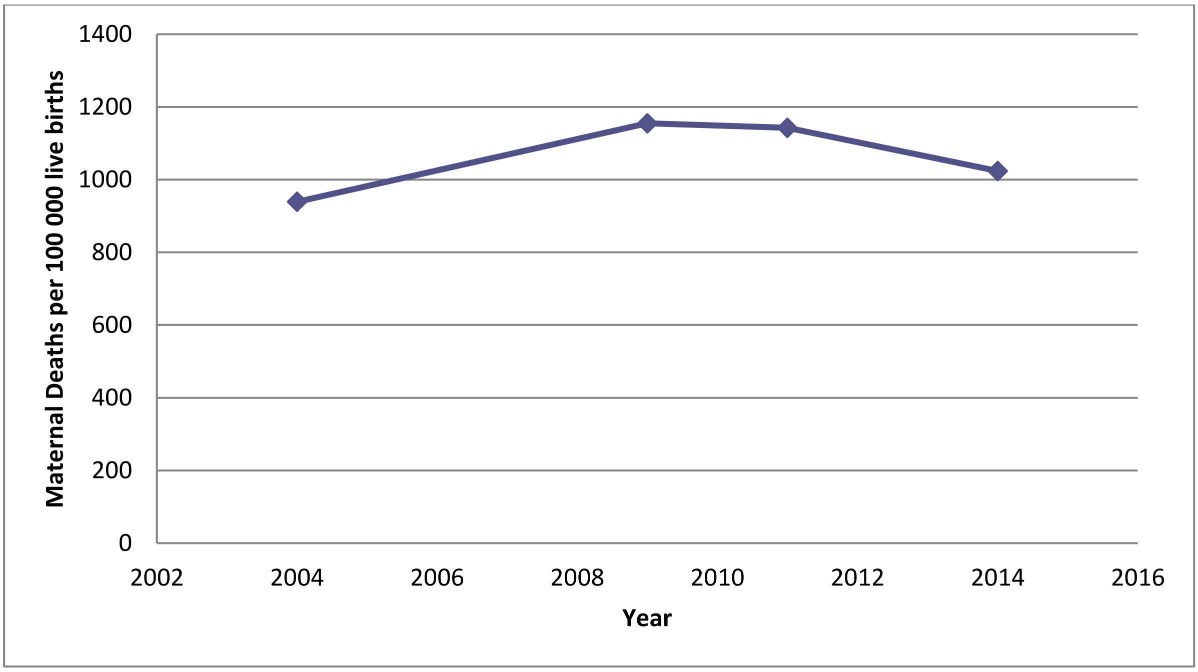
$$MMR = \frac{\text{Number of maternal deaths}}{\text{Number of live births}} \times 100\ 000 \qquad 1.2$$

and the maternal mortality rate is then calculated thus:

$$\frac{\text{Number of maternal deaths}}{\text{Number of women of reproductive ages}} \times 100\ 000 \qquad 1.3$$

Recent estimates, that is, LDHS 2014 estimates, indicate that maternal mortality ratio does not vary significantly from the one conveyed in the 2009 LDHS (Lesotho Government and ORC Macro, 2010). The maternal mortality ratio in 2014 was 1024 maternal deaths per 100 000 live births, while it was 1155 maternal deaths per 100 000 live births in 2009 (Lesotho Government and ORC Macro, 2010, 2015). We summarise these statistics in Figure 1.2. According to the Millennium Development Goal (MDG) five, maternal mortality should have decreased by three-quarters in 2015 (World Health Organization, 2010). However, based on the high levels of maternal mortality seen in Lesotho, the goal was not achieved.

Figure 1.2: Maternal Mortality Trends



Despite not meeting MDG five, Lesotho is still committed to reducing maternal mortality, further reducing child mortality, HIV and AIDS, as well as new HIV contagions as per the Sustainable Development Goal (SDG) number three which states “Ensure healthy lives and promote well-being for all at all ages”.

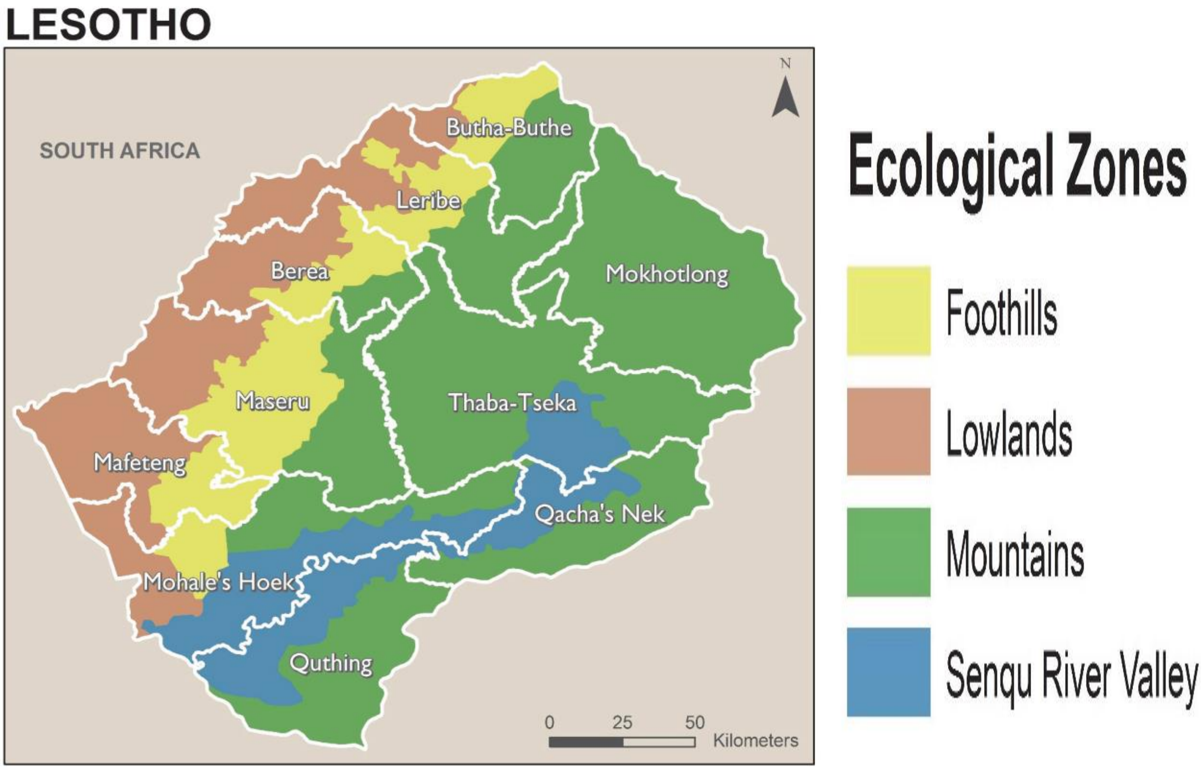
Quantifying maternal deaths comprises of determining the causes of that specific death. According to WHO, maternal deaths are divided into direct and indirect obstetric deaths. “The key specific causes for direct obstetric deaths are haemorrhage, obstructed labour, eclampsia, sepsis and consequences of abortion, while the indirect obstetric deaths are pregnancy-related deaths among women with a pre-existing or newly developed health problem exacerbated by the pregnancy or delivery" (World Health Organisation, 2018).

1.4 Features of the Country

Lesotho, officially known as the Kingdom of Lesotho, is an independent, landlocked country in Southern Africa with a population of about 1 916 573 in 2014 (Matsoso, 2015). Geographically, the ruggedly scenic Kingdom of Lesotho is completely surrounded by its only neighbouring country, South Africa, and economically integrated with it as well. The province of Kwazulu Natal bounds it to the east, the Eastern Cape to the south and the Free State to the north and west (Morgan-Jarvis, 2008). It is just over 30 000 km^2 in size and is inhabited by a complex ethnic group speaking a common language, Sesotho.

The country is divided into 10 administrative districts and has less than 10 percent arable land (Lesotho Government and ORC Macro, 2010). It is further divided into two residential areas namely: urban and rural, and is further subdivided into four ecological zones namely: the Lowlands, Foothills, Senqu River Valley and the Mountains (ibid), as seen in Figure 1.3. According to Morgan-Jarvis (2008), this mountainous country has an average altitude of more than 1600 metres above sea level, with the highlands covering around 65 percent of the land area at elevations ranging between 2300 and 3482 metres (Morgan-Jarvis, 2008). From the lowland districts to the highland districts, Lesotho is the only autonomous state in the world that lies completely above 1000 metres above sea level (ibid).

Figure 1.3: Geographical Map of Lesotho



(Mekbib, Olaleye, Mokhothu, Johane, Tilai, & Wondimu, 2012)

Lesotho has two major rivers namely, the Senqu (Orange) and the Tugela. These rivers have their basis in the Malotis, as do the tributaries of the Mohokare (Caldon) river, which forms Lesotho's western border. Morgan-Jarvis, 2008 states that, "The western quarter of the country comprises the lowlands with the lowest point being the junction of the Senqu and Makhaleng rivers at 1380 metres" (Morgan-Jarvis, 2008). He asserts that this is the highest lowest point of the country; that is, it is the lowest point in the country but the highest as compared to other Southern African countries.

According to the Labour Force Survey (LFS), which took place in 2008, Lesotho is mainly rural with over 80 percent of its inhabitant population surviving through subsistence farming (Bureau of Statistics, 2009). Roughly 20 percent of the formal labour work in South Africa, and 20 percent are in the textile industry in Lesotho. Concerning education, Lesotho is an exception to most African countries in the sense that it has high literacy levels, 89.6 percent, compared to 63 percent in the rest of sub-Saharan Africa and 86.4 percent in South Africa; the latter considered the most developed country on the continent (UNDP, 2011).

The mountain kingdom’s many territories have a high degree of indigenous and endemic plants; and various animal species, as well as a noteworthy premitive and cultural heritage (Morgan-Javis, 2008). The climate is continental, that is, there are substantial annual disparities in temperature due to the lack of large water bodies in the area. Owing to its altitude, the country is cooler than most areas at similar latitudes. Its temperature disparities may be extreme subject to the season of the year (ibid).

1.5 Justification

“The HIV/AIDS pandemic in Lesotho continues to have a negative effect on life expectancy and has reduced productivity, worsened household poverty, broken down family structures, and increased the number of orphans and child-headed households” (Lesotho Government and ORC Macro, 2010). The continuous increase in maternal and child mortality as a result of HIV and AIDS causes a big problem to the country, particularly its economy.

Poor economic growth results in poor development and the recognition of this by more developed countries. Thus, it is important to study what impacts maternal HIV status have on maternal mortality and child mortality. This will enhance and enable proper measures to be taken to decrease the rate of new contagions and ensure that people are fully aware of the consequences brought about by these effects.

Maternal mortality ratio (MMR) was found to be 419 per 100 000 live births (LDS, 2002), which increased to 1143 per 100 000 live births in 2011 (LDS, 2013), using the sisterhood method of maternal mortality estimation. “This method requires data on how many sisters of the respondent survived to the age of 15, how many of them died thereafter, and whether sisters who died did so during pregnancy or within 6 to 8 weeks of the end of a pregnancy” (Graham, Brass & Snow, 1989). The sisterhood method will be discussed in detail in chapter two. The data on which the estimates were based were the lifetime risk of death from maternal-related causes, and the estimates referred to a period of about 12-13 years before the survey, as data on sisters who survived are scarce.

The lifetime risk (LTR) is usually executed as the risk of death due to a maternal cause. LTR normally begins from age 15 onwards (Wilmoth, 2009). According to Wilmoth (2009), LFR is calculated per 1000 women reaching age 15, and it is as follows:

$$LTR = \frac{T_{15} - T_{50}}{l_{15}} \times MMR$$

where T_{15} and T_{50} refer to the person-years lived that are above ages 15 and 50 respectively, and l_{15} is the survivors who reach age 15, in an appropriate life-table for the population in question (Wilmoth, 2009).

The MMR for the 7-years period before the survey, during the 2014 LDHS, was found to be 1024 maternal deaths per 100 000 live births, which is not significantly different from the one conveyed in the 2009 LDHS (1243 deaths per 100 000 live births) (Lesotho Government and ORC Macro, 2010). The current levels of fertility and mortality designate that out of 32 pregnant women, one will die from pregnancy or childbearing. The estimated maternal mortality ratio was very high, and higher than that of many countries in the sub-region.

Although the MMR appears to be low in the 2001 census as compared to the 2006, the outcomes from the three Lesotho Demographic and Health Surveys of 2004, 2009 and 2014 (Lesotho Government and ORC Macro, 2005, 2010, 2015), show that when compared to the international standards of 402 deaths per 100 000 live births, the ratio is very high (Bureau of Statistics, 2018). A steady increase has been observed since 2004, with a slight decrease in 2014. Although the MMR is still very high, it seems to be stabilising.

The increase in the MMR observed is believed to have resulted from the increased HIV prevalence among young people in Lesotho, and women of reproductive age. Thus, further research should be done as to whether the HIV status of a woman has a significant impact on maternal and child mortality.

1.6 Problem Statement

The population growth rate of Lesotho is already diminishing at a high rate (1.5% in 2006 to 0.3% in 2016) (Bureau of Statistics, 2018); that is, Lesotho is already experiencing drastic declines in the growth of population. With the country moving towards a slow growing population, what more will happen if child mortality due to mother-to-child HIV transmission continues to increase? This study aims at determining the impact of maternal HIV status on maternal and child mortality. Therefore, these questions are of great importance to the study:

(a) Is there any association between maternal HIV status, maternal mortality and child mortality?
(b) Are the maternal and child mortality rates that are prevalent in Lesotho a result of maternal HIV status?
(c) Is there an association between maternal HIV status and education attainment?
(d) Does place of residence affect maternal and child mortality, as a result of maternal HIV status?
(e) Does age have any impact on maternal and child mortality, as a result of maternal HIV status?

If there is a high positive association between HIV status of the mother, maternal and child mortality, then there is a significant crisis in Lesotho, which could lead to more deaths because of HIV. In addition, it may imply a risk of new infections in the form of mother-to-child transmissions, which will eventually lead to increased levels of child mortality. Thus, it is imperative to study the effects of maternal HIV status on maternal and child mortality.

In addition, it will be of great interest to know how education attainment, age, marital status and place of residence affect maternal mortality, because of maternal HIV status. Knowledge of this information could help dispel many myths about HIV. These myths include that people with a higher level of education are at a much lower risk of getting HIV; marriage or living with a partner makes people safer from getting HIV; and that the place of residence can shield one from getting HIV. Through this study, these myths will be dispelled, and the truth about HIV will be exposed. The use of hypothesis testing and regression analysis will help us to prove what is factually correct about HIV.

1.7 Objectives of the study

The main objective of the research is to study how maternal HIV status affects child and maternal mortality.

Specific objectives

(a) To study how age patterns affect maternal and child mortality, due to maternal HIV status.

(b) To study if education attainment has any impact on maternal HIV status.

(c) To study the impact that the place of residence may have on the maternal and child mortality rates.

(d) To study if there is any association between marital status, and maternal and child mortality, due to maternal HIV status.

Hypothesis

The hypothesis of the research consists of the null (H_0) and alternative (H_1) hypothesis, and in this study, the hypotheses are:

H_0: There is no association between maternal HIV status and maternal mortality.

H_0: There is no association between maternal HIV status and child mortality.

H_0: the sample data are consistent with the distribution of the population (for various variables)

H_0: blood test result is dependent on various variables of interest

And the alternative hypotheses are:

H_1: There is an association between maternal HIV status and maternal mortality.

H_1: There is an association between maternal HIV status and child mortality.

H_1: the sample data are not consistent with the distribution of the population (for various variables)

H_1: blood test result is independent of various variables of interest

1.8 Conclusion

The introductory part of this research provided the fundamental concepts of the topic of interest, and includes the following:

(a) What the research will cover:

The research will cover many aspect of maternal and child mortality, as a result of maternal HIV status. The study will look at the descriptive statistics and inferential statistical investigation of the data in order to derive the results. These results will be used to draw valuable conclusions.

(b) The scope and area of interest of the research:

The research is based in Lesotho, and analyses how maternal HIV status impacts on maternal and child mortality. It tries to establish whether there is an association between various variables of interest and maternal and child mortality. The study will be looking at the impact that various variables, such as age, education attainment, marital status, and place of residence, have on maternal and child mortality due to maternal HIV status. The study will attempt to find out if there is any relationship, be it positive or negative, between these variables, and how this relationship relates to maternal and child mortality due to maternal HIV status.

(c) How the research topic relates to the subject area:

The topic of the study relates to the subject area of the research, in that the topic falls within health demography, which is the subject area of this research study.

Therefore, the subsequent chapter will deliberate on the literature related to this research topic.

Chapter 2 - Literature Study

2.1 Introduction

In the first chapter, we looked at the subject area for the study, the background, the justification and problem statement of the research. In this chapter, we will review the literature behind the study from different countries within the same area of research. There have been notable changes in mortality among women and children because of maternal HIV status across different societies and in most parts of the world. The literature in this chapter shows that many factors are shaping these changes in mortality and significant impacts are observed because of these factors. HIV and AIDS is a global issue, which has to be viewed with great care and concern, so as to attempt to reduce its increasingly high prevalence globally.

2.2 HIV/AIDS in Lesotho

The Elizabeth Glaser Pediatric AIDS Foundation (EGPAF) began to work towards elimination of the HIV and AIDS epidemic, in partnership with Lesotho's Ministry of Health, in 2004. EGPAF strives to end paediatric HIV and AIDS and improve maternal, neonatal and child health (MNCH). This they plan to do through the implementation of HIV/AIDS prevention, care and treatment programmes, advocacy, and research (Tiam et al., 2012).

According to EGPAF, "HIV and AIDS is Lesotho's leading cause of death and almost a quarter of the population is living with this disease". Lesotho also suffers from a high prevalence of tuberculosis (TB). TB is a treacherous opportunistic contagion for the many infected with HIV and is the second leading cause of death (TB/HIV co-infection stands at about 74%). The HIV/AIDS epidemic disproportionally affects women, with a prevalence that exceeds that of men in almost every age group under 40 years (Tiam et al., 2012). The country profile depicted by EGPAF as at 2014 looks as thus:

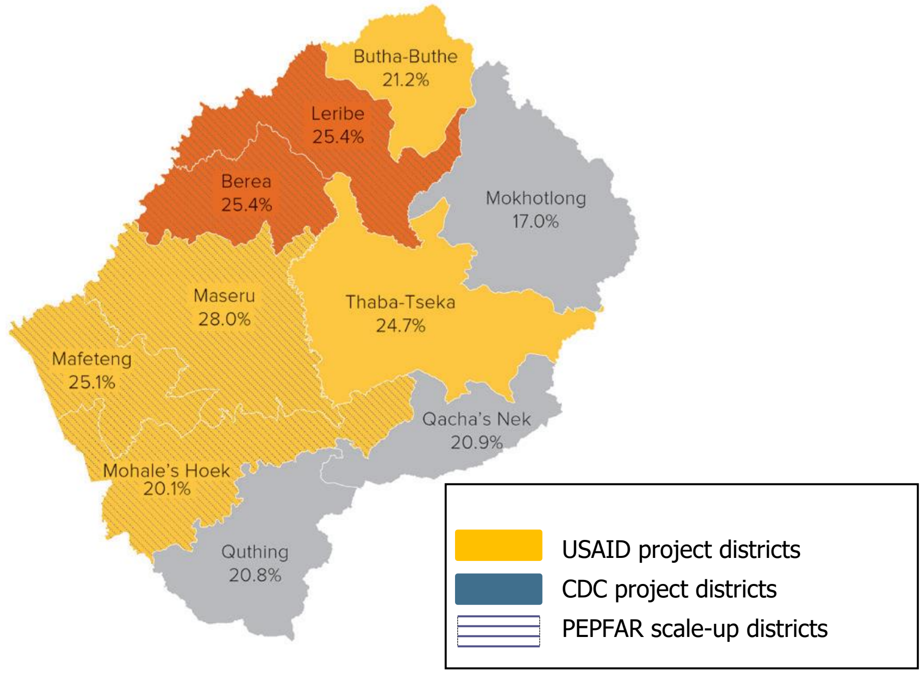
Table 2.1 Country Profile

Population	1 876 633
Number of people living with HIV	310 000
Adult (15-49 years of age) HIV prevalence rate	24.6%
Women 15 years and older living with HIV	170 000
Children (0-14 years of age) living with HIV	13 000
AIDS-related deaths in 2014	9 900
Prevalence of TB/HIV co-infection	74%
Number of women diagnosed with cervical cancer	66.7 per 100 000

(Tiam et al., 2012)

Through guidance from the Lesotho Government and funding from the U.S. President's Emergency Plan for AIDS Relief (PEPFAR), Lesotho has since significantly scaled up access to HIV services – the combined comprehensive HIV/AIDS services. EGPAF has used a district-oriented method to deliver the comprehensive HIV services and provide technical support to the Ministry of Health. EGPAF presently supports implementation of the comprehensive HIV package of services in more than 120 sites, in five districts. It advocates for informed health policies at the national level; and it conducts research and studies to inform improved and better-quality HIV/AIDS programming (Tiam et al., 2012). Its geographic coverage looks as follows:

Figure 2.1: EGPAF-Lesotho Program Geographic Coverage



(Lesotho Government and ORC Macro, 2015).

Lesotho has an HIV incidence rate of 1.5% and the prevalence of 25.6 percent among adults aged 15-59 years. This indicates that the country faces a high disease burden for HIV. There has been significant improvements in the handling of the epidemic, with the Government of Lesotho (GOL) implementing the UNAIDS 90-90-90 goals. These goals relate to the targets set by UNAIDS, to end the AIDs epidemic by the year 2020.

The first 90 states that by the end of 2020, 90% of people living with HIV are diagnosed. The second 90 relates to 90% of diagnosed people being on treatment, while the last 90 relates to 90% of people on treatment being virally suppressed. In Lesotho, 77 percent of Basotho living with HIV have been diagnosed; of those diagnosed, 90 percent are on treatment; and of those on treatment, 88 percent have their viral load suppressed. Lesotho, among other things, remains a high burden TB/HIV country. “Including the HIV/TB co-infection, it has an estimated TB incidence of about 724 per 100,000 population (16,000 incident TB cases, out of which 12,000 estimated to be TB and HIV co-infected)” (PEPFAR, 2018).

According to the 2012 Global AIDS Response Country Progress Report, the multi-sectoral response has improved in terms of its scale and complexity, with evidence in the form of strategic information. Lesotho's capacity to provide information has reached significant milestones, with the 2009 introduction of the new data collection and analysis framework called the Lesotho Output Monitoring System for HIV and AIDS (LOMSHA) (MOHSW, 2012).

Lesotho has one of the highest HIV prevalence rates in the world (25.6 percent); the prevalence among females is significantly higher than among males (30.4 percent and 20.8 percent respectively) (Mekbib, *et al.*, 2012), with women of childbearing age comprising 58 percent of the HIV positive population (Lule, *et al.*, 2009). According to the Annual Joint Review Report for 2010, only 71 percent of pregnant HIV-positive women receive antiretroviral drugs that reduce mother-to-child transmission. This is not enough, since the remaining 29 percent is still too much to be ignored.

In Lesotho, knowledge among women (aged 15-49 years), that HIV can be transmitted from mother to child through breast milk, and that the probability of transmitting HIV to a child can be abridged by drugs, increased remarkably from 42 percent in 2004 to 71 percent in 2008 (WHO, 2010). This has reduced the likelihood of children being infected by HIV by more than 50 percent (Bureau of Statistics, 2002). The majority of adults believe that 12–14 years old children should be educated about condom use (68 percent of adult women and 62 percent of adult men) in order to reduce the number of new infections.

The knowledge-behaviour gap concerning condom use, for HIV prevention among the population is a large. While the majority of young women are conscious that using a condom in every intercourse encounter helps prevent HIV, only 22 percent testified to having used a condom at their last intercourse encounter. This gap broadens among the older aged women, possibly because of the fact that the odds of using a condoms as a form of contraception reduce with marriage. However, this increases the chances of both men and women getting the HIV virus and thus transmitting it to their unborn children, thereby putting everybody in danger of contracting the virus.

2.3 HIV/AIDS in South Africa

South Africa has been overwhelmed by the AIDS epidemic from the time when the new democracy was establishment in 1994. The overwhelming increase in HIV and AIDS continues to inflict chaos throughout the country. “It was estimated that in 1999, about 250 000 South Africans lost their lives to AIDS. The total number of adults infected with HIV was estimated to be about 4.1 million, of which infected women were well over 50 percent” (UNAIDS, 2006). The 2006 AIDS epidemic update indicated an increase in the number of pregnant women living with HIV from 22.4 percent in 1999 to 30.2 percent in 2005 (a 35% increase) (UNAIDS, 2006).

Since 1998, comprehensive data on maternal deaths in South Africa have been available in the form of Confidential Enquiries reports (Moran & Moodley, 2012). The latest report (Saving Mothers Report, 2005-2007), suggested that the maternal mortality ratio in HIV-infected women was about 10 times higher than in uninfected women. This was in the context where only a minority of HIV-positive pregnant women was receiving the Highly Active Antiretroviral Therapy (HAART) (Moran & Moodley, 2012).

Moran and Moodley (2012) continues to assert that when it comes to the maternal deaths among HIV-positive women, the most common causes of death were found to be the non-pregnancy-related infections, including pneumonia, AIDS, meningitis, and tuberculosis. Moodley further explained that the HIV-infected pregnant women were also at great risk of dying from pregnancy-related sepsis and complications of abortion, than their uninfected counterparts. The decrease of HIV-related maternal deaths must be seen as a worldwide priority in maternal health care (Moran & Moodley, 2012).

Moreover, in South Africa, an estimation of about 70.4 percent of maternal deaths that were recorded were connected with HIV infection, as were half of all deaths of children younger than five years in the year 2011. Consequently, the achievement of prevention programmes for the mother-to-child transmissions (PMTCT) of HIV was critical for decreasing maternal and child mortality rates, as well as morbidity. However, Irin news (The New Humanitarian, 2012), indicated that there has been a charted significance in the reduction of mother-to-child HIV transmissions in South Africa for two consecutive years since 2011. New data shows that just 2.7 percent of babies born to HIV positive mothers contacted the virus by at least six weeks of age, in comparison to eight percent in 2008.

They also attested to the fact that this decrease was a result of the PMTCT programmes, which were extensively improved. “Without treatment, up to 40 percent of babies born to HIV positive women could become infected with the virus during pregnancy and delivery, but the risk drops by five percent when the women have access to the PMTCT services”, said Irin News (The New Humanitarian, 2012) in their column about PMTCT. According to the Washington DC Post, researchers estimated that about 120 000 HIV infections in infant were averted because of the expanded endowment of PMTCT services (Lule, Seifman & David, 2009). “The then South Africa’s Health Minister, Dr Aaron Motsoaledi, believed that if this successes could be sustained, it would help curb the high infant mortality rates powered by mother-to- child HIV transmissions- 42 out of every 1000 babies born, die before the age of one in South Africa because of HIV” (The New Humanitarian, 2012).

2.4 HIV/AIDS in other countries

2.4.1 Swaziland

“In Swaziland, like in most of sub-Saharan Africa, the national HIV prevalence approximations were derived primarily from a sentinel surveillance of pregnant women. In a number of settings, the rate of HIV infection in pregnant women has been shown to be a reasonable proxy for the level of HIV in the combined male and female adult population” (UNAIDS, 2006). However, UNAIDS explained that there are several well-recognised boundaries in estimating the HIV prevalence rate in the general adult population from the data derived exclusively from pregnant women that attend selected antenatal clinics.

According to the Central Statistics Office and Macro International Inc (2008), about 24 percent of women and 36 percent of men in Swaziland are not aware of the transmission of HIV by breastfeeding; that is, mother-to-child transmission, and that it can be abridged by taking special drugs during pregnancy. In order to reduce the mother-to-child transmissions (MTCT) of HIV, it is imperative that the level of knowledge about the transmission of HIV from mother to child is increased. It is also of great importance that the level of knowledge among populations, that the use of antiretroviral drugs throughout pregnancy can reduce the risk of transmission of HIV from mother to child is increased (ibid).

Swaziland having the highest prevalence in the world as it is, lack of knowledge and awareness about the mother to child HIV transmissions puts the country at risk of having a huge number of new infections, thus increasing the prevalence level. Swaziland has a high proportion of people aged 15-49 who lack correct knowledge about the ways in which HIV can and cannot be transmitted. In addition, according to this LDHS, the stigma and discrimination associated with HIV in populations can unfavourably affect both people's willingness to be tested for HIV and their willingness to adhere to antiretroviral therapy (ART).

2.4.2 Cambodia

Cambodia, with a population of about 11 million people, has a HIV prevalence rate that is among the highest in Asia, but is decreasing (UNAIDS, 2012). "'According to scientific estimation 2013, the HIV carrier rate among adults aged between 15 and 49 years is 0.7 percent, down further from 0.8 percent in 2011, and 2.5 percent in 1998,' Ieng Mouly, the chairman of the National AIDS Authority, said during the celebration of the 25th World AIDS Day" (UNAIDS, 2012).

An estimate of about 170 000 adults and 4600 children were HIV positive in 1999 and approximately a third of the infected people were females. Nevertheless, according to the 2006 AIDS epidemic update, women covered almost half (47%) of the people living with HIV in Cambodia, with at least 30 percent mother-to-child transmissions. Recently, Cambodia has an estimate of 71 347 people living with HIV/AIDS, inclusive of 38 420 females and 6850 children (UNAIDS, 2010).

According to Marie-Odile Emond, the UNAIDS country coordinator for Cambodia, there is still a high number of people living with HIV but she believes that the country will reach the three zeros which are, zero stigma and discrimination; zero new HIV infections; and zero AIDS- related deaths. According to the Cambodia DHS 2010, only 56 percent of women had comprehensive knowledge of the mother-to-child HIV transmissions, revealing a critical gap in access to lifesaving information (UNAIDS, 2010).

That lack of information increases the odds for mothers to inadvertently transmit the HIV virus to their babies. Limited access to services and the low quality of health services mean that many expectant mothers do not receive the support they need to break the chain of HIV transfer within families. This poses a threat to the country, since the new infections and the mother-to-child transmissions are said to be increasing at a very high rate, thus leading to high infant mortality rates (UNAIDS, 2010).

2.4.3 Kenya

HIV prevalence among pregnant women in Kenya dropped from a peak of 13.4 percent in 2001 to 6.7 percent in 2004. An analysis of behaviour change was done in the 1998 and 2003 (Lule, *et al.*, 2009). Kenya DHS, in this regard, showed that partner reduction among adults played a major role in the decline. It was supported by delayed sexual inception among youth and increased condom use. Although this was the case, Clark (2004) documented an amplified risk of HIV infection among young married females and this increases the mortality among young women.

Clark reported that 30 percent of male spouses of young wives are HIV positive in Kenya, thus increasing the risk of women getting new infections. She also showed that the HIV prevalence rate is considerably higher among the married women than it is among unmarried women. She finds that being matrimonial advances the risk of being HIV positive by 75 percent among sexually active women and this significantly impacts on the mortality of women and their unborn children (Clark, 2004).

2.5 HIV/AIDS in Africa as a whole

In Africa as a whole, child survival is subjective to the HIV endemic through several mechanisms. According to Newell, *et al.*, 2007, the mother-to-child transmissions of HIV in Africa range between 15 to 45%, with up to 15 to 20% consequential of breastfeeding. Newell, *et al.*, 2007, in their recent community-based study in Rakai, Uganda, said that, "the mortality rates among HIV infected children, HIV negative children born of HIV positive mothers, and HIV negative children born of HIV negative mothers were 547 166 and 128 per thousand respectively" (Newell, *et al.*, 2007).

According to these child mortality approximations from community-based cohorts, the children that were born of mothers infected with HIV have higher mortality rates than those born of uninfected mothers. This indicates that child mortality is closely connected to maternal health status. Throughout the 1990s, models that utilise HIV surveillance data, together with a set of expectations, specified that child mortality triggered by HIV and AIDS will increase to reach close to 10% by 2002 (ibid).

2.6 Sisterhood method

The dataset that will be used in the study is the secondary dataset from the Lesotho Demographic Health Survey (LDHS) and the Lesotho Demographic survey (LDS). These two surveys exploited the sisterhood method for the collection of data on maternal mortality. "The sisterhood method is an indirect measurement technique that is frequently used for a variety of demographic parameters and has been adapted to maternal mortality" (Graham, *et al.*, 1989). In developing countries, where maternal deaths are habitually registered poorly, this method is usually used to estimate maternal mortality. The method has been used magnificently in many community-based household surveys. "It decreases the sample size requirements because it attains evidence by interviewing respondents about the survival of all their adult sisters" (Graham, *et al.*, 1989).

Graham, *et al.* (1989) were the first to propose the use of sibling survival information to approximate maternal mortality. They suggested using a sibling history summary. Such a summary of historical data gathers evidence on the collective number of siblings that the respondent has by sex. It gathers evidence on the number of siblings who have survived to the age of 15 (or first marriage), and it also gathers evidence for sisters who have died after age 15 irrespective of whether they were pregnant, in childbirth, or in the 42 days post-partum when they died (Graham, *et al.*, 1989).

This method of collecting information is not recommended for use but it is the best method to use when only sibling history is available. The most important advantages of the sisterhood method take account of the fact that it uses minimal data requirements (four questions). It is simple to analyse and it has lower sample size requirements, in relation to other approximation procedures. “The age difference between the sisters of a respondent can vary from the respondent herself by about 30 years, with the outcome that the death of sisters can be spread over a very long period preceding to the survey” (Graham, *et al.*, 1989).

The reference dates of maternal mortality estimations resulting from this method (summary sibling histories) are traced, on average about 12 years before the survey, making them (reference dates) of limited practical value. This method is used in the LDHS to collect data related to maternal mortality and maternal health.

2.7 Conclusion

The aim of the above discussion was to aid the reader in understanding the diverse aspects modelled by the study on the impact of maternal HIV status on maternal and child mortality. The literature demonstrates that this study is significant because it is clear that the HIV status of the mother has a huge impact on the well-being of both the child and the mother, and their risk of death. In addition, it shows that the sisterhood method of analysing maternal mortality can best be used for the analysis of the data concerning maternal mortality, since the data are often poorly registered in official statistics.

Nevertheless, the analysis is not simply limited to the sisterhood method but rather, on a diverse number of analyses especially when the data are available. Thus, the subsequent chapter deliberates on the methodology and techniques used in the research.

Chapter 3 - Methodology

3.1 Introduction

The preceding chapter dealt with the literature from other studies in different countries, on how the HIV status of the mother has affected their population growth and mortality indices. This chapter summarises the methodology used in this study. It provides the contextual basis regarding the application of specific techniques and procedures used to identify, select, and scrutinise (analyse) information that is applied for one to understand the research problem. It allows for the study's general rationality and reliability. It designates how the data were generated, and analysed in order to ascertain useful information.

3.2 Dataset of the study

3.2.1 Type of data

The data set that was used was the secondary data since all the information was from past demographic surveys. The type of data that were used in the study is the quantitative data obtained from the Bureau of Statistics with all the variables that are needed for the study included in the data set. The study begins with exploratory research, since it explores the impacts of maternal HIV status on certain mortality aspects, namely the maternal and child mortality.

3.2.2 Sources of data

The study utilised data from the 2011 Lesotho Demographic Survey (LDS) and the 2014 Lesotho Demographic and Health Survey (LDHS). LDHS was implemented by the Lesotho Ministry of Health (MOH) with the help of ICF International, which provided technical assistance throughout the DHS Programme. The DHS was subsidised by the United States Agency for International Development (USAID), which offers financial support and technical assistance for population and health surveys in countries worldwide.

Other agencies and organisations, that assisted in the successful implementation of the survey, through technical and /or financial support were: the Global Fund (GF) to Fight AIDS; Tuberculosis and Malaria Global Fund; the U.S. President's Emergency Plan for AIDS Relief (PEPFAR); the Christian Health Association of Lesotho (CHAL); the United

Nations Children's Fund (UNICEF); the Bureau of Statistics (BOS) of the Ministry of Development Planning; the United Nations Population Fund (UNFPA); the World Health Organization (WHO); the National University of Lesotho; the World Bank, and the Food and Nutrition Coordinating Office (FNCO) of the Prime Minister's Office.

3.2.3 Sample design

The sampling frame used for the 2014 LDHS is an updated frame from the 2006 Lesotho Population and Housing Census (PHC) provided by the Bureau of Statistics (2007). The sampling frame excluded nomadic and institutional populations, such as persons in hotels, barracks, and prisons. The 2014 LDHS followed a two-stage sample design and was intended to allow estimates of key indicators at the national level, as well as in urban and rural areas, four ecological zones, and each of Lesotho's 10 districts. The first stage involved selecting sample points (clusters) consisting of enumeration areas (EAs) delineated for the 2006 PHC. A total of 400 clusters were selected, 118 in urban areas and 282 in rural areas.

The second stage involved the systematic sampling of households. A household listing operation was undertaken in all of the selected EAs in July 2014, and households to be included in the survey were randomly selected from these lists. About 25 households were selected from each sample point, for a total sample size of 9942 households. Because of the approximately equal sample sizes in each district, the sample is not self-weighting at the national level, and weighting factors have been added to the data file so that the results will be proportional at the national level.

All women aged 15-49 years who either were permanent residents of the selected households, or visitors who stayed in the household the night before the survey, were eligible to be interviewed. In half of the households, all men age 15-59 years who were either permanent residents of the selected households or visitors who stayed in the household the night before the survey were eligible to be interviewed. In the same subsample of households, blood specimens were collected for the laboratory testing of HIV from eligible women and men who consented; height and weight were measured for eligible women, men, and children aged 0-59 months; and mid-upper-arm circumference (MUAC) measurements were collected for children age 6-59 months.

3.2.4 Questionnaire design and data collection

Three questionnaires were used for the 2014 LDHS: the Household Questionnaire, the Woman's Questionnaire, and the Man's Questionnaire. These questionnaires, based on the DHS programme's standard Demographic and Health Survey questionnaires were adapted to reflect the population and health issues relevant to Lesotho. Input was solicited from various stakeholders representing government ministries and agencies, nongovernmental organisations, and international donors. After the preparation of the definitive questionnaires in English, the questionnaires were translated into Sesotho.

The Household Questionnaire was used to list all members of and visitors to selected households. Basic demographic information was collected on the characteristics of each person listed, including their sex, age, education, marital status, and relationship to the head of the household. For children under the age of 18, the parents' survival status was determined. The data on the age and sex of household members, obtained in the Household Questionnaire, were used to identify women and men eligible for individual interviews.

The Household Questionnaire also collected information on the characteristics of the household's dwelling unit, such as source of water, type of toilet facilities, materials used for the floor of the dwelling unit, and ownership of various durable goods. The Woman's Questionnaire was used to collect information from all eligible women age 15-49 years.

3.2.5 Measurement indices

The research intended measuring the rate at which maternal HIV status affects maternal mortality and child mortality. Measures of mortality were used, specifically the maternal mortality rate and the child mortality rate, as a result of the HIV status of the mother, since they are the best measures to use. To establish the validity and reliability of the results obtained, the maternal and child mortality as a result of maternal HIV status was compared with that of the past years. This helped to show the trend of these mortality measures as a result of the HIV status of the mother for a period of time.

3.2.6 Sampling frame

The sampling frame for this study was the children below the age of five, and the female reproductive population of Lesotho. This is because the females are the ones who give birth; thus, maternal and child mortality directly affects both the children and their mothers. In addition, the childbearing age begins at age 15 and ends at age 49 and this age group happens to be the most HIV prevalent, according to the Southern African Development Community Sexual and Reproductive Health Business Plan for 2011 to 2015. Moreover, since the study was based on maternal and child mortality due to the HIV status of the mothers in Lesotho, its (Lesotho) female and children inhabitants are the relevant sampling frame. In one hypothesis test, the female population was included in order to analyse the trend of testing for both males and females; thereafter, only the female population was considered.

3.2.7 Sampling method

To avoid bias, the sampling method that was used is a simple random sampling method. This method ensures that each member of the population has an equal chance of being selected, without another member being favoured. The Statistical Package for Social Science (SPSS) and Microsoft Excel were used for the analysis and to check how significant the data were.

3.3 Variables of interest

The variables studied in this research are as follows: HIV status of the individual; the marital status of the individual; the education status of the individual; the urban-rural residence of the individual, and the age of the individual in completed years. The dependent variable is the individual’s HIV status, which is the main variable in the research, with the other four variables being the explanatory variables which include:

3.3.1 Age of the individual

This is the age of the individual during the time when data were collected, in completed years.

3.3.2 Education status

From the education perspective, the research studied the impact based on the level of education that an individual had completed.

3.3.3 Urban-Rural residence

The place of residence at which the individual was currently staying, was urban or rural.

3.3.4 Marital status

The research studied the impact of maternal HIV status based on whether the individual was married or single.

3.4 Methods of Analysis

The analysis of the data was done in a three-stage method, which involved a descriptive analysis; an inferential statistical analysis, and a logistic regression analysis in the order stated. This three-stage method was done through different types of test statistics at each stage. These test statistics were inclusive of, but not limited to:

(a) Cochran Mantel Haenszel
(b) Chi square test
(c) Cramer’s V test
(d) Kendall Tau b test e.c.t.

The model of analysis that was used was the regression analysis, specifically the logistic regression analysis model. “This model is a probabilistic statistical model that is used to predict a binary response from a binary predictor; that is, it calculates the probability of the occurrence of an event by fitting data to a logit function” (Nemes, *et al.*, 2009).

3.4.1 Cochran Mantel Haenszel

“The Cochran-Mantel-Haenszel (CMH) Test is a statistical test of association for data from stratified data of one source or from different sources” (Sullivan, 2017). Since the LDHS data are stratified using the primary sampling units, it is the best method to use to test for conditional independence. The CMH statistic is very useful in clinical trials, where a confounding variable (an ‘extra’ variable that one did not account for) can cause extra links between the dependent variable (outcome variable) and independent variable (predictor variable) (DiMaggio, 2012).

The null hypothesis for the CMH test states that the odds ratio (OR) are equal to one. “An odds ratio of exactly one indicates that exposure to property A does not affect the odds of property B, that is, if one gets a significant result in this test (i.e. if the test rejects the null hypothesis), then one can conclude there is an association between A and B” (Walker & Shostak, 2010).

3.4.2 Chi-square Goodness-of-Fit

This is a test that makes a statement or claim concerning the nature of the distribution for the whole population. Chi-Square goodness of fit test is a non-parametric test that is used to find out how the observed value of a given phenomenon is significantly different from the expected value (Balakrishnan, *et al.*, 2013). The test determines how well the theoretical distribution (such as normal, binomial, or Poisson) fits the empirical distribution. It can be used to examine how closely a sample matches a population and it begins by hypothesising that the distribution of a variable behaves in a particular manner. It is used to compare the observed sample distribution with the expected probability distribution (Balakrishnan, *et al.*, 2013).

3.4.3 Cramer’s V correlation for nominal data

The Cramer’s V test was used to find out if there was any association between the dependent variable and the nominal predictor variables. Cramer's V calculates the correlations for any nominal variables in tables that have 2x2 rows and columns or more (Cohen, 1988). It is used to quantify the strength of relationship between one nominal variable, either with a nominal variable or with an ordinal variable, after chi-square has determined the significance (Field, 2017).

The value of the Cramer’s V test has to be between zero and one, whereby a value close to zero depicts weak association between variables, and a value close to one depicts strong association. The association cut off points can be interpreted as follows:

- $V < 0.05$ implies no or very week association
- $0.05 < V \leq 0.1$ implies weak association

- $0.1 \leq V \leq 0.15$ implies moderate association
- $0.15 < V < 0.25$ implies strong association
- $V \geq 0.25$ implies very strong association

(Field, 2017)

V is calculated by first computing chi-square, and then using the following calculation:

$$V = \sqrt{\frac{x^2}{n(k-1)}}$$

where x^2 is the chi-square and k is the number of rows or columns in the table (Cohen, 1988).

3.4.4 Kendall Tau correlation for ordinal data

The Kendall Tau test was used to determine if there was any relationship between the dependent variable and the ordinal predictor variable. “The Kendall rank correlation coefficient, in statistics, usually referred to, as Kendall's Tau coefficient (after the Greek letter τ) is a test statistic used to quantity the association between two ordinal quantities. Kendall tau test is a non-parametric hypothesis test used to test for statistical dependence of variables based on the tau coefficient” (Vlaminck, *et al.*, 2001). The tau statistic can be calculated as follows:

$$\tau = \frac{n_c - n_d}{n(n-1)/_s}$$

where n_c is the number of concordant pairs (ordered in the same way)
n_d is the number of discordant pairs (ordered differently)

The Kendall correlation between two variables will spontaneously be high when the observations have similar ranks between the two variables of interest, and low when observations are dissimilar in rank (Marshall & Boggis., 2016). The Tau correlation coefficient yields a value between 0 to 1 where:

- 0 represents no relationship,
- 1 represents a perfect relationship.

A twist of this test can produce negative values (i.e. from -1 to 0). Unlike a linear graph, a negative relationship does not mean much with ranked columns (other than that, perhaps the columns have been switched), so given a situation of this nature, we work with the absolute value of Tau when interpreting the results. The results of the test can be interpreted as thus:

- $|\tau| < 0.05$ implies no or very week relationship
- $0.05 < |\tau| \leq 0.1$ implies weak relationship
- $0.1 \leq |\tau| \leq 0.15$ implies moderate relationship
- $0.15 < |\tau| < 0.25$ implies strong relationship
- $|\tau| \geq 0.25$ implies very strong relationship

(Field, 2017)

3.4.5 Binary logistic regression

Logistic regression is used in estimating empirical values of the parameter in a quantitative response model. It measures the relationship between a categorical dependent variable and one or more independent variables; thus it helps with interdependency of the independent variables. Binary logistic regression is used to predict the odds of being a case based on the values of the independent variables (predictors) (Sperandei, 2014).

Sperandei (2014) further explained that the odds are defined as the probability that a particular outcome is a case divided by the probability that it is a non-case. In this research, the dependent variable, HIV status of the mother, is a categorical variable. The research tries to establish if there is a positive association between the dependent variable; and other independent variables, thus binary logistic regression is the best model to use. The interpretations will be based on the results and findings obtained from the analysis of the data that will be used.

3.5 Conclusion

This chapter highlighted the dataset of the study, the variables of interest, and the methods of analysis that will be used in the research. When scrutinising the dataset, some aspects we looked at were:

(a) Type and sources of data
(b) Sample design, questionnaire design and data collection
(c) Measurement indices
(d) Sampling frame and sampling method
(e) Variables of interest
(f) Methods of Analysis

The variables of interest that were highlighted in this chapter include the age of the respondent, marital status, education status and urban-rural residence status. The methods of analysis that were highlighted include the Cochran-Mante-Haenszel test, the Chi-square tests, the Cramer's V test and the Kendall's tau correlation. The study was not limited to just these methods.

The next chapter contains the analysis and results of data displayed in terms of descriptive statistics and the inferential statistics analysis.

Chapter 4 - Analysis and Results

4.1 Introduction

The methodology for the study was discussed in the previous chapter, in terms of all the methods and techniques that were used to produce the results and findings. This chapter deals with the analysis of the data, which is a process of reviewing, cleaning, altering and modelling data with the goal of determining useful information, proposing conclusions and supporting decision-making (Xia & Gong, 2014). It also includes the results obtained from analysing the data and the discussions. The data that were used are the data from the Lesotho Demographic Health Survey that was conducted in 2014. The results are based upon respondents aged between 15 and 49 years and who tested for HIV.

4.1.1. Percentage tested for HIV

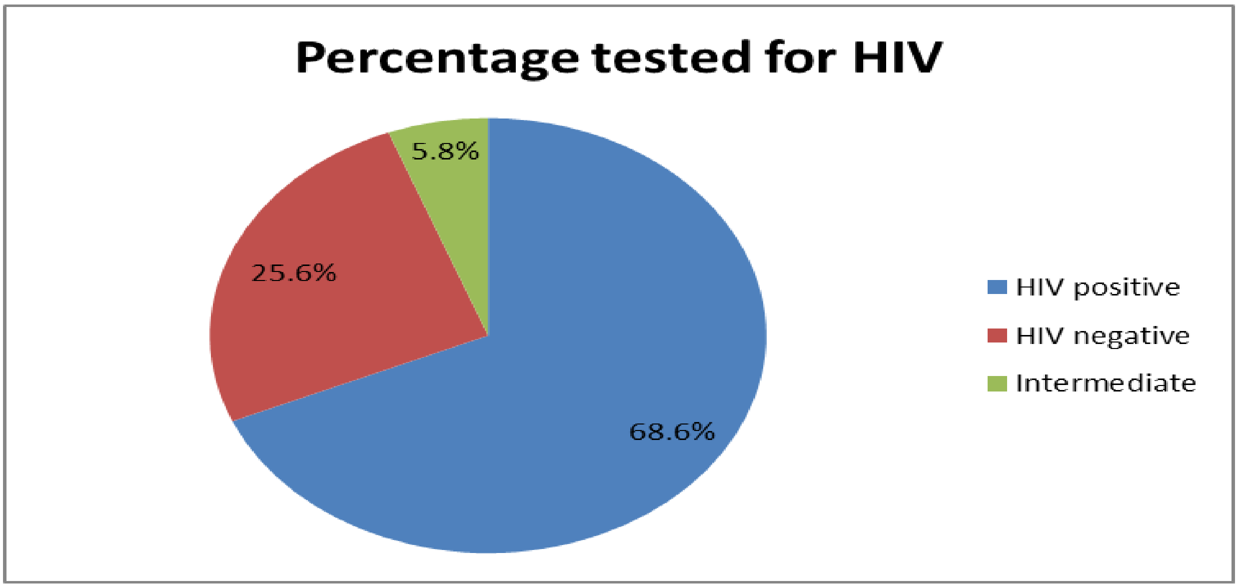
Table 4.1 shows the percentage distribution of respondents who tested for HIV. This table shows the blood test results of the respondents who consented to test for HIV and who underwent the test. The table shows that out of 11 710 respondents who were tested for HIV, 68.6 percent of the respondents blood results came out HIV negative, while 25.6 percent of the blood samples were positive for HIV. This (25.6%) is a very high percentage, given that Lesotho as a nation is looking to have an HIV-free generation, and that measures have to be taken to control the spread of HIV.

Table 4.1: Distribution of tested respondents by blood test result

Blood test result	**Frequency**	**Percent**
HIV negative	8028	68.6%
HIV positive	2999	25.6%
Indeterminate	683	5.8%
Total	**11710**	**100.0%**

The above information can also be represented in the form of a pie chart to show the share that each blood test result is composed of. Figure 4.1 is a pie chart that represents the distribution of the tested respondents by their blood test results. The pie chart shows that the HIV negative respondents comprised a major share.

Figure 4.1: Distribution of tested respondents by blood test result



4.2 Descriptive statistics

Descriptive statistics is the simplest form of analysing data. This type of analysis does not deal with root causes or relationships; its major purpose is to describe, that is, it takes data, summarises them and then finds patterns in the data. In this section, all the respondents' selected demographic characteristics were discussed with respect of a group of citizens from Lesotho who were tested for HIV (the sample) and all citizens (irrespective of whether they had been tested for HIV or not) of Lesotho (the population).

4.2.1 Demographics for people who go for testing

a) Gender

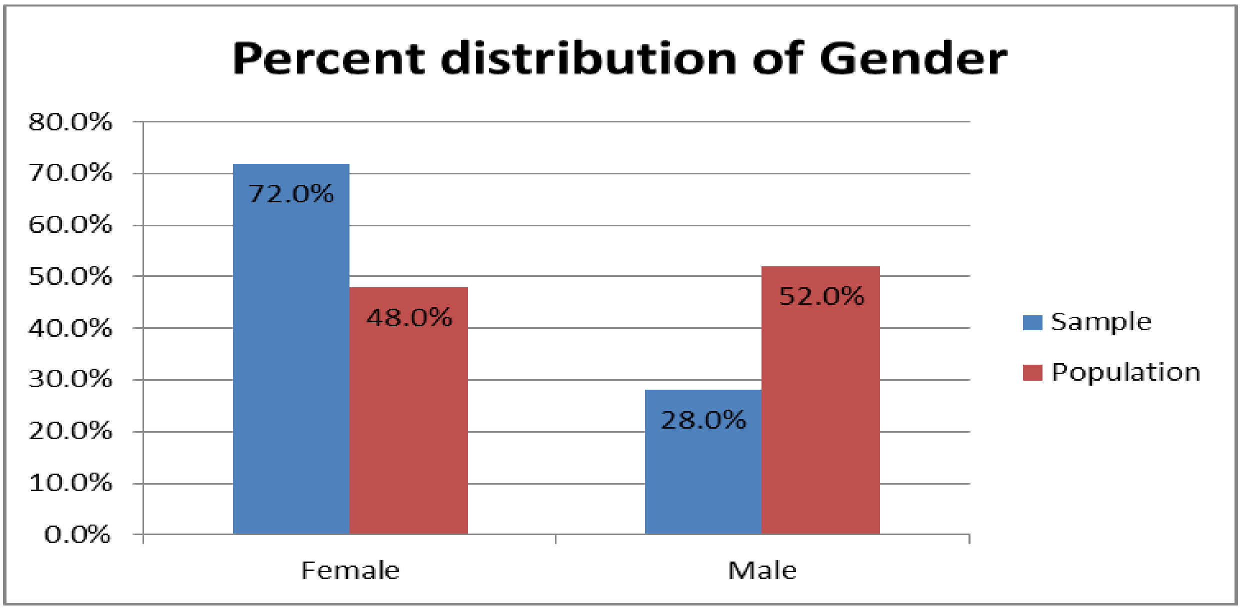
Table 4.2 shows the percentage distribution of respondents who participated in the survey by their gender. The table shows that there was a total of 11 710 respondents who were tested for HIV. Among the respondents, 72 percent of them were females, while 28 percent were males. This shows that more women go for HIV testing and counselling than males. This seems like a norm that has to be addressed to avoid new infections; everyone should be encouraged to test for HIV.

Table 4.2: Distribution of tested respondents by Gender

	Sample (n)		**Population (N)**	
Gender	**Frequency**	**Percent**	**Frequency**	**Percent**
Female	8 427	72.0%	526 658	48.0%
Male	3 283	28.0%	570 331	52.0%
Total	**11 710**	**100.0%**	**1 096 989**	**100.0%**

Figure 4.2 that gives a visual representation of the percentage distribution of gender for respondents who tested for HIV and the distribution of gender for the general population of Lesotho. The figure shows that there is a significant variance in the gender distribution between the females in the sample and those in the population, as well as for males. More females tend to go for HIV testing than males, whereas in the general population, there are more males than females. This is a result of the fear in men to do HIV testing and the stigma attached to being HIV positive.

Figure 4.2: Distribution of tested respondents by Gender for sample and general population



b) Place of residence

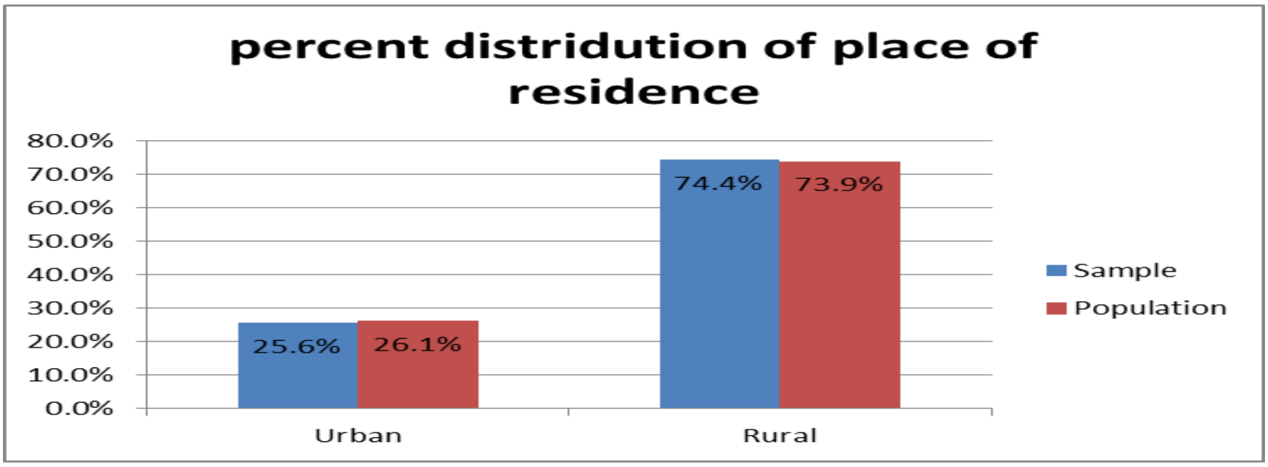
Table 4.3 shows the percentage distribution of respondents by place of residence, who tested for HIV. The table depicts that most of the respondents were from the rural areas of the country (74.4 percent). The rural area population covers most of the country, which is why the higher percentage of respondents who tested came from this region. The urban population that tested for HIV covers only 25.6 percent. The table further shows that Lesotho's population mostly comprises of people living in the rural areas than in the urban areas, 73.9 percent and 26.1 percent respectively.

Table 4.3: Distribution of tested respondents by place of residence

	Sample (n)		**Population (N)**	
Place of residence	**Frequency**	**Percent**	**Frequency**	**Percent**
Urban	2 995	25.6%	286 606	26.1%
Rural	8 715	74.4%	810 383	73.9%
Total	**11 710**	**100.0%**	**1 096 989**	**100.0%**

Figure 4.3 shows that the distribution of the sample of tested respondents was almost the same as that of the general population for both the urban and rural residents in Lesotho. The percentage of people who were tested for HIV in the rural areas was slightly larger than that of the urban areas, as seen in figure 4.3.

Figure 4.3: Distribution of tested respondents by place of residence for sample and general population

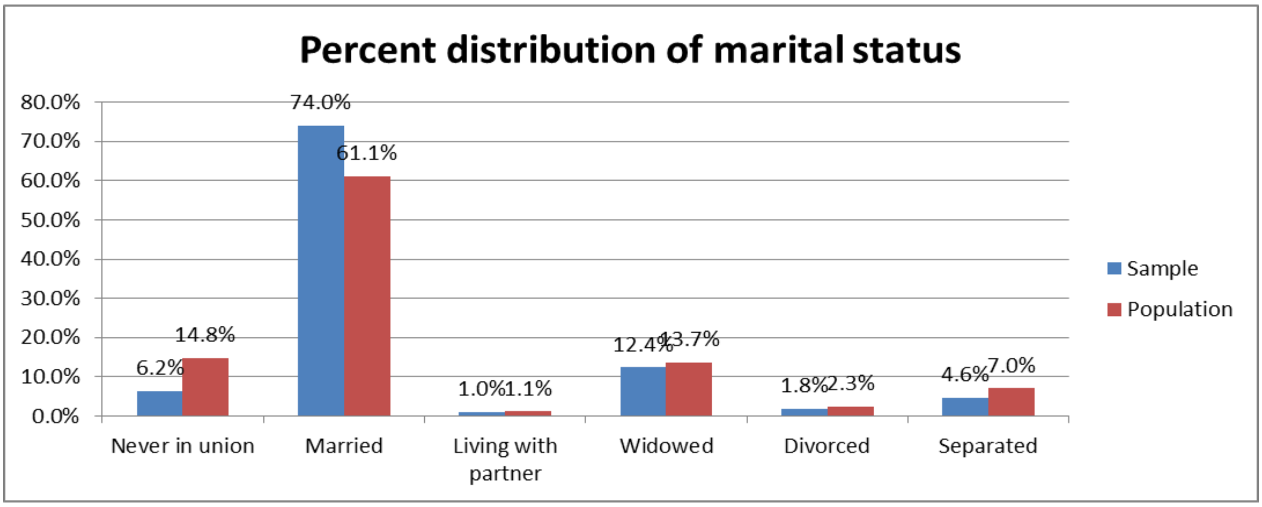


c) Marital status

Marital status is one of the most important aspects when dealing with HIV; thus, it is crucial to see the trend of HIV within the different statuses of marriage. Figure 4.4 shows the distribution of tested respondents with respect to their marital statuses.

In comparison to the general population of Lesotho, the figure that follows figure 4.4shows that Lesotho's population comprises mostly married people (61.1 percent), followed by those who have never been married (14.8 percent), with the least being those living with a partner (1.1 percent).

Figure 4.4: Comparison of tested respondents by marital status for sample and the general population



The table shows that there was a higher percentage of married respondents, who tested for HIV as depicted in table 4.4 (74.0 percent). This percentage was followed by that of the widowed respondents, with the lowest percentage being that of respondents living with a partner 12.4 percent and one percent respectively. Thus, in this sample, respondents who tested for HIV were mostly married respondents. This may be that people think that they are in less danger of contracting HIV when they are married.

Table 4.4: Distribution of tested respondents by marital status

	Sample (n)		Population (N)	
Marital status	**Frequency**	**Percent**	**Frequency**	**Percent**
Never in union	729	6.2%	162 427	14.8%
Married	8 660	74.0%	670 171	61.1%
Living with partner	120	1.0%	12 100	1.1%
Widowed	1 449	12.4%	149 863	13.7%
Divorced	211	1.8%	25 337	2.3%
Separated	541	4.6%	77 090	7.0%
Total	**11 710**	**100.0%**	**1 096 988**	**100.0%**

d) Education attainment

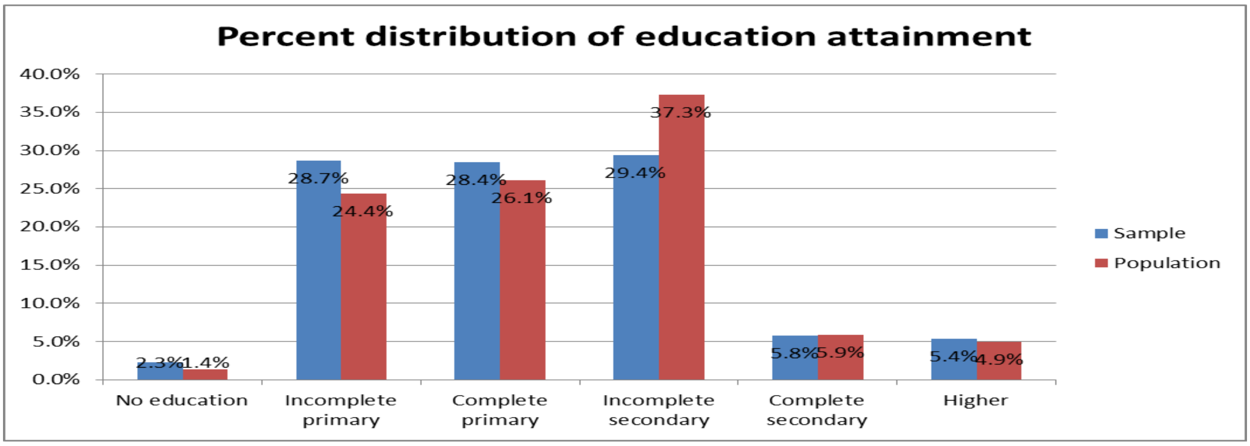
Education is one of the basic tools for helping people understand more on how HIV can be transmitted and on how new infections can be reduced. Table 4.5 and figure 4.5 show the distribution of respondents that were tested for HIV in accordance with their education attainment. Based on the level of education attainment, a smaller percentage of respondents with no education tested for HIV, 2.3 percent as depicted in table 4.5. Respondents with incomplete secondary education had the highest percentage tested, followed by those with incomplete primary 29.4 percent and 28.7 percent respectively. For those respondents with a higher education attainment only 5.4 percent tested for HIV.

Table 4.5: Distribution of tested respondents by Education attainment

	Sample (n)		Population (N)	
Education attainment	**Frequency**	**Percent**	**Frequency**	**Percent**
No education	272	2.3%	15 310	1.4%
Incomplete primary	3 356	28.7%	267 124	24.4%
Complete primary	3 330	28.4%	286 110	26.1%
Incomplete secondary	3 442	29.4%	409 313	37.3%
Complete secondary	682	5.8%	64 860	5.9%
Higher	628	5.4%	54 272	4.9%
Total	**11 710**	**100.0%**	**1 096 989**	**100.0%**

In comparison to the general population, the same trend as that of the sample was observed. That is, respondents in the category no education had the least percentages with the second least being those in the higher education category. Respondents in the category incomplete secondary had the highest percentages 37.3 percent for the general population and 29.4 percent for the sampled respondents.

Figure 4.5: Distribution of tested respondents by education attainment for sample and general population



e) Age

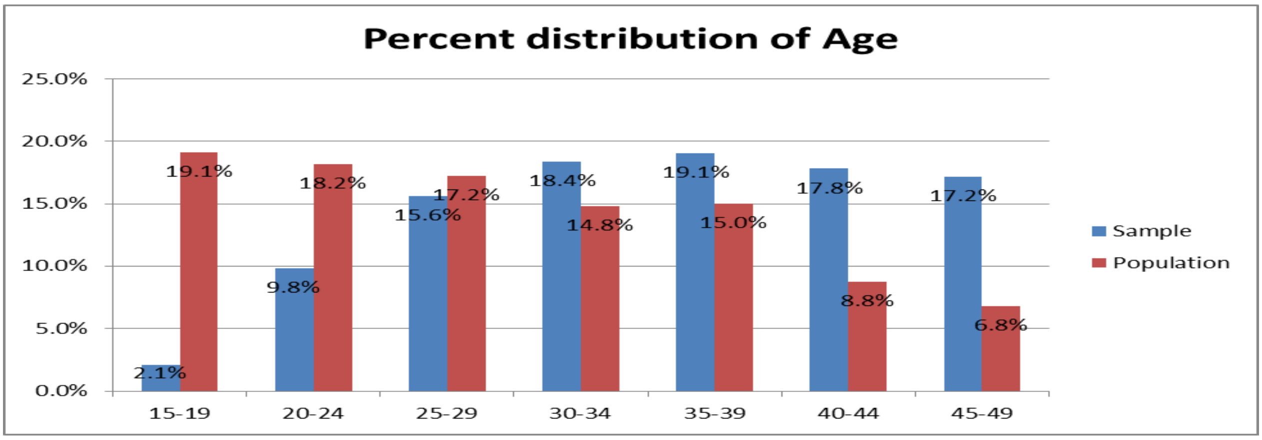
Table 4.6 shows the percentage distribution of respondents who tested for HIV by their age groups. Respondents aged 35-39 years were the most tested (19.1 percent), followed by those aged 30-34 years (18.4 percent). Age groups 40-44 years and 45-49 years had almost the same percentages of respondents who were tested for HIV, 17.8 percent and 17.2 percent respectively. The respondents of age group 15-19 years had the least percentage 2.1 percent.

Table 4.6: Distribution of tested respondents by Age of respondent

	Sample (n)		Population (N)	
Age groups	**Frequency**	**Percent**	**Frequency**	**Percent**
15-19	242	2.1	209 870	19.1
20-24	1 153	9.8	199 272	18.2
25-29	1 831	15.6	188 943	17.2
30-34	2 153	18.4	162 784	14.8
35-39	2 235	19.1	164 938	15.0
40-44	2 086	17.8	96 296	8.8
45-49	2 010	17.2	74 887	6.8
Total	**11 710**	**100.0**	**1 096 989**	**100.0**

In comparison to the general population there is a huge percentage difference seen at age groups 15-19 years and 20-24 years as observed from figure 4.6. These age groups have the highest population frequency and yet for some reason, respondents in these age groups were the least tested for HIV. In addition, the age groups 40-44 years and 45-49 years have the lowest population frequency and yet the respondents in these age groups have the highest percentages that tested for HIV. Generally, people of working-class age seem to be the ones who test more for HIV than those of younger ages.

Figure 4.6: Distribution of tested respondents by age-groups for sample and general population



4.2.2 Blood test results based on demographics

In this section, we will give the HIV test results for different groups of people based on their background characteristics.

a) Blood test results and Gender

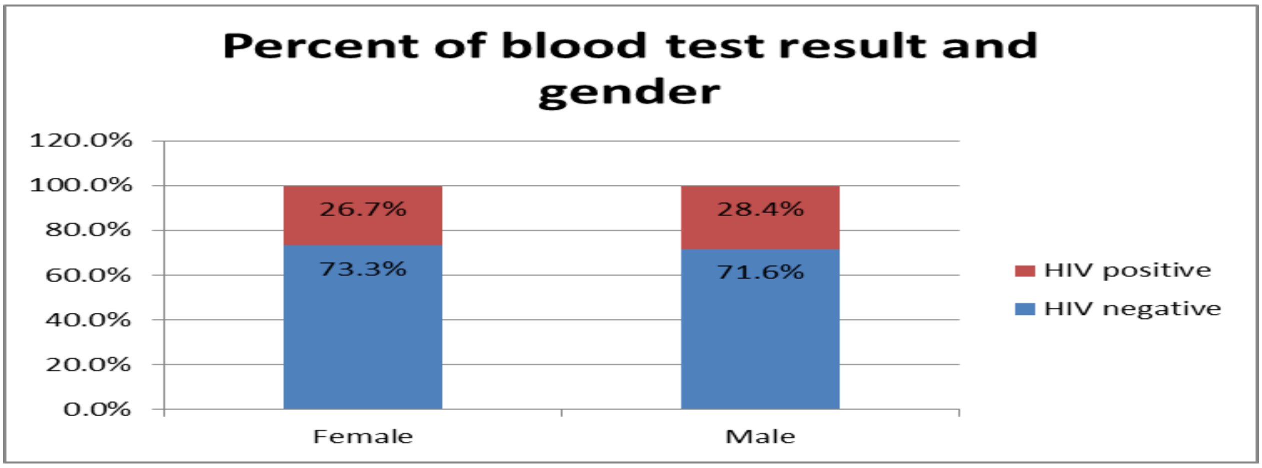
The table that follows table 4.7 gives a summary of how the HIV status or blood test results of the respondent can be affected by gender. Among the females who tested, 26.7 percent tested HIV positive and among the males, 28.4 percent tested positive. For both males and females, respondents who tested negative for HIV had the highest percentages, 71.6 percent and 73.3 percent respectively.

Table 4.7: Percentage distribution of tested respondents by Gender

Gender	Blood test result					
	HIV negative		**HIV positive**		**Total**	
Female	5 768	73.3%	2 103	26.7%	7 871	100.0%
Male	2 260	71.6%	896	28.4%	3 156	100.0%
Total	**8 028**	**N/A**	**2 999**	**N/A**	**11 027**	**N/A**

Figure 4.7 shows the percentage distribution of respondents by their gender and blood test results. The figure shows that for both female and male respondents who tested for HIV, respondents who tested HIV negative outweighed the HIV positive respondents.

Figure 4.7: Distribution of tested respondents by gender and blood test results



b) Blood test results and place of residence

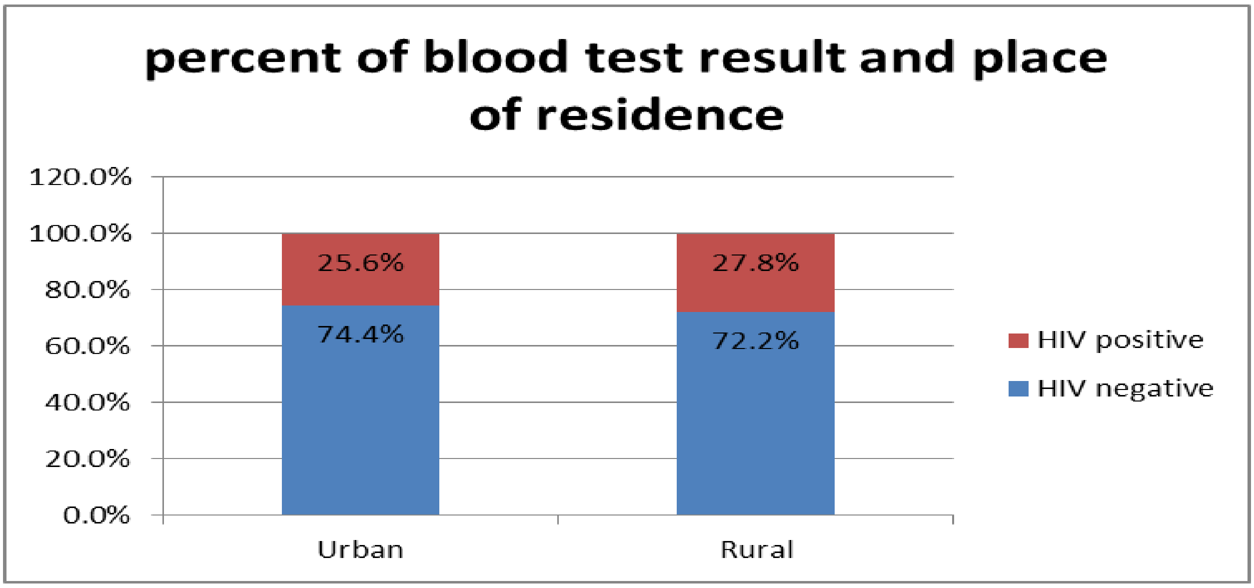
Table 4.8 shows the percentage distribution of tested respondents' blood test results based on the place of residence. The table shows that in the urban areas, 25.6 percent of the respondents tested positive, while the percentage who tested positive in the rural areas was 27.8 percent. It further shows that for both urban and rural residents, the majority tested negative for HIV, 74.4 percent and 72.2 percent respectively.

Table 4.8: Percentage distribution of tested respondents by Place of residence

Place of residence	Blood test result					
	HIV negative		HIV positive		Total	
Urban	2 141	74.4%	737	25.6%	2 878	100.0%
Rural	5 887	72.2%	2 262	27.8%	8 149	100.0%
Total	**8 028**	**N/A**	**2 999**	**N/A**	**11 027**	**N/A**

Figure 4.8 shows the graphical distribution of respondents who tested for HIV with respect to their place of residence and the results of the blood test.

Figure 4.8: Distribution of tested respondents by place of residence and blood test results



c) Blood test results and marital status

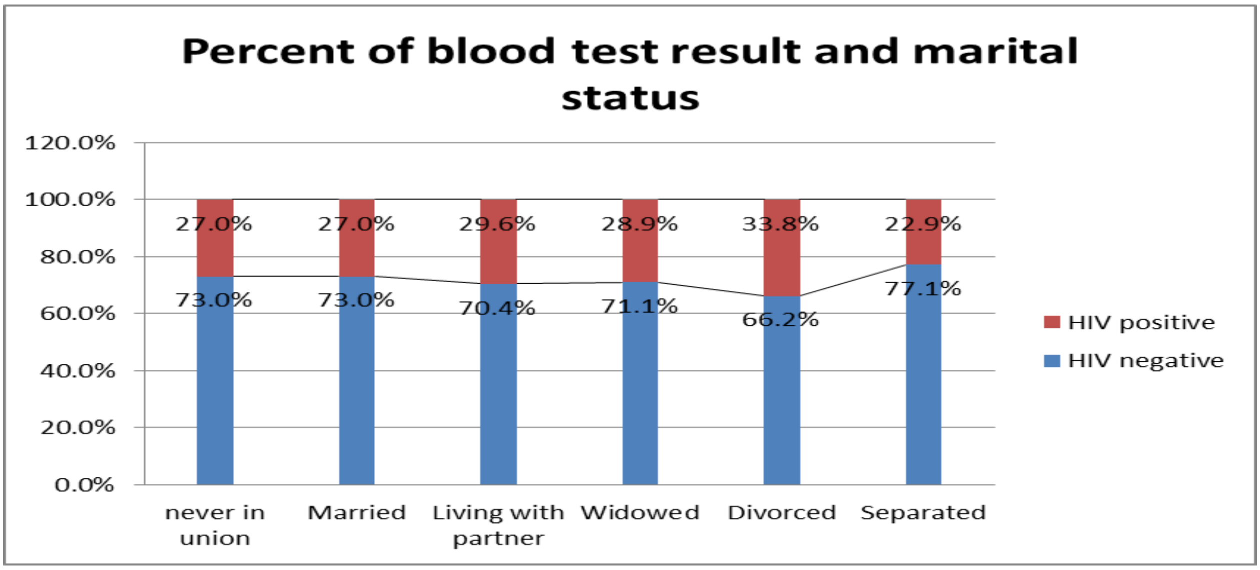
The table that follows represents the percentage distribution of tested respondents based on their blood test results and marital status. In the 'never in union' and 'married' category, 27.0 percent of respondents tested positive for HIV. Respondents who tested positive were highest in the category 'divorced' followed by the category 'living with partner', 33.8 percent and 29.6 percent respectively. The category with the lowest percentage of respondents who tested positive was the 'separated' category with 22.9 percent. Therefore, the highest risk for HIV was among the divorcees, followed by the living with partner, with the least at risk being the separated.

Table 4.9: Percentage distribution of tested respondents by marital status

Marital Status	**Blood test result**					
	HIV negative		**HIV positive**		**Total**	
Never in union	508	73.0%	188	27.0%	696	100.0%
Married	5 918	73.0%	2 189	27.0%	8 107	100.0%
Living with partner	81	70.4%	34	29.6%	115	100.0%
Widowed	983	71.1%	400	28.9%	1 383	100.0%
Divorced	131	66.2%	67	33.8%	198	100.0%
Separated	407	77.1%	121	22.9%	528	100.0%
Total	**8 028**	**N/A**	**2 999**	**N/A**	**11 027**	**N/A**

A visual representation of the results of tested respondents based on the blood test results and marital status is shown in figure 4.9. The figure shows that generally, for all categories of marital status, the majority of respondents tested negative for HIV.

Figure 4.9: Distribution of tested respondents' blood test result based on marital status



d) Blood test results and education attainment

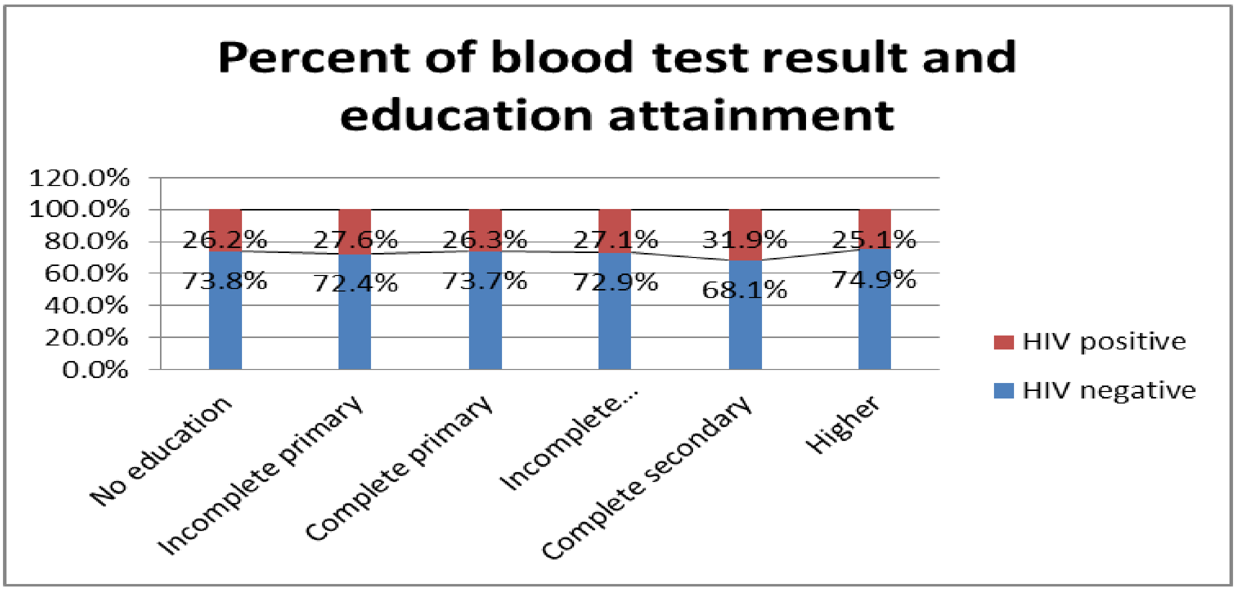
Table 4.10 shows that respondents who fell within the 'completed secondary' category had the highest percentages that tested HIV positive (31.9 percent). Moreover, 25.1 percent of respondents with a higher education attainment tested positive, while 74.9 tested negative. The 'incomplete primary' and "incomplete secondary" categories had almost the same percentages for respondents who tested positive 27.6 percent and 27.1 percent respectively. This implies that the highest risk of HIV infection was among the respondents in the category of complete secondary education with the least risk being among those with no education attainment.

Table 4.10: Percentage distribution of tested respondents by education attainment

Education Attainment	**Blood test result**					
	HIV negative		**HIV positive**		**Total**	
No education	175	73.8%	62	26.2%	237	100.0%
Incomplete primary	2 316	72.4%	885	27.6%	3 201	100.0%
Complete primary	2 273	73.7%	812	26.3%	3 085	100.0%
Incomplete secondary	2 383	72.9%	886	27.1%	3 269	100.0%
Complete secondary	442	68.1%	207	31.9%	649	100.0%
Higher	439	74.9%	147	25.1%	586	100.0%
Total	**8 028**	**N/A**	**2 999**	**N/A**	**11 027**	**N/A**

Figure 4.10 shows the percentage distribution of tested respondents' blood test results based on the education attainment of the respondent. The figure shows that in all the categories of education attainment, between 25 percent and 32 percent of the respondents tested positive for HIV.

Figure 4.10: Distribution of tested respondents' blood test result based on education status



e) **Blood test results and age**

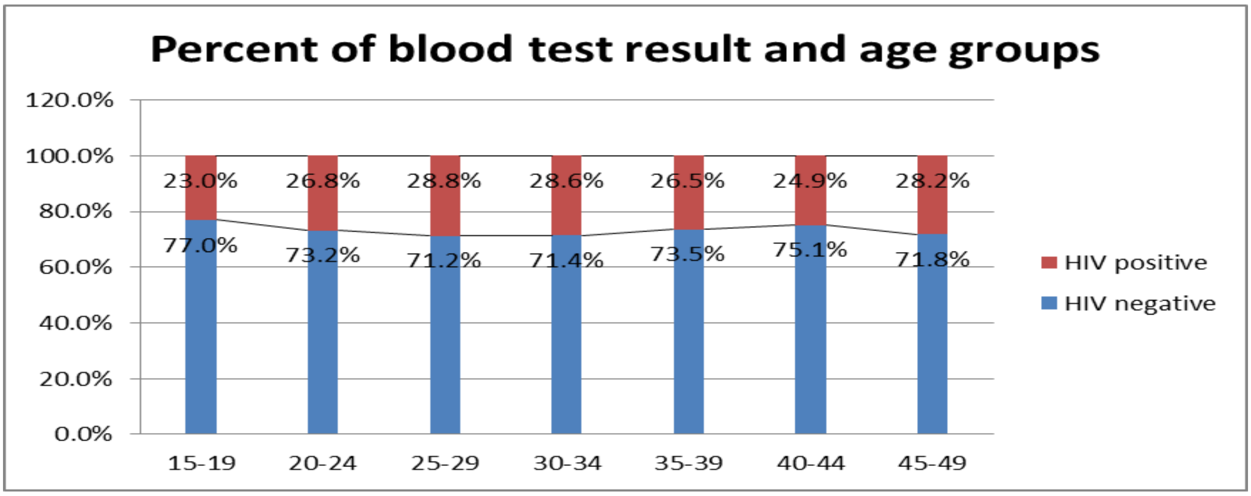
Table 4.11 shows that respondents in the age group 25 to 29 had the highest percentages that tested HIV positive (28.8 percent). Furthermore, respondents in the age group 15 to 19 had the lowest percentages that tested HIV positive (23.0 percent). This implies that the highest risk of HIV was among the respondents aged 25 to 29 years, followed by those aged 30 to 34 years. The lowest risk was among respondents aged 15 to 19 years.

Table 4.11: Percentage distribution of tested respondents by Age group

Age Groups	Blood test result					
	HIV negative		**HIV positive**		**Total**	
15-19	177	77.0%	53	23.0%	230	100.0%
20-24	793	73.2%	290	26.8%	1 083	100.0%
25-29	1 245	71.2%	504	28.8%	1 749	100.0%
30-34	1 431	71.4%	574	28.6%	2 005	100.0%
35-39	1 533	73.5%	552	26.5%	2 085	100.0%
40-44	1 511	75.1%	500	24.9%	2 011	100.0%
45-49	1 338	71.8%	526	28.2%	1 864	100.0%
Total	8 028	N/A	2 999	N/A	11 027	N/A

Figure 4.11 shows the distribution of tested respondents' blood test results based on their age groups. It shows that there were between 70 percent and 77 percent of the respondents who tested for HIV and tested negative within the different age groups.

Figure 4.11: Distribution of tested respondents' blood test result based on age groups



4.3 Inferential statistics (analysis)

Inferential statistics are a form of analysis where a random data sample is taken from a population to describe and make suggestions about that population. Inferential statistics are valuable when the inspection of each member of an entire population is not convenient or possible.

4.3.1 Expected frequencies of respondents' demographics

In this section we want to test if the observed frequencies (grouped according to various demographic characteristic) vary significantly from the expected frequencies when the significance level is 0.05 (p=value is 0.05); that is, we want to conduct the Chi-square Goodness-of-Fit test for the data. A chi-square Goodness-of-Fit test was then performed to test the different hypotheses with different socio-economic variables. The expected values for the different variables were calculated as follows

$$E(x) = n * p$$

where n is the sample size

P is the population proportion

For example, the expected value for females was calculated as thus:

$$E(x) = 11710 * 0.48$$

=5620.8

4.3.1.1 Gender

Table 4.12 gives the representation of the observed and expected frequencies in order to test whether the sample data are consistent with the distribution of the population.

Table 4.12: Expected and Observed frequencies by gender

Gender	Observed frequency	Expected frequency
Female	8427	5620.8
Male	3283	6089.2
Total	**11710**	**11710**

For the above data the hypothesis that was tested was:

H_0: the sample data are consistent with the distribution of the population based on gender

H1: the sample data are not consistent with the distribution of the population based on gender

The chi-square goodness of fit test statistic was calculated as:

$$\chi^2 = \sum_{i=1}^{2} \frac{(O_i - E_i)^2}{E_i} \qquad 4.1$$

$$= \frac{(8427-5620.8)^2}{5620.8} + \frac{(3283-6089.2)^2}{6089.2}$$

$$= 2206.69$$

Since gender has two categories, the degrees of freedom affiliated with this variable is calculated as k-1, whereby k is the number of categories of a variable. Thus, for gender k = 2, and this makes the degrees of freedom associated with this variable one (df = 1). Now at df = 1, the critical value of the chi-square statistics at α = 0.05 is $\chi^2_{\frac{0.05}{2}\ 1} = 5.02$. We are to reject the null hypothesis if this value (critical value) is less than the calculated chi-square value. That is:

$$Rejection\ H_0\ if\ \chi^2_{\frac{\alpha}{2}\ k-1} \leq \chi^2$$

In this case, the critical value is less than the calculated chi-square, that is, $\chi^2_{\frac{0.05}{2}\ 1} = 5.02 < 2206.69$; thus, we reject the null hypothesis and conclude that the data are not consistent with the distribution of the population based on gender.

4.3.1.2 Place of residence

A representation of the observed and expected frequencies based upon place of residence is shown in Table 4.13. The expected frequency was calculated as:

$$E(x) = n * p$$

$$=11710 * 0.261$$

$$=3056.3$$

Table 4.13: Expected and Observed frequencies by place of residence

Place of residence	**Observed frequency**	**Expected frequency**
Urban	2995	3056.3
Rural	8715	8653.7
Total	**11710**	**11710**

The hypothesis in this case was given as:

> **H$_0$:** the sample data are consistent with the distribution of the population based on the place of residence
>
> **H$_1$:** the sample data are not consistent with the distribution of the population based on the place of residence

Based on the frequencies given in the table, the chi-square goodness of fit test was calculated as:

$$\chi^2 = \sum_{i=1}^{2} \frac{(O_i - E_i)^2}{E_i} \qquad 4.2$$

$$= \frac{(2995-3056.3)^2}{3056.3} + \frac{(8715-8653.7)^2}{8653.7}$$

$$= 1.66$$

Place of residence also has two categories: the degrees of freedom is one (df = 1) and the critical value is 5.02. The rejection rule is given as:

$$Reject\ H_0\ if\ \chi^2_{\frac{\alpha}{2}\,k-1} \leq \chi^2$$

Now, since the critical value is greater than the calculated chi-square value (5.02 > 1.66), we fail to reject the null hypothesis, and conclude that the data are consistent with the distribution of the population, based on the place of residence of the respondent.

4.3.1.3 Marital status

Table 4.14 gives the observed and expected frequencies, based on the marital status of the respondents. The expected frequency, for different categories, was calculated as:

$$E(x) = n * p$$

$$=11710 * 0.148$$

$$=1733.9$$

The hypothesis that was tested was given as:

H_0: the sample data are consistent with the distribution of the population based on the marital status

H_1: the sample data are not consistent with the distribution of the population based on the marital status

Table 4.14: Expected and Observed frequencies by marital status

Marital status	Observed frequency	Expected frequency
never in union	729	1733.9
married	8660	7153.9
living with partner	120	129.2
widowed	1449	1599.7
divorced	211	270.5
separated	541	822.9
Total	**11710**	**11710**

The chi-square goodness of fit statistics was given as:

$$\chi^2 = \sum_{i=1}^{2} \frac{(O_i - E_i)^2}{E_i} \qquad 4.3$$

$$= \frac{(729-1733.9)^2}{1733.9} + \frac{(8660-7153.9)^2}{7153.9} + \cdots + \frac{(541-822.9)^2}{822.9}$$

$$= 1023.49$$

The rejection rule was then stated as:

$$Reject\ H_0\ if\ \chi^2_{\frac{\alpha}{2}\,k-1} \le \chi^2$$

This indicates that we reject the null hypothesis if the chi-square critical value is less than the chi-square calculated value at the significance level of 0.05. Marital status has six categories (k = 6); therefore the degrees of freedom (df) are k-1 = 5 in this case. The tabulated value (critical value) at df = 5 is 12.83 and the calculated value is 1023.49. Since the critical value is much smaller than the calculated value, we reject the null hypothesis and conclude that the sample data were not consistent with the distribution of the population based on the marital status. To check why the data were not consistent, a hypothesis test for the proportions within the categories of marital status was done.

a) Hypothesis test for the proportions never in union respondents

We want to test the hypothesis that the sample proportion is equal to or less than the population proportion. The following hypotheses were tested at $\alpha = 0.05$ for respondents who had never been in a marital union previously.

H_0: $P_0 = 0.148$

H_1: $P_0 \neq 0.148$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1-P_0)}{n}}} \tag{4.4}$$

where P is the sample proportion for marital status categories

P_0 is the population proportion

n is the sample size and

z is the test statistics

Now the proportion was calculated as:

$$P = \frac{x}{n} \tag{4.5}$$

where x is the frequency for the category being tested.

$$P = \frac{729}{11710} \tag{4.6}$$

$= 0.062$

The z statistics then becomes:

$$z = \frac{0.062 - 0.148}{\sqrt{\frac{0.148(1-0.148)}{11710}}} \tag{4.7}$$

$= -26.2075$

For a two-tailed hypothesis the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

In this case, the absolute value of -26.2075 is actually greater than the critical value ($|-26.2075| = 26.2075 > 1.96$); thus, the null hypothesis was rejected. The conclusion is that the sample proportion is not equal to the population proportion meaning that the sample proportion is either larger or smaller than the population proportion for the category “never in union”.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as follows:

H_0: $P_0 < 0.148$

H_1: $P_0 \geq 0.148$

The z statistics were calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule for this hypothesis was given as:

$$Reject\ H_0\ if\ Z \leq Z_{1-\propto}$$

The calculated z statistics was -26.2075, and it was less than the critical value ($-26.2075 < 1.64$), thus the null hypothesis was rejected. This is an indication that the population proportion for respondents in the ‘never in union’ category was larger than the sample proportion in that same category.

b) Hypothesis test for the proportion of married respondents

We wanted to test the hypothesis that the sample proportion for married respondents’ category was equal to or less than the population proportion in the same category. The following hypothesis was tested at $\alpha = 0.05$ for respondents who were married:

H_0: $P_0 = 0.611$

H_1: $P_0 \neq 0.611$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \qquad 4.8$$

Now the proportion was calculated as:

$$P = \frac{8660}{11710} \qquad 4.9$$

$$= 0.74$$

The z statistics then becomes:

$$z = \frac{0.74 - 0.611}{\sqrt{\frac{0.611(1 - 0.611)}{11710}}} \qquad 4.10$$

$$= 28.6336$$

For a two-tailed hypothesis the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of 28.6336 was actually greater than the critical value ($|28.6336| = 28.6336 > 1.96$); thus, the null hypothesis was rejected. The conclusion was that the sample proportion for respondents in the category ‘married’ was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion a one-tailed hypothesis from the same data was done and the hypothesis was as follows:

H_0: $P_0 > 0.611$

H_1: $P_0 \leq 0.611$

The z statistics was calculated the same way as it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \geq Z_{1-\propto}$$

The calculated z statistics was 28.6336, and it was greater than the critical value (28.6336 > 1.64), thus the null hypothesis was rejected. This is an indication that the population proportion for respondents in the 'married' category was smaller than the sample proportion in the same category.

c) Hypothesis test for the proportion of respondents living with a partner

We wanted to test the hypothesis that the sample proportion in the living with partner category of marital status was equal to or less than the population proportion in the same category. The following hypotheses were tested at $\alpha = 0.05$ for respondents who were living with a partner:

H_0: $P_0 = 0.011$

H_1: $P_0 \neq 0.011$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1-P_0)}{n}}} \qquad 4.11$$

Now the proportion was calculated as:

$$P = \frac{120}{11710} \qquad 4.12$$

$$= 0.01$$

The z statistics then becomes:

$$z = \frac{0.01 - 0.011}{\sqrt{\frac{0.011(1-0.011)}{11710}}} \qquad 4.13$$

$$= -1.0375$$

For a two-tailed hypothesis the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of -1.0375 is less than the critical value ($|-1.0375| = -1.0375 < 1.96$); thus, the null hypothesis was not rejected. The conclusion was that the population proportion for respondents in the category 'living with partner' was equal to the sample proportion in the same category. Since the sample and population proportions were equal, the one-tailed hypothesis was not tested for this category.

d) Hypothesis test for the proportion of widowed respondents

We wanted to test the hypothesis that the sample proportion in the categary of marital status "widowed" was equal to or less than the population proportion in that same marital status category. The following hypotheses were tested at α = 0.05 for respondents who were widowed:

H_0: $P_0 = 0.137$

H_1: $P_0 \neq 0.137$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \tag{4.14}$$

Now the proportion was calculated as:

$$P = \frac{1449}{11710} \tag{4.15}$$

$$= 0.124$$

The z statistics then becomes:

$$z = \frac{0.124 - 0.137}{\sqrt{\frac{0.137(1 - 0.137)}{11710}}} \tag{4.16}$$

$$= -4.0913$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of -4.0913 was actually greater than the critical value ($|-4.0913| = 4.0913 > 1.96$); thus, the null hypothesis was rejected. The conclusion was that the sample proportion for respondents in the category 'widowed' was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as follows:

H_0: $P_0 < 0.137$

H_1: $P_0 \geq 0.137$

The z statistics was calculated the same way as it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \leq Z_{1-\propto}$$

The calculated z statistics was -4.0913, and it was less than the critical value (-4.0913 < 1.64), thus the null hypothesis was rejected. This was an indication that the population proportion for respondents in the 'widowed' category was greater than the sample proportion in the same category.

e) Hypothesis test for the proportion of divorced respondents

We wanted to test the hypothesis that the sample proportion in the divorced category of marital status was equal to or less than the population proportion in the same category. The following hypotheses were tested at α = 0.05 for respondents who were divorced.

H_0: $P_0 = 0.023$

H_1: $P_0 \neq 0.023$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \qquad 4.17$$

Now the proportion was calculated as:

$$P = \frac{211}{11710} \qquad 4.18$$

$$= 0.018$$

The z statistics then becomes:

$$z = \frac{0.018 - 0.023}{\sqrt{\frac{0.023(1 - 0.023)}{11710}}} \qquad 4.19$$

$$= -3.6094$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)}/_{2} = Z_{(1-0.05)}/_{2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Rejection\ Region\ is\ Z\colon |Z| \geq Z_{(1-\propto)}/_{2}$$

The absolute value of -3.6094 was actually greater than the critical value ($|-3.6094| = 3.6094 > 1.96$); thus, the null hypothesis was rejected. The conclusion was that the sample proportion for respondents in the category ‘divorced’ was not equal to the population proportion in the same category, that is, the sample proportion was either larger or smaller than the population proportion.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done and it was as follows:

H_0: $P_0 < 0.023$

H_1: $P_0 \geq 0.023$

The z statistics was calculated the same way as it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$
$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \leq Z_{1-\propto}$$

The calculated z statistics was -3.6094, and it was less than the critical value (-3.6094 < 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the 'divorced' category was greater than the sample proportion in the same category.

f) Hypothesis test for the proportion of separated respondents

We wanted to test the hypothesis that the sample proportion in the separated category was equal to or less than the population proportion in the same marital status category. The following hypotheses were tested at $\alpha = 0.05$ for respondents who were separated.

H_0: $P_0 = 0.07$

H_1: $P_0 \neq 0.07$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \tag{4.20}$$

Then the proportion becomes:

$$P = \frac{541}{11710} \tag{4.21}$$
$$= 0.046$$

The z statistics then becomes:

$$z = \frac{0.046 - 0.07}{\sqrt{\frac{0.07(1 - 0.07)}{11710}}} \tag{4.22}$$
$$= -10.1789$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of -10.1789 was greater than the critical value ($|-10.1789| = 10.1789 > 1.96$); thus, the null hypothesis was rejected. The conclusion was that the sample proportion for respondents in the category ‘separated’ was not equal to the population proportion in the same category. The sample proportion was either larger or smaller than the population proportion in the separated marital status category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done.

H_0: $P_0 < 0.07$

H_1: $P_0 \geq 0.07$

The z statistics was calculated the same way as it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \leq Z_{1-\propto}$$

The calculated z statistics was -10.1789, and it was less than the critical value (-10.1789< 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the ‘separated’ category was greater than the sample proportion in the same category.

4.3.1.4 Education attainment

The expected and observed frequencies are represented in table 4.15, based on the education status of respondents. The expected frequencies for the different categories were calculated as follows:

$$E(x) = n * p$$

$$=11710 * 0.014$$

$$=163.4$$

The hypothesis that was tested was shown as:

H0: the sample data are consistent with the distribution of the population based on the education attainment

H1: the sample data are not consistent with the distribution of the population based on the education attainment

Table 4.15: Expected and Observed frequencies by education attainment

Education attainment	**Observed frequency**	**Expected frequency**
no education	272	163.4
incomplete primary	3356	2851.5
complete primary	3330	3054.1
incomplete secondary	3442	4369.3
complete secondary	682	692.4
Higher	628	579.3
Total	**11710**	**11710**

The chis-square statistics was then calculated as follows:

$$\chi^2 = \sum_{i=1}^{2} \frac{(O_i - E_i)^2}{E_i} \qquad 4.23$$

$$= \frac{(272-163.4)^2}{163.4} + \frac{(3356-2851.5)^2}{2851.5} + \cdots + \frac{(628-579.3)^2}{579.3}$$

$$= 387.41$$

The rejection rule was given by:

$$Reject\ H_0\ if\ \chi^2_{\frac{\propto}{2}k-1} < \chi^2$$

The degrees of freedom in this case were five, because education attainment has six categories. Now at df = 5 and α = 0.05 the critical value is 12.83. The calculated chi-square value was 387.41, which is greater than the tabulated value, thus we reject the null hypothesis. The conclusion was that at five percent level of significance, we were certain that the sample data were not consistent with the distribution of the population based on their education attainment. A hypothesis test for the proportions within the categories of education attainment was performed.

a) Hypothesis test for the proportion of no education

We wanted to test the hypothesis that the sample proportion in the no education category was equal to or greater than the population proportion in the same category. The following hypotheses were tested at α = 0.05 for respondents who had no education.

H_0: $P_0 = 0.014$

H_1: $P_0 \neq 0.014$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \tag{4.24}$$

Now the proportion was calculated as:

$$P = \frac{272}{11710} \tag{4.25}$$

$$= 0.023$$

The z statistics then becomes:

$$z = \frac{0.023 - 0.014}{\sqrt{\frac{0.014(1 - 0.014)}{11710}}} \tag{4.26}$$

$$= 8.2893$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of 8.2893 was greater than the critical value ($|8.2893| = 8.2893 > 1.96$); thus, we reject the null hypothesis. The conclusion drawn form this was that the sample proportion for respondents in the category ‘no education’ was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as follows:

H_0: $P_0 > 0.014$

H_1: $P_0 \leq 0.014$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \geq Z_{1-\propto}$$

The calculated z statistics was 8.2893, and it was greater than the critical value (8.2893 > 1.64); thus, the null hypothesis was rejected. This is an indication that the population proportion for respondents in the ‘no education’ category was smaller than the sample proportion in the same category.

b) Hypothesis test for the proportion of incomplete primary education

We wanted to test the hypothesis that the sample proportion in the incomplete primary education category was equal to or greater than the population proportion in that same category. The following hypotheses were tested at $\alpha = 0.05$ for respondents who had incomplete primary education.

H_0: $P_0 = 0.244$

H_1: $P_0 \neq 0.244$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \tag{4.27}$$

Now the proportion was calculated as:

$$P = \frac{3356}{11710} \tag{4.28}$$

$$= 0.287$$

The z statistics then becomes:

$$z = \frac{0.287 - 0.244}{\sqrt{\frac{0.244(1 - 0.244)}{11710}}} \tag{4.29}$$

$$= 10.8341$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of 10.8341 was greater than the critical value ($|10.8341| = 10.8341 > 1.96$); thus, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the category ‘incomplete primary education’ was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done and it was as follows:

H_0: $P_0 > 0.244$

H_1: $P_0 \leq 0.244$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$
$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \geq Z_{1-\propto}$$

The calculated z statistics was 10.8341, and it was greater than the critical value (10.8341 > 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the 'incomplete primary education' category was smaller than the sample proportion in the same category.

c) Hypothesis test for the proportion of complete primary education

We wanted to test the hypothesis that the sample proportion in the category "complete primary education" was equal to or greater than the population proportion in that category. The following hypotheses were tested at $\alpha = 0.05$ for respondents who had complete primary education.

H_0: $P_0 = 0.261$

H_1: $P_0 \neq 0.261$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1-P_0)}{n}}} \qquad 4.30$$

Now the proportion was calculated as:

$$P = \frac{3330}{11710} \qquad 4.31$$
$$= 0.284$$

The z statistics then becomes:

$$z = \frac{0.284 - 0.261}{\sqrt{\frac{0.261(1-0.261)}{11710}}} \qquad 4.32$$
$$= 2.1656$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$
$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of 2.1656 was greater than the critical value ($|2.1656| = 2.1656 > 1.96$); thus, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the category 'complete primary education' was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as below:

H_0: $P_0 > 0.261$

H_1: $P_0 \leq 0.261$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$
$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \geq Z_{1-\propto}$$

The calculated z statistics was 2.1656, and it was greater than the critical value (2.1656 > 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the 'complete primary education' category was smaller than the sample proportion in the same category.

d) Hypothesis test for the proportion of incomplete secondary education

We wanted to test the hypothesis that the sample proportion in the category incomplete secondary education was equal to or less than the population proportion in that category. The following hypotheses were tested at $\alpha = 0.05$ for respondents who had incomplete secondary education.

H_0: $P_0 = 0.373$

H_1: $P_0 \neq 0.373$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \qquad 4.33$$

Now the proportion was calculated as:

$$P = \frac{3442}{11710} \qquad 4.34$$

=0.294

The z statistics then becomes:

$$z = \frac{0.294 - 0.373}{\sqrt{\frac{0.373(1 - 0.373)}{11710}}} \qquad 4.35$$

= -17.6774

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/2} = Z_{(1-0.05)/2}$$

= 1.96

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/2}$$

The absolute value of -17.6774 was greater than the critical value ($|-17.6774| = 17.6774 > 1.96$); thus, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the category ‘incomplete secondary education’ was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as follows:

H_0: $P_0 < 0.373$

H_1: $P_0 \geq 0.373$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \leq Z_{1-\propto}$$

The calculated z statistics was -17.6774, and it was less than the critical value (-17.6774 < 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the 'incomplete secondary education' category was greater than the sample proportion in the same category.

e) Hypothesis test for the proportion of complete secondary education

We wanted to test the hypothesis that the sample proportion in the complete secondary education category was equal to or less than the population proportion in the same category of education attainment. The following hypotheses were tested at α = 0.05 for respondents who had completed secondary education.

H_0: $P_0 = 0.059$

H_1: $P_0 \neq 0.059$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1-P_0)}{n}}} \qquad 4.35$$

Now the proportion was calculated as:

$$P = \frac{682}{11710} \qquad 4.37$$

$$=0.058$$

The z statistics then becomes:

$$z = \frac{0.058 - 0.059}{\sqrt{\frac{0.059(1-0.059)}{11710}}} \qquad 4.38$$

$$= -0.4593$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)}/_{2} = Z_{(1-0.05)}/_{2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)}/_{2}$$

The absolute value of -0.4593 was less than the critical value ($|-0.4593| = 0.4593 < 1.96$); thus, we failed to reject the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the category 'complete secondary education' was equal to the population proportion in the same category. Because of this conclusion, the one-tailed hypothesis was not tested, since the conclusion was clear.

f) Hypothesis test for the proportion of higher education

We wanted to test the hypothesis that the sample proportion in the "higher education" category was equal to or greater than the population proportion in that same category. The following hypotheses were tested at α = 0.05 for respondents who had a higher education.

H_0: $P_0 = 0.049$

H_1: $P_0 \neq 0.049$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1-P_0)}{n}}} \qquad 4.38$$

Now the proportion was calculated as:

$$P = \frac{628}{11710} \qquad 4.40$$

$$=0.054$$

The z statistics then becomes:

$$z = \frac{0.054 - 0.049}{\sqrt{\frac{0.049(1-0.049)}{11710}}} \qquad 4.41$$

$$= 2.5065$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/2} = Z_{(1-0.05)/2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/2}$$

The absolute value of 2.5065 was greater than the critical value ($|2.5065| = 2.5065 > 1.96$); thus, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the category 'higher education' was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as follows:

H_0: $P_0 > 0.049$

H_1: $P_0 \leq 0.049$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \geq Z_{1-\propto}$$

The calculated z statistics was 2.5065, and it was greater than the critical value (2.5065 > 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the 'higher education' category was less than the sample proportion in the same category.

4.3.1.5 Age-groups

The age groups' observed and expected frequencies were also calculated. The data were then represented in the form of a table, as in table 4.16. Then a hypothesis test was done to check if the data were consistent with the distribution of the population.

Table 4.16: Expected and Observed frequencies by age

Age groups	**Observed frequency**	**Expected frequency**
15-19	242	2240.3
20-24	1153	2127.2
25-29	1831	2016.9
30-34	2153	1737.7
35-39	2235	1760.6
40-44	2086	1027.9
45-49	2010	799.4
Total	**11710**	**11710**

The expected frequencies for the different age categories were calculated as:

$$E(x) = n * p$$

$$=11710 * 0.191$$

$$=2240.3$$

The formula was the same for the differnet categories. The hypothesis that was tested was given as:

H$_0$: the sample data are consistent with the distribution of the population based on the age groups

H$_1$: the sample data are not consistent with the distribution of the population based on the age groups

Based on the data in table 4.16, the chi-square goodness of fit test statistic was calculated and the results of the test were given as:

$$\chi^2 = \sum_{i=1}^{2} \frac{(O_i - E_i)^2}{E_i} \qquad 4.42$$

$$= \frac{(242-2240.3)^2}{2240.3} + \frac{(1153-2127.2)^2}{2127.2} + \cdots + \frac{(2010-799.4)^2}{799.4}$$

$$= 5395.43$$

This variable has seven different categories within it; thus, the degrees of freedom were calculated as k – 1 = 6. At α = 0.05 significance level, the critical value was 14.45, and the rejection rule was given as:

$$Reject\ H_0\ if\ \ \chi^2_{\frac{\propto}{2}k-1} < \chi^2$$

The rejection rule stated that we rejected the null hypothesis only if the critical value was less than the calculated value, and in this case, it was less than the calculated value since 14.45 < 5395.43. Therefore, we rejected the null hypothesis, and the conclusion was that at five percent level of significance, we were confident that the sample data were not consistent with the distribution of the population based on the age groups. To see why the data were not consistent, a hypothesis test for the proportions within the categories of age groups was performed, and a conclusion made based on the results of the proportions test.

a) Hypothesis test for the proportion of 15-19 age group

We wanted to test the hypothesis to establish if the sample proportion for the age group category 15-19 years was equal to or less than the population proportion in the same category of age. The following hypotheses were tested at α = 0.05 for respondents who were aged 15-19 years.

H_0: $P_0 = 0.191$

H_1: $P_0 \neq 0.191$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1-P_0)}{n}}} \qquad 4.43$$

Now the proportion was calculated as:

$$P = \frac{242}{11710} \qquad 4.44$$

$$=0.021$$

The z statistics then becomes:

$$z = \frac{0.021 - 0.191}{\sqrt{\frac{0.191(1 - 0.191)}{11710}}} \tag{4.45}$$

= -46.7990

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of -46.7990 was greater than the critical value ($|-46.7990| = 46.7990 > 1.96$); thus, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the age category ‘15-19 years’ was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done below:

H_0: $P_0 < 0.191$

H_1: $P_0 \leq 0.191$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \leq Z_{1-\propto}$$

The calculated z statistics was -46.7990, and it was less than the critical value (-46.7990 < 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the ‘15-19 years’’ age category was greater than the sample proportion in the same category.

b) Hypothesis test for the proportion of 20-24 years' age group

We wanted to test the hypothesis that the sample proportion in the category of age groups 20-24 years was equal to or less than the population proportion for the same category. The following hypotheses were tested at α = 0.05 for respondents who were aged 20-24 years.

H_0: $P_0 = 0.182$

H_1: $P_0 \neq 0.182$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \tag{4.46}$$

Now the proportion was calculated as:

$$P = \frac{1153}{11710} \tag{4.47}$$

$$=0.098$$

The z statistics then becomes:

$$z = \frac{0.098 - 0.182}{\sqrt{\frac{0.182(1 - 0.182)}{11710}}} \tag{4.48}$$

$$= -23.5584$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of -23.5584 was greater than the critical value ($|-23.5584| = 23.5584 > 1.96$); therefore, we reject the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the age category ‘20-24 years’ was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done.

H_0: $P_0 < 0.182$

H_1: $P_0 \leq 0.182$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$
$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \leq Z_{1-\propto}$$

The calculated z statistics was -23.5584, and it was less than the critical value (-23.5584 < 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the ‘20-24 years’ age category was greater than the sample proportion in the same category.

c) Hypothesis test for the proportion of 25-29 years’ age group

We wanted to test the hypothesis that the sample proportion for the age group category 25-29 years was equal to or less than the population proportion within the same age group category. The following hypotheses were tested at $\alpha = 0.05$ for respondents who were aged 25-29 years.

H_0: $P_0 = 0.172$

H_1: $P_0 \neq 0.172$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \qquad 4.49$$

Now the proportion was calculated as:

$$P = \frac{1831}{11710} \qquad 4.50$$
$$=0.156$$

The z statistics then becomes:

$$z = \frac{0.156 - 0.172}{\sqrt{\frac{0.172(1-0.172)}{11710}}} \qquad 4.51$$

$$= -4.5880$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of -4.5880 was greater than the critical value ($|-4.5880| = 4.5880 > 1.96$); thus, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the age category '25-29 years' was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as follows:

H_0: $P_0 < 0.172$

H_1: $P_0 \geq 0.172$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \leq Z_{1-\propto}$$

The calculated z statistics was -4.5880, and it was less than the critical value (-4.5880 < 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the '25-29 years' age category was larger than the sample proportion in the same category.

d) Hypothesis test for the proportion of 30-34 years' age group

We wanted to test the hypothesis that the sample proportion in the age groups 30-34 years category was equal to or greater than the population proportion in the same age group category. The following hypotheses were tested at $\alpha = 0.05$ for respondents who were aged 30-34 years.

H_0: $P_0 = 0.148$

H_1: $P_0 \neq 0.148$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \qquad 4.52$$

Now the proportion was calculated as:

$$P = \frac{2153}{11710} \qquad 4.53$$

$$=0.184$$

The z statistics then becomes:

$$z = \frac{0.184 - 0.148}{\sqrt{\frac{0.148(1 - 0.148)}{11710}}} \qquad 4.54$$

$$= 10.9706$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of 10.9706 was greater than the critical value ($|10.9706| = 10.9706 > 1.96$); thus, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the age category '30-34 years' was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done.

H_0: $P_0 > 0.148$

H_1: $P_0 \leq 0.148$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$
$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \geq Z_{1-\propto}$$

The calculated z statistics was 10.9706, and it was greater than the critical value (10.9706 > 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the '30-34 years' age category was less than the sample proportion in the same category.

e) Hypothesis test for the proportion of 35-39 years' age group

We wanted to test the hypothesis that the sample proportion in the category '35-39 years" of age was equal to or greater than the population proportion within the same age group category. The following hypotheses were tested at $\alpha = 0.05$ for respondents who were aged 35-39 years.

H_0: $P_0 = 0.15$

H_1: $P_0 \neq 0.15$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1-P_0)}{n}}} \qquad 4.55$$

Now the proportion was calculated as:

$$P = \frac{2235}{11710} \qquad 4.56$$
$$=0.191$$

The z statistics then becomes:

$$z = \frac{0.191 - 0.15}{\sqrt{\frac{0.15(1-0.15)}{11710}}} \qquad 4.57$$

= 12.4253

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/2} = Z_{(1-0.05)/2}$$
$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/2}$$

The absolute value of 12.4253 was greater than the critical value ($|12.4253| = 12.4253 > 1.96$); thus, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the age category ‘35-39 years’ was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done below:

H_0: $P_0 > 0.15$
H_1: $P_0 \leq 0.15$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$
$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \geq Z_{1-\propto}$$

The calculated z statistics was 12.4253, and it was greater than the critical value (12.4253 > 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the ‘30-34 years’’ age category was smaller than the sample proportion in the same category.

f) Hypothesis test for the proportion of 40-44 years' age group

We wanted to test the hypothesis that the sample proportion in the 40-44 years age group category was equal to or greater than the population proportion in the same category. The following hypotheses were tested at $\alpha = 0.05$ for respondents who were aged 40-44 years.

H_0: $P_0 = 0.088$

H_1: $P_0 \neq 0.088$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \qquad 4.58$$

Now the proportion was calculated as:

$$P = \frac{2086}{11710} \qquad 4.59$$

$$=0.178$$

The z statistics then becomes:

$$z = \frac{0.178 - 0.088}{\sqrt{\frac{0.088(1 - 0.088)}{11710}}} \qquad 4.60$$

$$= 34.3781$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of 34.3781 was greater than the critical value ($|34.3781| = 34.3781 > 1.96$); thus, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the age category '40-44 years' was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done.

H_0: $P_0 > 0.088$

H_1: $P_0 \leq 0.088$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \geq Z_{1-\propto}$$

The calculated z statistics was 34.3781, and it was greater than the critical value (34.3781 > 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the '40-44 years' age category was smaller than the sample proportion in the same category.

g) Hypothesis test for the proportion of 45-49 years' age group

We wanted to test the hypothesis that the sample proportion in the age group category "45-49 years" was equal to or greater than the population proportion in that same age group. The following hypotheses were tested at $\alpha = 0.05$ for respondents who were aged 45-49 years.

H_0: $P_0 = 0.088$

H_1: $P_0 \neq 0.088$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1-P_0)}{n}}} \tag{4.61}$$

Now the proportion was calculated as:

$$P = \frac{2010}{11710} \tag{4.62}$$

$$=0.172$$

The z statistics then becomes:

$$z = \frac{0.172 - 0.068}{\sqrt{\frac{0.068(1 - 0.068)}{11710}}} \qquad 4.63$$

= 44.7043

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ |Z| \geq Z_{(1-\propto)/_2}$$

The absolute value of 44.7043 was greater than the critical value ($|44.7043| = 44.7043 > 1.96$); therefore, we rejected the null hypothesis. The conclusion drawn from this was that the sample proportion for respondents in the age category ‘45-49 years’ was not equal to the population proportion in the same category.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done.

H_0: $P_0 > 0.088$

H_1: $P_0 \leq 0.088$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ Z \geq Z_{1-\propto}$$

The calculated z statistics was 44.7043, and it was greater than the critical value (44.7043 > 1.64); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the ‘45-49 years’ age category was smaller than the sample proportion in the same category.

4.3.2 Chi-square tests

The Pearson chi-squared statistic was calculated for the data that were collected for the respondents who went for HIV testing, to check for independence between the main variable blood test result and the other socio-economic variables that are of intrinsic interest in this research project. Table 4.11 gives a representation of the chi-square results, the degrees of freedom, and the p-value associated with each variable. The following null hypotheses were tested:

(a) H_{01}: blood test result is dependent on gender of the respondent
(b) H_{02}: blood test result is dependent on place of residence of the respondent
(c) H_{03}: blood test result is dependent on marital status of the respondent
(d) H_{04}: blood test result is dependent on education attainment of the respondent
(e) H_{05}: blood test result is dependent on age-group that the respondent falls within

These hypotheses were tested against the alternative hypothesis that there was independence between blood test results and all the other socio-economic variables of interest. That is, the alternative hypotheses that were tested were as follows:

(a) H_{11}: blood test result is independent of gender of the respondent
(b) H_{12}: blood test result is independent of place of residence of the respondent
(c) H_{13}: blood test result is independent of marital status of the respondent
(d) H_{14}: blood test result is independent of education attainment of the respondent
(e) H_{15}: blood test result is independent of age-group that the respondent falls within

For all the hypotheses that were tested, the results were significant at 0.05 level, which is an indication that for the alternative hypothesis, there was independence between the blood test result and the other socio-economic variables. Therefore, the alternative hypothesis was accepted, while the null hypotheses were rejected.

Table 4.17: Pearson Chi-Square Tests

Variable of interest	**Specification**	**Outcome**
Gender	Chi-square	35.266
	Degrees of freedom	2
	P-value	0.000*
Place of residence	Chi-square	32.213
	Degrees of freedom	2
	P-value	0.000*
Current marital status	Chi-square	35.694
	Degrees of freedom	10
	P-value	0.000*
Educational attainment	Chi-square	64.011
	Degrees of freedom	10
	P-value	0.000*
Age in 5-year groups	Chi-square	54.164
	Degrees of freedom	12
	P-value	0.000*
***. The Chi-square statistic is significant at the .05 level.**		

4.3.3 Correlations

A correlation is a statistical quantity that specifies the extent to which two or more variables altenate. A positive correlation shows the extent to which those variables increase or decrease concurrently; a negative correlation shows the degree to which one variable increases as the other variable decreases (Schober, *et al.*, 2018).

4.3.3.1 Cramer's V for nominal data

Cramer's V correlation is used to quantity the forte of the association between one nominal variable, either with another nominal variable, or with an ordinal variable, after chi-square has envisaged the significance (Cohen, 1988). The value of Cramer's V has to be between zero and one. The association cut off points can be interpreted as follows:

- $V < 0.05$ implies no or very week association
- $0.05 < V \leq 0.1$ implies weak association
- $0.1 \leq V \leq 0.15$ implies moderate association
- $0.15 < V < 0.25$ implies strong association
- $V \geq 0.25$ implies very strong association

  (Cohen, 1988)

a) Blood test result and gender

We wanted to test if there was an association between gender and blood test results using the Cramer's V test; the results of the test are shown in table 4.18. The hypothesis that we wanted to test was as follows:

H_0: there is no relationship between gender and blood test result

H_1: there is a relationship between gender and blood test results

The table shows that the value of Cramer's V is 0.055, which is less than the cut-off point of 0.1, thus indicating a weak or no association between gender and blood test results; thus, the null hypothesis (H_0) cannot be rejected. This implies that the variable gender was independent of blood test results; that is, gender does not, in any way have an impact on the blood test results of respondents.

Table 4.18: Cramer's V correlation between gender and blood test results

	Correlation co-efficient	Value	Approx. Sig.
Nominal by Nominal	Phi	0.055	0.000
	Cramer's V	0.055	0.000
N of Valid Cases		11710	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

b) Blood test result and place of residence

Table 4.19 shows that there was significant evidence of a weak association between place of residence and the blood test result. The hypothesis that was tested is:

H_0: there is no relationship between place of residence and blood test result

H_1: there is a relationship between place of residence and blood test results

The value of the Cramer's V was 0.052, which was between 0.05 and 0.1; thus, a weak or no relationship. This was an indication that place of residence was indeed independent of the blood test result of the respondents, since the null hypothesis was not rejected.

Table 4.19: Cramer's V correlation between place of residence and blood test results

	Correlation co-efficient	Value	Approx. Sig.
Nominal by Nominal	Phi	0.052	0.000
	Cramer's V	0.052	0.000
N of Valid Cases		11710	
a. Not assuming the null hypothesis. b. Using the asymptotic standard error assuming the null hypothesis.			

c) Blood test result and current marital status

The hypothesis that we want to test is:

H_0: there is no relationship between marital status and blood test result

H_1: there is a relationship between marital status and blood test results

The value of the Cramer's V correlation as per table 4.20 was 0.055, and the value was significant at 0.05 level. This value was between 0.05 and 0.1 indicating a weak or no relationship between current marital status and the blood test result. Therefore**,** the null hypothesis (H_0) was not rejected, indicating that marital status was independent of the blood test results.

Table 4.20: Cramer's V correlation between current marital status and blood test results

	Correlation co-efficient	Value	Approx. Sig.
Nominal by Nominal	Phi	0.055	0.000
	Cramer's V	0.039	0.000
N of Valid Cases		11710	
a. Not assuming the null hypothesis. b. Using the asymptotic standard error assuming the null hypothesis.			

4.3.3.2 Kendall's Tau correlation for ordinal data

The Kendall rank correlation coefficient, usually referred to as Kendall's tau coefficient (after the Greek letter τ), is used to quantity the relationship between two ordinal quantities. The relationship between two variables is said to be high when observations have similar ranks between them and low when they have different ranks (Blackwell Science Ltd, 2001). The tau correlation coefficient returns a value of zero (no relationship) to one (perfect relationship). The results of the test can be interpreted as thus:

- $|\tau| < 0.05$ implies no or very week relationship
- $0.05 < |\tau| \leq 0.1$ implies weak relationship
- $0.1 \leq |\tau| \leq 0.15$ implies moderate relationship
- $0.15 < |\tau| < 0.25$ implies strong relationship
- $|\tau| \geq 0.25$ implies very strong relationship

  (Field, 2017)

a) Blood test result and education attainment

The hypothesis that we want to test is:

H_0: there is no relationship between education attainment and blood test result

H_1: there is a relationship between education attainment and blood test results

Table 4.21 depicts the correlation between blood test results and education attainment at an approximate significance level of 91.2%. It shows that the value for Kendall's tau-b was -0.001, with a standard error of about 0.008. Kendall's tau-b value is below 0.05; therefore is an indication that there is no relationship between education attainment and blood test results. Therefore, we do not reject H_0, and we conclude that there was no relationship between education attainment and blood test results.

Table 4.21: Kendall Tau correlation between education attainment and blood test results

Correlation co-efficient	Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Kendall's tau-b	-0.001	0.008	-0.111	0.912
N of Valid Cases	11710			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

b) Blood test result and age groups

The correlation between blood test results and age group was shown in table 4.22. The hypothesis that was tested is as follows:

H_0: there is no relationship between age groups and blood test result

H_1: there is a relationship between age groups and blood test results

The results show that Kendall's tau-b value was found to be -0.002, which was less than 0.05 but very close to zero; thus, an indication of no relationship between the two variables. At 83.3% level of significance, the standard error for the tau value was very insignificant (0.008). Therefore, the null hypothesis (H_0) was not rejected.

Table 4.22: Kendall's Tau correlation between Age groups and blood test results

	Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Kendall's tau-b	-0.002	0.008	-0.211	0.833
N of Valid Cases	11710			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

4.4 Descriptive Statistics on Maternal Mortality

In this section, women aged between 15 and 49 years were considered, since they are women of childbearing age for whom maternal mortality is calculated. As mentioned in the methodology, the data are from the Lesotho Demographic Health Survey. The tables that follow in this section show the disaggregation of both HIV positive and HIV negative women, based on various socio-economic characteristics. The tables also show the disaggregation of the whole population of women of childbearing ages, as per categories within the variables of interest.

Table 4.23 shows the population of female respondents of childbearing age within the categories of various variables of interest. The table depicts that the majority of the population of females of childbearing age are from the rural areas (77.7 percent). It also shows that 87.1 percent of the female population are married, followed by 8.1 percent who have never been in a union, with the least percentage being that of divorcees. The table further shows that females of childbearing age who had incomplete secondary education had the population’s highest percentage, with the least percentage being that of females with no education.

Table 4.24 shows the percentage distribution of female respondents of childbearing age by blood test results and place of residence of the respondent. The table shows that the majority of female respondents who tested for HIV reside in the rural areas of Lesotho. It also shows that 23.6 percent of women who tested HIV positive reside in the urban areas of Lesotho. Furthermore, women who tested positive for HIV and live in the rural areas of Lesotho outnumbered those in the urban areas by a margin of 4.1 percent; that is 27.7 percent in the rural and 23.6 percent in the urban areas.

Table 4.23: Percentage distribution of the population of women of childbearing age as per the variables of interest

Variable	Category	Women of childbearing age	
		Population	Percent
Place of residence	**Urban**	110 028	22.3%
	Rural	382 583	77.7%
	Total	**492 611**	**100.0%**
Marital Status	**Never in union**	39 897	8.1%
	Married	429 058	87.1%
	Living with partner	3 152	0.6%
	Widowed	6 016	1.2%
	Divorced	1 822	0.4%
	Separated	12 684	2.6%
	Total	**492 611**	**100.0%**
Education Attainment	**No education**	7 340	1.5%
	Incomplete primary	123 390	25.0%
	Complete primary	130 227	26.4%
	Incomplete secondary	183 452	37.2%
	Complete secondary	30 332	6.2%
	Higher	17 869	3.6%
	Total	**492 611**	**100.0%**
Age Groups	**15-19**	96 836	19.7%
	20-24	94 039	19.1%
	25-29	88 320	17.9%
	30-34	75 220	15.3%
	35-39	57 550	11.7%
	40-44	45 497	9.2%
	45-49	35 148	7.1%
	Total	**492 611**	**100.0%**

Table 4.24: Distribution of female respondents by Blood test result and place of residence

Place of residence	**Blood test result**					
	HIV negative		**HIV positive**		**Total**	
Urban	1 430	76.4%	442	23.6%	1 872	100.0%
Rural	4 338	72.3%	1 661	27.7%	5 999	100.0%
Total	**5 768**	**N/A**	**2 103**	**N/A**	**7 871**	**N/A**

Figure 4.12 represents the percentage distribution of tested female respondents, based on their place of residence and their blood test results. The figure shows that the majority of females who tested in both the urban and rural areas tested negative for HIV, while 23.6 percent tested positive in the urban areas, and 27.7 percent tested positive in the rural areas.

Figure 4.12: Distribution of tested respondents' blood test result based on place of residence

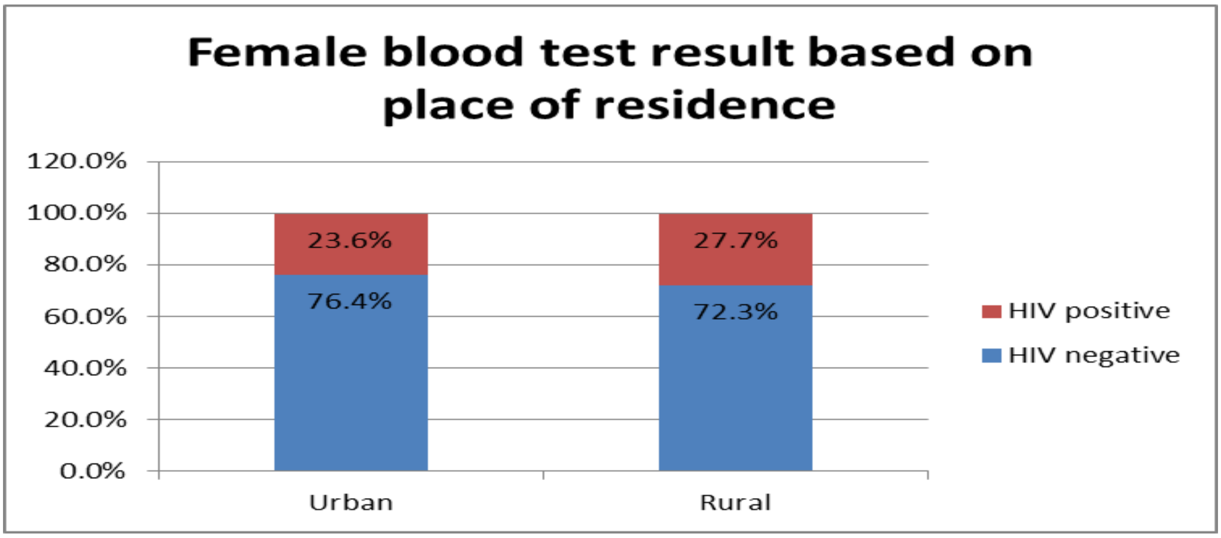


Table 4.25 shows the percentage distribution of female respondents of childbearing age by blood test results and marital status. The table shows that in the category 'never in union' 24.4 percent of females tested positive for HIV, while 75.6 percent tested negative. The percentage of positive female respondents ranges between 18 percent and 28 percent. In the category 'married', 27.0 percent of the females tested positive, and in the 'living with partner' category, 27.4 percent tested positive. The category with the least percentage who tested positive is the 'divorced' category, which yielded 18.8 percent.

Table 4.25: Percentage distribution of female respondents by Blood test result and marital status

Marital Status	Blood test result					
	HIV negative		HIV positive		Total	
Never in union	180	75.6%	58	24.4%	238	100%
Married	5 306	73.0%	1 962	27.0%	7 268	100%
Living with partner	45	72.6%	17	27.4%	62	100%
Widowed	91	77.1%	27	22.9%	118	100%
Divorced	26	81.2%	6	18.8%	32	100%
Separated	120	78.4%	33	21.6%	153	100%
Total	**5 768**	**N/A**	**2 103**	**N/A**	**7 871**	**N/A**

Figure 4.13 shows a representation of the data provided in table 4.20. It shows that based on marital status, the majority of the child bearing age female respondents' blood test results were negative. However, some categories still had higher percentages that tested positive.

Figure 4.13: Distribution of tested respondents' blood test result based on marital status

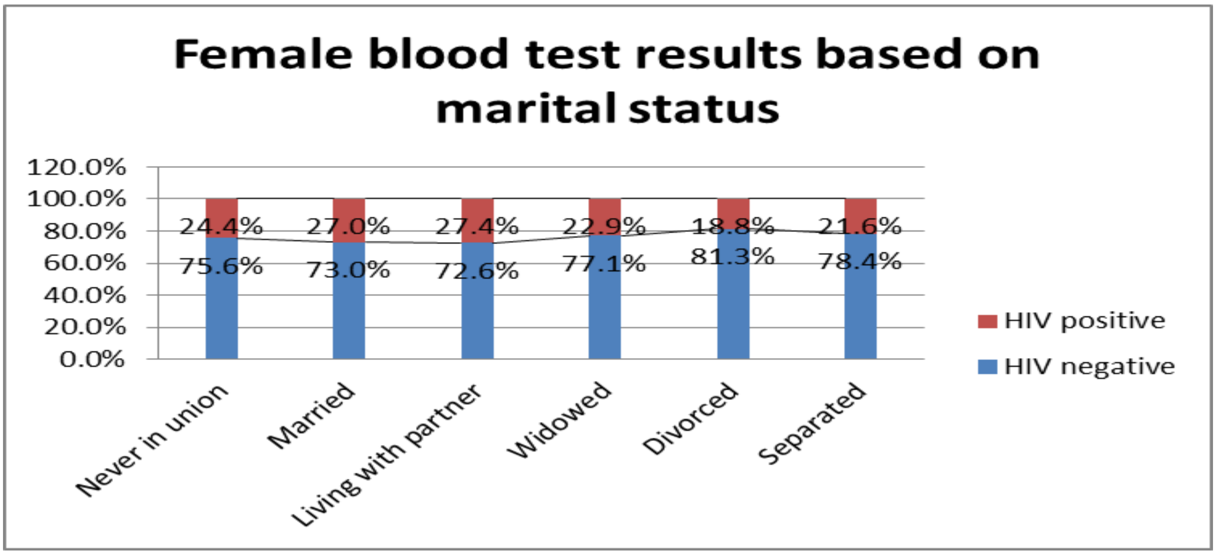


Table 4.26 shows the percentage distribution of women respondents of childbearing age by blood test results and their education attainment. It shows that the category of education, namely 'no education', had the least number of female respondents who were tested for HIV at 18.8 percent.

The table further shows that the 'incomplete primary' and 'incomplete secondary' categories had almost the same percentages for female respondents who tested positive (28.2 percent and 28.7 percent respectively). Moreover, 23.8 percent of respondents with a higher education attainment tested positive, while 76.4 tested negative.

Table 4.26: Percentage distribution of female respondents by Blood test result and education attainment

Education Attainment	**Blood test result**					
	HIV negative		**HIV positive**		**Total**	
No education	147	81.2%	34	18.8%	181	100%
Incomplete primary	1 657	71.8%	652	28.2%	2 309	100%
Complete primary	1 660	74.3%	575	25.7%	2 235	100%
Incomplete secondary	1 701	73.2%	624	26.8%	2 325	100%
Complete secondary	335	71.3%	135	28.7%	470	100%
Higher	268	76.4%	83	23.6%	351	100%
Total	**5 768**	**N/A**	**2 103**	**N/A**	**7 871**	**N/A**

Figure 4.14 represents the distribution of tested childbearing female respondents' blood test results based on their education attainment. The figure shows that the dispersion of respondents within the different categories of education attainment was almost the same.

Figure 4.14: Distribution of tested female respondents' blood test result based on education attainment

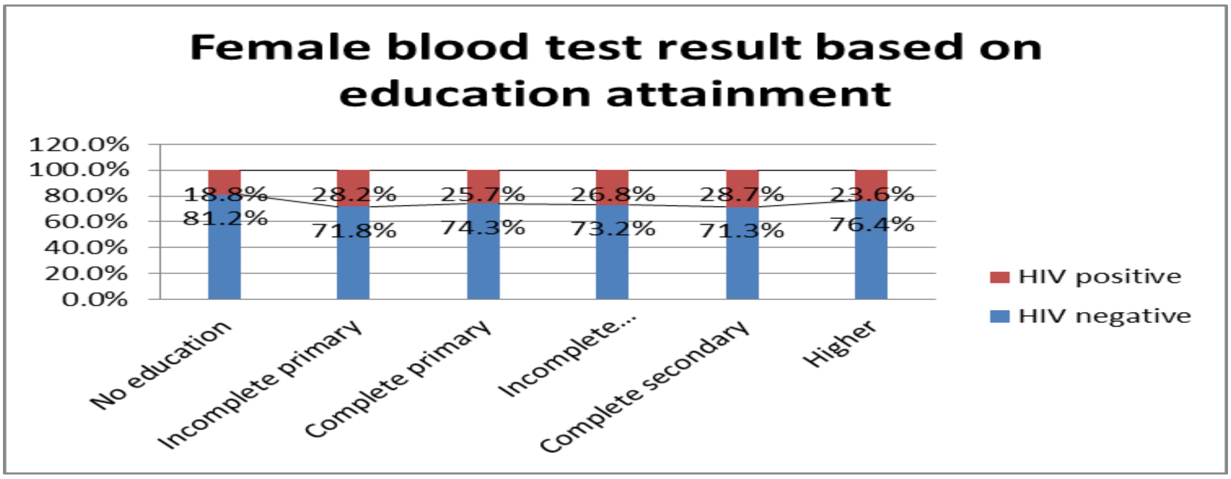


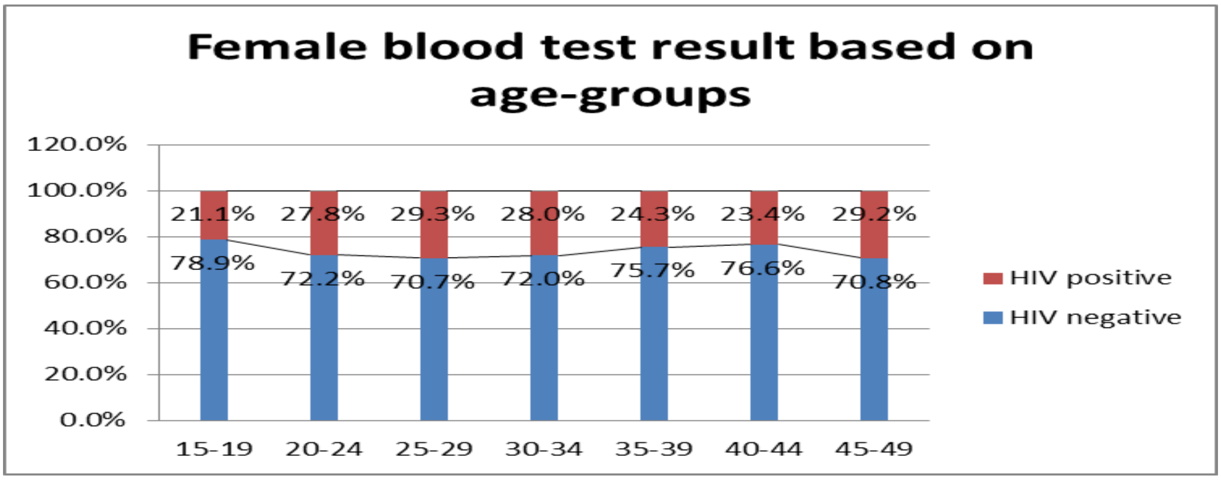
Table 4.27, depicts the percentage distribution of women respondents of childbearing age based on the blood test result and age group of the woman. The table shows that age groups 25-29 years and 45-49 years had almost the same percentage who tested positive (29.3 percent and 29.2 percent respectively). It further shows that within the age group 30-34 years, 28.0 percent of respondents tested positive for HIV, while 72.0 percent tested negative. In addition, age group 15-19 had the least percentage who tested positive (21.1 percent).

Table 4.27: Percentage distribution of female respondents by Blood test result and age groups

Age Groups	Blood test result					
	HIV negative		HIV positive		Total	
15-19	112	78.9%	30	21.1%	142	100%
20-24	530	72.2%	204	27.8%	734	100%
25-29	933	70.7%	386	29.3%	1 319	100%
30-34	1 071	72.0%	416	28.0%	1 487	100%
35-39	1 150	75.7%	369	24.3%	1 519	100%
40-44	1 079	76.6%	329	23.4%	1 408	100%
45-49	893	70.8%	369	29.2%	1 262	100%
Total	**5 768**	**N/A**	**2 103**	**N/A**	**7 871**	**N/A**

Figure 4.15 depicts the distribution of tested childbearing female respondents' blood test results based on age groups. These women were of childbearing age. The figure shows that a major part of the female population who tested for HIV, were found to be negative. It further shows that the dispersion of the respondents within the age groups differ by a small percentage.

Figure 4.15: Distribution of tested female respondents' blood test result based on age groups



4.4.1 Calculation of maternal mortality rate

Maternal mortality rate as seen earlier, can be calculated using the formula below:

$$MMR = \frac{\text{Number of maternal deaths}}{\text{Number of women of reproductive ages}} \times 100\,000 \qquad 4.64$$

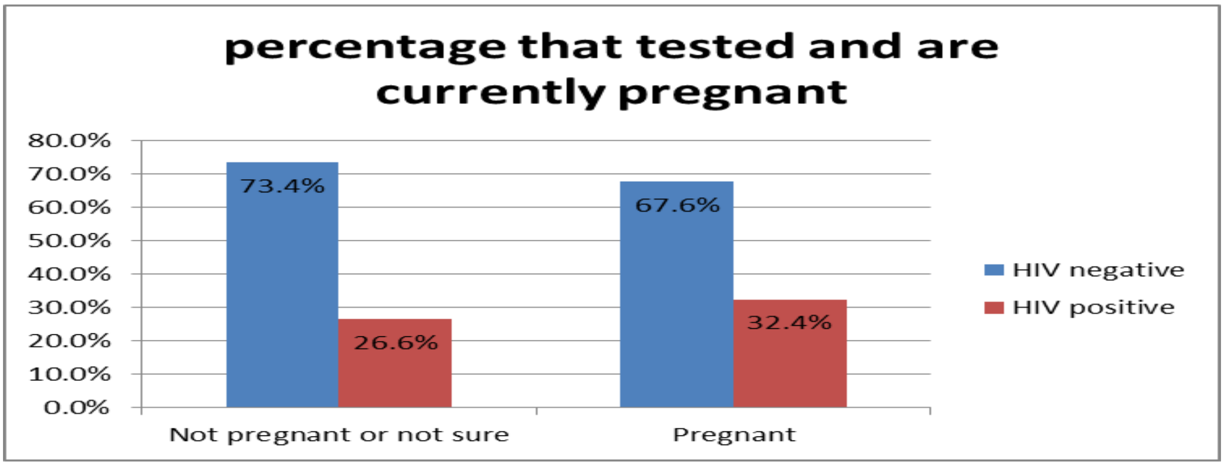
As seen from the descriptive statistics, the number of women in their reproductive ages was found to be 8427, which was 72 percent of the total respondents who were involved in the study and were tested for HIV. Of all these women, 2103 were found to have been infected with the HIV virus and of the HIV positive women 70 were pregnant at the time of survey, as shown in table 4.28.

Table 4.28: Percentage distribution of currently pregnant female based on HIV status

Currently pregnant	**Blood test result**					
	HIV negative		**HIV positive**		**Total**	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
No or unsure	5622	73.4%	2033	26.6%	7655	100%
Yes	146	67.6%	70	32.4%	216	100%
Total	**5768**	**73.3%**	**2103**	**26.7%**	**7871**	**100%**

Figure 4.16 shows that 26.6 percent of females who tested positive were not pregnant, or not sure if they were pregnant. Moreover, it shows that 32.4 percent of females who did know they were pregnant, tested positive for HIV. However, higher percentages were observed for females who tested HIV negative in comparison to those who tested positive, irrespective of whether they were pregnant, not pregnant, or were not sure if they were pregnant.

Figure 4.16: Distribution of tested female respondents' blood test result based on pregnancy situation



Now, the table 4.29 displays the number of female deaths as the result of the HIV status of the mother. This table shows that 1.6 percent of the deaths that occurred for HIV positive females occurred in the female reproductive age 15 to 49 years, which is of interest in this case. This implies that of a total of 8427 women, of whom 2103 tested HIV positive, 33 out of a total of 70 (about 47 percent) that were pregnant died as a result of their positive status.

Table 4.29: Percentage distribution of female deaths as a result of the HIV status of the mother

Age	**Blood test result**		
	HIV positive		
	Count	**Percent (%)**	**Population percentage**
0 to 5 years	116	5.5	5.2
6 to 14 years	28	1.3	1.0
15 to 49 years	33	1.6	1.2
50+ years	1 926	91.6	92.5
Total	**2 103**	**100.0**	**100.0**

Therefore, the maternal mortality rate was calculated as:

$$MMR = \frac{33}{8427} \times 100\,000 \approx 392 \qquad 4.65$$

This simply means that for every 100 000 women infected with the HIV virus, 392 die as a result of their HIV status.

4.5 Child Mortality

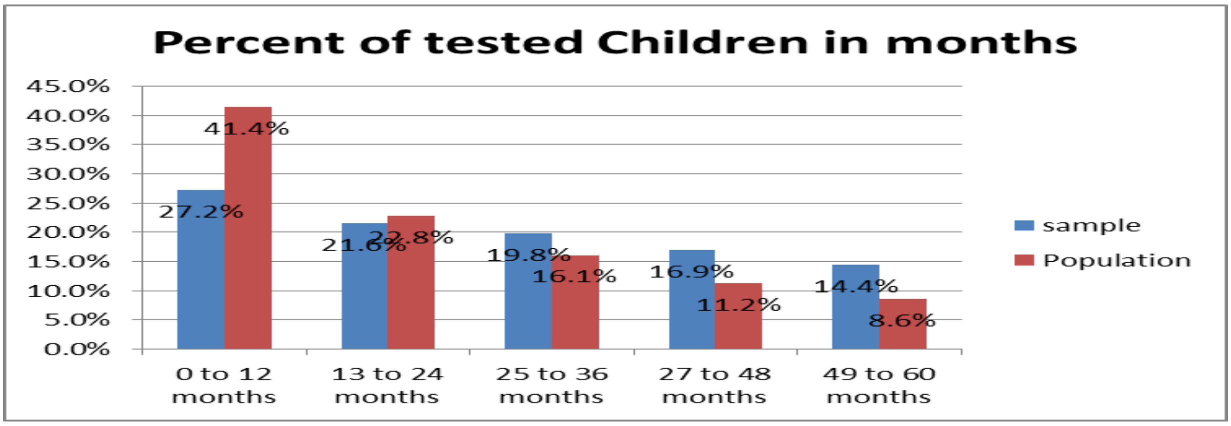
For this section children aged zero to five years were the major priority; thus, they were considered for the calculations that follow. The data as in the previous section are from the Lesotho Demographic Health Survey. Here, both sons and daughters were evaluated with respect to their mother's HIV status and the results were tabulated in table 4.30. The results show that the majority of the children who were tested for HIV, fall within the zero to 12 months category (27.2 percent) followed by those that are in the 13 to 24 months category (21.6 percent). The least tested children were found in the 49 to 60 months category, which is five years (14.4 percent).

Table 4.30: Percentage distribution of children that tested for HIV

Tested children	Sample		Population	
	Frequency	Percent	Frequency	Percent
0 to 12 months	376	27.2%	91 757	41.4%
13 to 24 months	298	21.6%	50 404	22.8%
25 to 36 months	274	19.8%	35 570	16.1%
27 to 48 months	234	16.9%	24 849	11.2%
49 to 60 months	199	14.4%	18 946	8.6%
Total	**1 381**	**100.0%**	**221 526**	**100%**

The bar chart in figure 4.17 represents the distribution of children that tested for HIV based on their age in months. The figure shows that in comparison to the general population of children aged zero to 12 months, the percentage of children that tested for HIV was lower than that of the population. It further shows that in the 12-24 months category, the percentages were almost the same, while in the rest of the categories the sample percentages were higher than the population percentages.

Figure 4.17: Bar chart of the distribution of tested children by age in months



4.5.1 Chi-square Goodness-of-Fit for children who tested

A chi-square Goodness-of-Fit test was then performed to test whether the observed frequencies vary significantly from the expected frequencies when the significance level is 0.05 (p=value is 0.05). The expected frequencies were calculated as follows:

$$E(x) = n * p$$

$$=1381 * 0.414$$

$$=572.0$$

This was calculated for all the categories of age. The following hypothesis was then tested:

> **H_0:** the sample data for tested children are consistent with the distribution of the population
>
> **H_1:** the sample data for tested children are not consistent with the distribution of the population

Table 4.31 gives a representation of the observed and expected frequencies for children who tested for HIV in months.

Table 4.31: Expected and observed frequencies for children that tested for HIV

Age in months	Observed frequency	Expected frequency
0-12	376	572.0
13-24	298	314.2
25-36	274	221.7
37-48	234	154.9
49-60	199	118.1
Total	**1 381**	**1 381**

The chis-square statistics was calculated as follows:

$$\chi^2 = \sum_{i=1}^{2} \frac{(O_i - E_i)^2}{E_i} \qquad 4.66$$

$$= \frac{(376-572)^2}{572} + \frac{(298-314.2)^2}{314.2} + \cdots + \frac{(199-118.1)^2}{118.1}$$

$$= 176.14$$

The rejection rule was given as:

$$Reject\ H_0\ if\ \chi^2_{\frac{\propto}{2}k-1} < \chi^2$$

The degrees of freedom (df) in this case were calculated as k – 1, whereby k = 5, since the age of the children tested was disaggregated into five categories. Thus, the value for the degrees of freedom was four. Now at df = 4 and α = 0.05, the critical value is 11.14. The calculated chi-square value was 176.14, which is greater than the tabulated value; thus, the null hypothesis was reject.

The conclusion is that at the five percent (5%) level of significance, we are certain that the sample data for tested children are not consistent with the distribution of the population. To check what caused the inconsistency in the data, the proportions test within each category of tested children was done and the results were as follows:

a) Hypothesis test for the proportions of children aged 0-12 months

We wanted to test the hypothesis that the sample proportion was equal to or less than the population proportion. The following hypotheses were tested at α = 0.05 for the category of children aged 0 to 12 months:

H_0: $P_0 = 0.414$

H_1: $P_0 \neq 0.414$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \qquad 4.67$$

Now the proportion was calculated as:

$$P = \frac{376}{1381} \qquad 4.68$$

$$= 0.272$$

The z statistics then becomes:

$$z = \frac{0.272 - 0.414}{\sqrt{\frac{0.414(1 - 0.414)}{1381}}} \qquad 4.69$$

$$= -10.7136$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ \ |Z| \geq Z_{(1-\propto)}/_2$$

In this case, the absolute value of -10.7136 was essentially larger than the critical value ($|-10.7136| = 10.7136\ > 1.96$); thus, the null hypothesis was rejected. The conclusion was that the sample proportion was not equal to the population proportion.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as follows:

H_0: $P_0 < 0.414$

H_1: $P_0 \geq 0.414$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$
$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ \ Z \leq Z_{1-\propto}$$

The calculated z statistics was -10.7136, and it was less than the critical value (-10.7136 < 1.64); thus, the null hypothesis was rejected. This is an indication that the population proportion for respondents in the ‘0-12 months’ category of tested children was larger than the sample proportion in the same category.

b) Hypothesis test for the proportions of children aged 13-24 months

We wanted to test the hypothesis that the sample proportion was equal to or less than the population proportion. The following hypotheses were tested at $\alpha = 0.05$ for the category of children aged 13 to 24 months.

H_0: $P_0 = 0.228$

H_1: $P_0 \neq 0.228$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \qquad 4.70$$

Now the proportion was calculated as:

$$P = \frac{298}{1381} \qquad 4.71$$

$$= 0.216$$

The z statistics then becomes:

$$z = \frac{0.216 - 0.228}{\sqrt{\frac{0.228(1 - 0.228)}{1381}}} \qquad 4.72$$

$$= -1.0629$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ \ |Z| \geq Z_{(1-\propto)/_2}$$

In this case, the absolute value of -1.0629 was essentially larger than the critical value ($|-1.0629| = 1.0629 < 1.96$); thus, the null hypothesis was not rejected. The conclusion was that the sample proportion was equal to the population proportion. Since the two-tailed null hypothesis was not rejected, the one-tailed-hypothesis was not done for the sample, and population proportions were found to be the same.

c) Hypothesis test for the proportions of children aged 25-36 months

We wanted to test the hypothesis that the sample proportion was equal to or greater than the population proportion. The following hypotheses were tested at α = 0.05 for the category of children aged 25 to 36 months.

H_0: $P_0 = 0.161$

H_1: $P_0 \neq 0.161$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \tag{4.73}$$

Now the proportion was calculated as:

$$P = \frac{274}{1381} \tag{4.74}$$

$$= 0.198$$

The z statistics then becomes:

$$z = \frac{0.198 - 0.161}{\sqrt{\frac{0.161(1 - 0.161)}{1381}}} \tag{4.75}$$

$$= 3.7411$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ \ |Z| \geq Z_{(1-\propto)/_2}$$

In this case, the absolute value of 3.7411 was essentially larger than the critical value ($|3.7411| = 3.7411\ > 1.96$); thus, the null hypothesis was rejected. The conclusion was that the sample proportion was not equal to the population proportion.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as below:

H_0: $P_0 > 0.161$

H_1: $P_0 \leq 0.161$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ \ Z{:}Z \geq Z_{1-\propto}$$

The calculated z statistics was 3.7411, and it was greater than the critical value ($3.7411 > 1.64$); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the '25-36 months' category of tested children was less than the sample proportion in the same category.

d) Hypothesis test for the proportions of children aged 37-48 months

We wanted to test the hypothesis that the sample proportion was equal to or less than the population proportion. The following hypotheses were tested at $\alpha = 0.05$ for the category of children aged 37 to 48 months.

H_0: $P_0 = 0.112$

H_1: $P_0 \neq 0.112$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \qquad 4.76$$

Now the proportion was calculated as:

$$P = \frac{234}{1381} \qquad 4.77$$

$$= 0.169$$

The z statistics then becomes:

$$z = \frac{0.169 - 0.112}{\sqrt{\frac{0.112(1 - 0.112)}{1381}}} \qquad 4.78$$

$$= 6.7167$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ \ |Z| \geq Z_{(1-\propto)/_2}$$

In this case, the absolute value of 6.7167 was essentially larger than the critical value ($|6.7167| = 6.7167\ > 1.96$); thus, the null hypothesis was rejected. The conclusion is that the sample proportion was not equal to the population proportion.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done as follows:

H_0: $P_0 < 0.112$

H_1: $P_0 \geq 0.112$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ \ Z \geq Z_{1-\propto}$$

The calculated z statistics was 6.7167, and it was greater than the critical value ($6.7167 > 1.64$); thus, the null hypothesis was rejected. This was an indication that the population proportion for respondents in the ‘37-48 months’ category of tested children was smaller than the sample proportion in the same category.

e) Hypothesis test for the proportions of children aged 49-60 months

We wanted to test the hypothesis that the sample proportion was equal to or less than the population proportion. The following hypotheses were tested at $\alpha = 0.05$ for the category of children aged 49 to 60 months.

H_0: $P_0 = 0.086$

H_1: $P_0 \neq 0.086$

The Z score was calculated as follows:

$$z = \frac{P - P_0}{\sqrt{\frac{P_0(1 - P_0)}{n}}} \tag{4.79}$$

Now the proportion was calculated as:

$$P = \frac{199}{1381} \tag{4.80}$$

$$= 0.144$$

The z statistics then becomes:

$$z = \frac{0.144 - 0.086}{\sqrt{\frac{0.086(1-0.086)}{1381}}} \tag{4.81}$$

$$= 7.6878$$

For a two-tailed hypothesis, the critical value is given as:

$$Z_{(1-\propto)/_2} = Z_{(1-0.05)/_2}$$

$$= 1.96$$

The rejection rule for a two-tailed hypothesis is given as:

$$Reject\ H_0\ if\ \ |Z| \geq Z_{(1-\propto)/_2}$$

In this case, the absolute value of 7.6878 was essentially larger than the critical value ($|7.6878| = 7.6878\ > 1.96$); thus, the null hypothesis was rejected. The conclusion was that the sample proportion was not equal to the population proportion.

To find out if the sample proportion was less than or larger than the population proportion, a one-tailed hypothesis from the same data was done.

H_0: $P_0 < 0.086$

H_1: $P_0 \geq 0.086$

The z statistics was calculated the same way it was for the two-tailed hypothesis but the critical value in this case was:

$$Z_{1-\propto} = Z_{1-0.05}$$

$$= 1.64$$

The rejection rule was given as:

$$Reject\ H_0\ if\ \ Z \geq Z_{1-\propto}$$

The calculated z statistics was 7.6878, and it was greater than the critical value (7.6878 > 1.64); therefore the null hypothesis was rejected. This was an indication that the population proportion for respondents in the '49-60 months' category of tested children was smaller than the sample proportion in the same category.

4.5.2 Blood test results for children

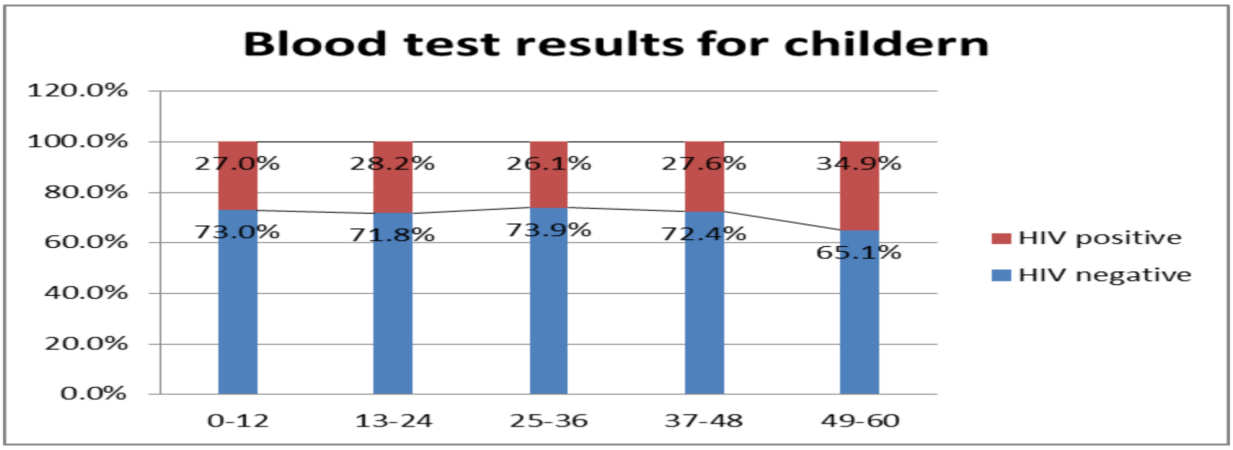
The table below shows the results for the percentage distribution of children who tested HIV positive along with the results for those that were negative. The table shows that majority of children who tested positive for HIV were within the category 49 to 60 months (34.9 percent). It also shows that the category 25 to 36 months had the least percentage who tested positive (26.1 percent).

Table 4.32: Percentage of children that tested positive for HIV

Child's age in months	Blood test result					
	HIV negative		HIV positive		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0 to 12	257	73.0%	95	27.0%	352	100.0%
13 to 24	204	71.8%	80	28.2%	284	100.0%
25 to 36	193	73.9%	68	26.1%	261	100.0%
27 to 48	160	72.4%	61	27.6%	221	100.0%
49 to 60	123	65.1%	66	34.9%	189	100.0%
Total	**937**	**N/A**	**370**	**N/A**	**1 307**	**100.0%**

Figure 4.18 is a representation of the percentage distribution of the blood test results for children who tested for HIV. The figure shows that the dispersion of HIV positive and negative children was almost the same within the categories, although it was a bit different for the 49 to 60 months category. Generally, the figure shows that majority of children who went for blood testing were found to have been HIV negative.

Figure 4.18: Percentage distribution of blood test results for children



4.5.3 Calculation of child mortality rate

As discussed in the earlier chapters, child mortality rate is calculated as:

$$CMR = \frac{\text{Numbers of child deaths}}{\text{Number of live births}} \times 1000 \qquad 4.82$$

The figure that follows shows the percentage distribution of children's death irrespective of the mother's HIV status. The figure shows that in all the ages of children (age in months) mortality for HIV negative children is greater than that of HIV positive children, with mortality being highest in infants aged 0-12 months.

Figure 4.19: Distribution of children's deaths in months

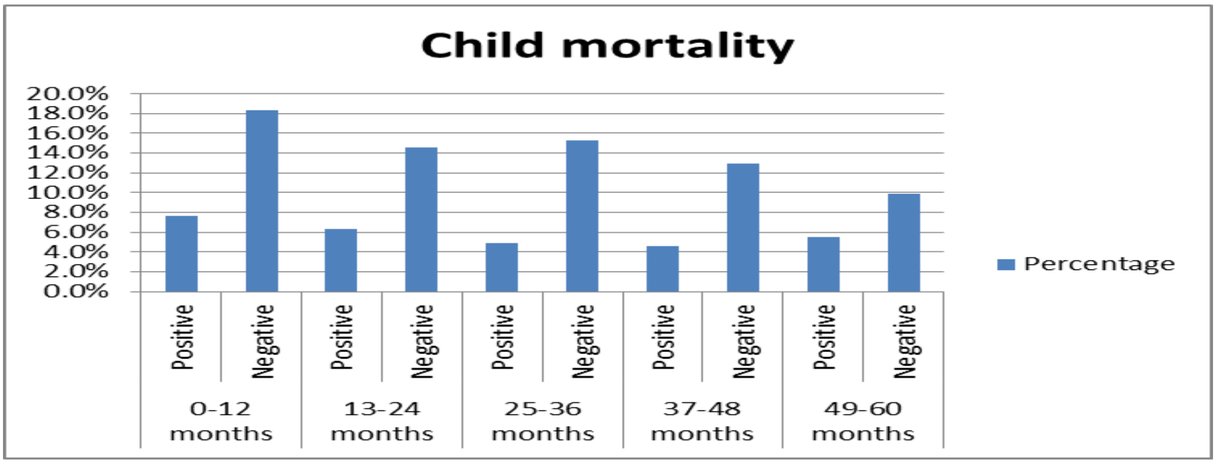
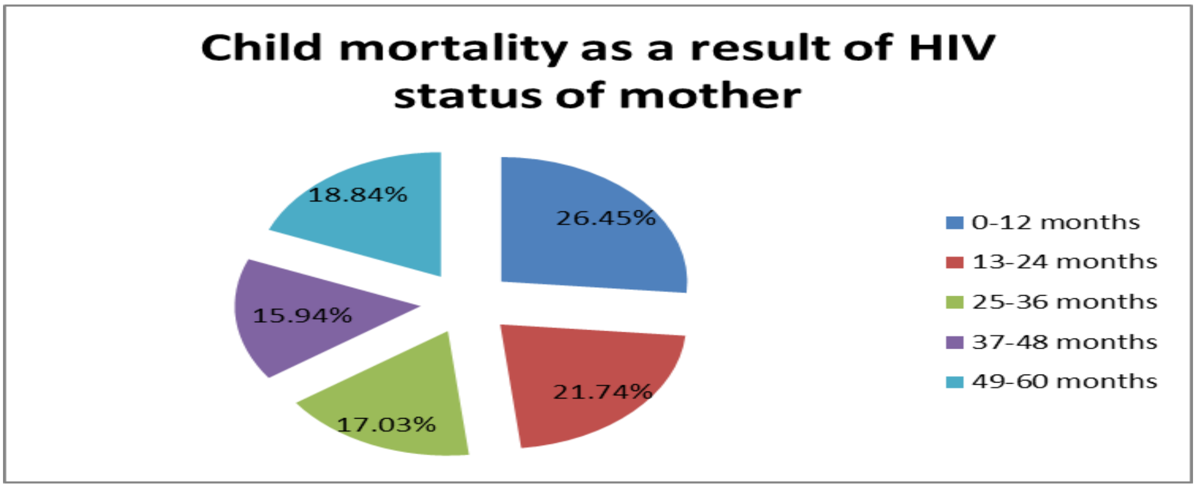


Figure 4.19 depicts the percentage distribution of children's deaths because of the HIV status of the mother. Its shows that majority of the children who died due to their mother being

positive, fall within the zero to 12 months category, with the least percentages being in the 25 to 36 months category 26.5 percent and 17.0 percent respectively.

Figure 4.20: Pie chart of the distribution of children's deaths in months as a result of HIV status of the mother



Now, in a total of 1381 children who tested for HIV, 370 were found to have died before reaching the age of five. The most common reason behind these deaths was that the mother of the dead child was HIV positive. Using this statistic the child mortality rate was then calculated as:

$$CMR = \frac{370}{1381} \times 1000 \qquad 4.83$$

$$= 268$$

That is, for every 1000 live births there occur 268 child deaths because of the HIV status of the mother of that child.

4.6 Logistic Regression

Logistic regression is a statistical method for analysing a dataset that has one or more independent variables that determine an outcome (Nick & Campbell, 2007). It gauges the relationship between the categorical dependant variable and one or more independent variables by approximating probabilities using the logistic function, which is the cumulative logistic distribution (Nick & Campbell, 2007). It was performed to assess the impact of the HIV status of the mother on the child and maternal mortality in Lesotho. The model contained five independent variables: mortality (child and maternal); place of residence; marital status; education attainment and age.

4.6.1 Block 0 (baseline model)

This model functions as the standard for comparing with the model whereby the predictor variables are included. In this model, the results of the analysis are based upon only the dependent variable and the model is given as:

$$y = \beta_0 + \beta_1 x \qquad 4.84$$

where y is the dependent variable (probability of mother or child dying due to HIV status of the mother).

x is the independent variable (predictor variable)

β_0 is the constant

β_1 is the model co-efficient

However, considering that in this model none of the predictor variables is included the model becomes:

$$y = \beta_0 \qquad 4.85$$

Looking at the table that follows, our model is significant since p-value < 0.05 with a standard error of 0.025 and a β = -1.009 which indicates a negative relationship. This means that without other variables being included in the model, the likelihood of a positive HIV status decreases by 36.5 percent (Exp (β) = 0.365).

Table 4.33: Variables in the Equation

		B	S.E.	Wald	Degree of freedom	Sig.	Exp(B)
Step 0	Constant	-1.009	0.025	1 568.855	1	0.000	0.365

4.6.2 Block 1 (full model)

4.6.2.1 Omnibus test of model co-efficients

The full model that contains all the five-predictor variables was found to be statistically significant at p-value < 0.01, with a chi-square value of 52.66, and 17 degrees of freedom as seen in the Omnibus test of model co-efficients. This is the Goodness of fit model, which assesses how well the model performs in comparison to the model in block 0. Since the p-value is less than 0.05, this model performs better than the block 0 model demonstrating that it was able to make a distinction between respondents who tested positive and those who tested negative for HIV.

Table 4.34: Omnibus Tests of Model Coefficients

		Chi-square	Degree of freedom	p-value
Step 1	Step	52.660	17	0.000
	Block	52.660	17	0.000
	Model	52.660	17	0.000

4.6.2.2 *Hosmer and Lemeshow test*

This test is also a Goodness of fit test, in which a poor fit is indicated by a p-value < 0.05; so to support our model, we want a p-value > 0.05. Table 4.35 shows the Hosmer and Lemeshow test of goodness of fit. The chi-square value for this statistic is 10.298, with 8 degrees of freedom, and a significance level of 0.245; thus, the test is in support of our model since the p-value > 0.05.

Table 4.35: Hosmer and Lemeshow Test

Step	Chi-square	Degree of freedom	p-value
1	10.298	8	0.245

4.6.2.3 *Model summary*

The model summary provides an indication of the quantity of the difference in the dependent variable that is clarified by the model. The model as a whole explained between 0.7% (Cox and Snell R square) and 1.0% (Nagelkerke R square) of the variability in the HIV status of the mother and the set of predictor variables.

Table 4.36: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	9084.582[a]	.007	.010

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Table 4.37 is a tabulation of the results of the regression model when all the predictor variables are included in the model. The negative β values show that when the independent variable score increases, the probability of the case recording a score of 1 will result in a decrease in the dependent variable (an indication of dying as a result of HIV blood test result of the mother in this case). The β = -0.143 observed for maternal mortality indicates that women who know the results of their blood test are less likely to die as a result of pregnancy. However, the odds of a woman dying as a result of not knowing their blood test results during pregnancy are very high (0.866).

The odds of a child dying as a result of their mother's HIV status are 1.136 which is the implication that for each female respondent who tested positive for HIV, the chances of a child born to such a mother increase by a factor of 1.136. The value of β = 0.128 which is significant at 10 percent (p-value < 0.1), indicates that maternal HIV status does have a significant impact on child mortality.

The table further shows that with the urban areas as the reference category (RC), place of residence has a significant impact on increasing the likelihood of a child or its mother dying as a result of the HIV status of that mother. The β value is positive indicating that the chances of a positive status are increased by a factor of 1.237. These odds are significant as one percent of women and children living in the rural areas are more at risk than those in the urban areas.

Marital status has no significant implication for child and maternal mortality as a result of the mother's HIV status. Although there is no significant evidence to indicate that marital status impacts on child and maternal mortality, the odds for the 'married' category and the 'living with partner' category are greater than one, which indicates that the chance of a positive status is higher in these categories than in the other categories.

Education attainment has more significant evidence that it impacts hugely on both maternal and child mortality, as a result of the HIV status of the mother. All the categories of education attainment are significant at either one percent, five percent, or a 10 percent level of significance. Women within the category 'complete secondary' are more at risk than in the other categories (1.813 times at risk), followed by those in the 'incomplete primary' category (1.667 times at risk). Women in the 'higher education' category have the lowest odd ratio

(1.470) which implies that they are the least at risk of their HIV status impacting on maternal and child mortality.

The last variable of interest was age, which was arranged into age groups. Women in the age groups 25-29 are at most risk of being affected by mortality (child or maternal), as a result of their HIV status (1.531 times at risk), and there is substantial evidence to support this at a five percent level of significance. Although the age group 45-49 has a higher odds ratio (1.529), there is no significant evidence to suggest that women in this age group impact significantly on mortality as a result of their HIV status. Age groups 20-24 and 30-34 also contain significant evidence to support the claim that maternal HIV status has an impact on both child and maternal mortality at a 10 percent significance level.

Therefore, the model that will best fit the data perfectly will include the variables:

a) Place of residence
b) Education attainment
c) Age

For these are the variables that add significantly towards the claim that maternal HIV status has an impact on both child and maternal mortality. The other variable, marital status, does not show sufficient evidence to support our claim and thus does not bring any significant impact to the models that one can expect to create, given the specific outcomes that they can expect to get from the data.

The regression model that best fits all the data and represents the impact of maternal HIV status on both maternal and child mortality is given as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots + \beta_n x_n \qquad 4.86$$

where β_0 is the constant

β_1 β_2 $\beta_3 \ldots \beta_n$ are the model co-efficients

x_1 x_2 $x_3 \ldots x_n$ are the independent variables (predictor variables)

y is the dependent variable (probability of mother or child dying due to HIV status of the mother).

Table 4.37: Logistic model co-efficients

Variables	**Categories**	**B**	**Wald**	**p-value**	**Exp (B)**	**95% C.I.for EXP(B)**	
						Lower	**Upper**
Mortality	Child mortality	0.128*	2.783	0.095	1.136	0.978	1.320
	Maternal mortality	-0.143	0.403	0.525	0.866	0.557	1.349
Place of residence	Urban (RC)		12.084	0.001			
	Rural	0.213***	10.708	0.001	1.237	1.089	1.406
Marital status	Never in union (RC)		4.217	0.519			
	Married	0.123	0.607	0.436	1.131	0.830	1.540
	Living with partner	0.157	0.231	0.631	1.170	0.617	2.216
	Widowed	-0.042	0.024	0.876	0.959	0.565	1.628
	Divorced	-0.232	0.232	0.630	0.793	0.309	2.035
	Separated	-0.199	0.635	0.426	0.819	0.502	1.338
Education attainment	No education (RC)		10.093	0.073			
	Incomplete primary	0.511***	6.746	0.009	1.667	1.134	2.452
	Complete primary	0.420**	4.537	0.033	1.522	1.034	2.241
	Incomplete secondary	0.499***	6.389	0.011	1.647	1.119	2.426
	Complete secondary	0.595***	7.413	0.006	1.813	1.181	2.783
	Higher	0.385*	2.784	0.095	1.470	0.935	2.312
Age groups	15-19 (RC)		23.332	0.001			
	20-24	0.357*	2.543	0.111	1.429	0.921	2.215
	25-29	0.426**	3.811	0.051	1.531	0.998	2.349
	30-34	0.386*	3.137	0.077	1.471	0.960	2.255
	35-39	0.195	0.796	0.372	1.215	0.792	1.865
	40-44	0.126	0.329	0.566	1.134	0.738	1.744
	45-49	0.424	3.747	0.053	1.529	0.995	2.349
	Constant	-2.064	44.031	0.000	0.127		

NOTE: *** denotes significance level at 1% ** indicates significance level at 5% and * indicates significance level at 10%.

4.6.3 Child mortality

Considering the child mortality while controlling for other factors the model becomes:

$$y = \beta_0 + \beta_1 x_1$$

$$= -2.064 + 0.128x_1 \qquad 4.87$$

where x_1 is the child mortality co-efficient

Now considering the other variables that are significant towards the impact of maternal HIV status on maternal and child mortality, the model when adding another significant variable (place of residence) becomes:

$$y = -2.064 + 0.128x_1 + 0.213x_2 \qquad 4.88$$

where x_1 is the child mortality co-efficient

x_2 is the place of residence co-efficient

x_3 is the education attainment co-efficient

Depending on the number of significant variables, the model can increase and can change depending on which variables one considers using. For instance, if we want a model for child mortality wherein the mother resides in the rural areas has incomplete primary education and is within the age group 20-24, then the model that best fits these kinds of data is given as:

$$y = -2.064 + 0.128x_1 + 0.213x_2 + 0.511x_3 + 0.357x_4 \qquad 4.89$$

where x_1 is the child mortality co-efficient

x_2 is the place of residence co-efficient

x_3 is the education attainment co-efficient

x_4 is the age groups co-efficient

4.6.4 Maternal mortality

The model that best fits the data for maternal mortality while controlling for other significant variable is given as:

$$y = -(2.064 + 0.143x_1) \qquad 4.90$$

where x_1 is the child mortality co-efficient

When adding a significant variable in the model it changes depending on what variable one has added. Now, adding the variable ‘place of residence’ in the model it then becomes:

$$y = -(2.064 + 0.143x_1 - 0.213x_2) \quad 4.91$$

where x_1 is the child mortality co-efficient

x_2 is the place of residence co-efficient

Therefore, the model changes depending on what outcome one is expecting. Now, let us suppose that we want a model which we are controlling for place of residence, education attainment, and age of a woman who resides in the urban area, has complete secondary education, and is aged between 30 and 34, the model that will best fit these data will look as follows:

$$y = -(2.064 + 0.143x_1 - 0.213x_2 - 0.595x_3 - 0.386x_4) \quad 4.92$$

where x_1 is the maternal mortality co-efficient

x_2 is the place of residence co-efficient

x_3 is the education attainment co-efficient

x_4 is the age groups co-efficient

Therefore, depending on the outcome that one expects to find from the data, the model can change. In addition, there can be as many models as one wants, although, one still has to pick the one model that can best describe the data.

Chapter 5 - Conclusion of the Study

5.1 Introduction

The previous chapter discussed the analysis of the data, and the results obtained through the analysis. A descriptive analysis of the data was discussed, which gave a picture of the sample and population percentages in the different categories of variable of interest. Discussed in the chapter was also inferential statistics, which gave insight into the different hypotheses tested for different categories of variable. The hypothesis tests included the goodness-of-fit tests, tests based on Kendall’s Tau correlations, and the test on proportions.

In this chapter, we will concentrate on discussing the results and findings of the study in detail, giving relevant examples where needed.

5.2 Discussion

The study examined the socio-economic and demographic effects of maternal HIV status on maternal and child mortality. The study showed that among the respondents who went for HIV testing services, 25.6 percent of the respondents tested positive for HIV, while 68.6 percent tested negative. The results further indicate that 5.8 percent of the respondents had neither positive nor negative blood test results (intermediate results). The study further showed that 72.0 percent of people who tested for HIV were women.

In comparison to the general population of Lesotho, 48.0 percent are females, and this says that more women go for HIV testing services than males. The reason for this could be that men have a fear of testing for HIV due to the stigma attached to being HIV positive. The study also shows that among these people who tested for HIV, the majority resided in the rural areas of Lesotho (74.4 percent), which is the case with the general population.

The research also showed that the majority of the respondents were found to be married respondents, followed by widowed respondents, at 74.0 percent and 12.4 percent respectively. Respondents in the category ‘living with partner’, had the least percentage of one percent.

Moreover, the results of the research show that respondents with incomplete secondary education and incomplete primary education had the highest percentage of tested respondents

29.4 percent and 28.7 percent respectively. Respondents with no education had the least percentage (2.3 percent), followed by those in the ‘higher education’ category (5.4 percent). These results indicate that generally, the people who go for HIV testing services in Lesotho are those with minimal education, and this same trend was observed for the general population as depicted in the results.

Furthermore, at age groups 35-39 years and 30-34 years, there were higher percentages of respondents who tested for HIV than there were in other categories of age (19.1 percent and 18.4 percent respectively). Respondents within the age groups 15-19 years and 20-24 years had the least percentages who tested for HIV.

Scrutinising the bivariate analysis, the results show that 26.7 percent of female respondents who tested for HIV were HIV positive, while the percentage was 28.4 percent for males who tested for HIV. HIV negative respondents had high percentages for both males and females (71.6 percent and 73.3 percent respectively). In addition, the results indicate that among the respondents who reside in the urban areas, 74.4 percent tested negative for HIV, while 25.6 percent tested positive. For respondents residing in the rural areas 27.8 percent tested positive for HIV.

The results further depicted that the category ‘divorced’ had the highest HIV prevalence (33.8%) in relation to other categories. This category was followed by the ‘living with partner’ category at 29.6 percent. The category with the least prevalence was the ‘separated’ category at 22.9 percent.

In addition, the results of the bivariate analysis depict that respondents with minimal education were the most affected by the HIV virus. They had the highest percentages of those who tested positive for HIV; that is, 31.9 percent of respondents with complete secondary education tested HIV positive. Those with incomplete primary and secondary education had 27.6 percent and 27.1 percent respectively who tested positive.

The results also indicate that of the childbearing age groups, the age group with the highest prevalence was the age group 25-29, which makes sense since this is the most mobile group. At this age, respondents are trying to settle down; thus, move around looking for ways to find stability in their lives. The age group with the lowest prevalence was age 15-19 at 23.0 percent. Although this group seems to have the lowest prevalence, the percentage is still very high, and preventive measures need to be taken to reduce the prevalence and new incidences within this age group.

The inferential statistics analysis depicts that for the hypothesis the sample data were consistent with the distribution of the population. The results showed that the data was not consistent with the distribution of the population for the following variables: Age, Marital status, Gender, and Education attainment. The sample proportions tests were then conducted to see where the inconsistencies were within each variable. As for the variable place of residence, the sample data were consistent with the distribution of the population; thus, there was no need for the sample proportions tests.

The Pearson chi-square tests were calculated to test for independence between the explanatory variables and the independent variables. The null hypothesis (H_0) for the independence test, which was that the blood test results was dependent on the predictor variables, was rejected, indicating that the dependant variable was independent of the predictor variables. This means that the occurrence of the predictor variables' place of residence, marital status, education attainment and age of respondent does not depend on the blood test result. That is, being HIV positive has nothing to do with where one comes from or whether one is educated or not. HIV affects everyone.

Moreover, the correlations were done to test if there was any correlation between the dependant variable and the predictor variables. The correlations were done separately for nominal and ordinal data. Cramer's V correlation for nominal data was used and it depicted that there was no correlation between the variables of gender, place of residence, and marital status with the blood test results. Therefore, these variables do not influence one another in any way. As for Kendall's Tau correlation for ordinal data, it showed that for the variables education attainment, and age groups, there was no relationship between these variables and the blood test results; thus, the variables were independent of one another.

Furthermore, the study depicts that the majority of the female population of childbearing age who tested for HIV were from the rural areas (77.7 percent). This is an indication that the bulk of Lesotho's population resides in the rural areas. This accounts for the high prevalence in those areas. It further shows that there were more females of childbearing age, who tested for HIV within the 'married' category, than in any other marital category. The category with the lowest percentage of tested women was that of the 'divorced' women (0.4 percent).

As for education attainment, the highest percentage who tested was observed in the category of 'incomplete secondary' (37.2%), with the lowest percentage in the category of 'no education' (1.5%). In terms of age group, the younger categories of women of childbearing age had the highest percentages who tested for HIV (19.7% in the age group 15-19, and 19.1% in age group 20-24). The categories of older females of childbearing age had the lowest tested percentages (9.2% for ages 40-44 and 7.1% for ages 45-49). This may be because the older generation of females are afraid of HIV and the stigma it may bring; thus, they avoid testing for HIV. The observation is that, as women get closer to the end of their childbearing years, the percentages who go for HIV testing decrease.

The results showed that the distribution of female respondents of childbearing age by blood test results and place of residence depicts that in both the urban and rural areas, the majority of females tested HIV negative (76.4 percent and 72.3 percent respectively). Scrutinising the marital status of the female respondents, the categories 'married' and 'living with partner' have high HIV prevalence (27% and 27.4% respectively). This is perhaps because married people and those people living with a partner tend to believe that they are safe from HIV, neglecting the fact that not everyone is faithful to their partner. They tend to relax, and forget about all the different ways that can lead them to being infected by HIV, which is why their prevalence is high

Regarding the education attainment with respect to the blood test results, the findings showed that respondents with no education had the lowest prevalence of HIV (18.8%), relative to other categories of education. This may be because uneducated people have a fear of exploring; thus, they avoid issues that will bring complications to their lives. The prevalence of respondents with higher education was the second lowest, at 23.6 percent. This is perhaps because at this level of education, people are wiser and more knowledgeable about how they can protect themselves from HIV.

In the study, we saw that age groups 25-29, 30-34 and 45-49 have high percentages of those who tested HIV positive. These groups are highly mobile looking to earn a living; thus, it makes sense that their HIV prevalence is high. As for ages 35-39 and 40-44, the percentages are a bit lower than in the latter groups because at this age, the expectation is that one has to settle down. With settling down comes the responsibility of having to take care of a family; therefore, the reduced prevalence in these groups.

As seen from the descriptive analysis, the number of women who were found to have been HIV positive was 2103. Of all these women, 70 were pregnant at the time of survey (32.4%). Of the 70 women who were pregnant and HIV positive, 33 died because of complications brought about by their positive HIV status. Therefore, the MMR due to complications of being HIV positive by the mother, was found to be high, namely, 392 per 100,000 women infected by HIV.

Given that Lesotho is working toward decreasing the MMR as per the Sustainable Development Goals (SDG), 392 is a relatively high number, given that the maternal mortality rate, according to the 2016 Lesotho census, was 618 deaths per 100 000 women. Therefore, this means that about 63 percent of the maternal deaths in Lesotho occur as a result of the positive HIV status of the mother. This means that Lesotho has a long way to go if they are to reach zero deaths due to the HIV status of the mother.

Moving on to child mortality, the results showed that new-borns (0-12 months) were the most tested for HIV (41.4%), relative to babies that are over a year but less than five years. This is probably because new-borns are tested for HIV at birth, given they have no apparent health complications. The category of children who have the lowest percentages who tested for HIV were the 49-60 months category.

The chi-square goodness-of-fit was performed to test the null hypothesis that the sample data for the tested children was consistent with the distribution of the population. This was tested against the alternative hypothesis that the sample data were not consistent with the distribution of the population. At the five percent level of significance, the null hypothesis was rejected, thus concluding that the sample data were not consistent with the distribution of the population of tested children.

The inconsistencies in the data were checked through a hypothesis test for proportions within each category of the tested children. For the category 13-24 months, the null hypothesis was not rejected, so the sample proportions did not statistically differ from the population proportion (0.228). For the other categories, we rejected the null hypothesis.

The percentage of children who tested HIV positive was found to increase as the child's age increased, with the highest percentage of 34.9 percent at 49-60 months. This may be because at this age, the frequency at which children go to hospitals for their injections has decreased, and some children have completely stopped the injections, thus their monitoring becomes complicated. Although the highest percentages of HIV positive children are seen at 49-60 months, the highest percentages of children who die because of their mothers' HIV status fall within zero to 12 months of birth (26.5%). At this stage, the children are very vulnerable, so if the HIV positive mother fails to take care of herself, the child suffers the consequences.

The results indicated that out of a total of 1381 children who tested for HIV, 370 were HIV positive, and the root cause of death was negligence of the HIV positive mother. These results lead to a calculation of child mortality as 268 deaths for every 1000 live births, which is a very high number for a children's death rate, given that we want an HIV free generation in the near future.

The results of the binary logistic regression models specified that an increase in the independent variable scores result in a decrease in the probability of a pregnant woman dying as a result of her HIV blood test result. The results show that women who know their blood test results are less likely to die during pregnancy. This can be because when mothers know their HIV status, they are bound to take good care of themselves for the sake of their child. However, not all mothers feel obliged to give their child a chance; thus, a lot of them still fail to test for HIV during pregnancy, thereby increasing their odds of dying as a result of not knowing their HIV status during pregnancy, which is very high (0.866).

The odds of a child dying as a result of their mother's HIV status is 1.136. This implies that for each female respondent who tested positive for HIV, the chances of a child dying who is born to such a mother, increases by a factor of 1.136. Thus, it is evident that knowledge of a mother’s HIV status plays a major role in the survival of both the mother and the baby during pregnancy.

The place of residence has a significant impact on increasing the likelihood of a child or its mother dying as a result of the HIV status of that mother. This implies that, depending on the place of residence (urban or rural residence) of a woman in Lesotho, the chances of a positive status in the rural areas are increased by a factor of 1.237. These odds are significant at one percent, and they imply that women and children living in the rural areas are more at risk of being HIV positive than those in the urban areas. This may be because of a lack of knowledge about how HIV is transmitted, and what its consequences are, concerning mortality.

Marital status has no significant impact on child and maternal mortality as a result of the mother’s HIV status. Although there is no significant evidence to indicate that marital status impacts on child and maternal mortality, the odds for the ‘married’ category and the ‘living with partner’ category are greater than one, which indicates that the chance of a positive status is higher in these categories than they are in the other categories. The reasons may be that married couples and the ‘living with partner’ tend to believe that they are safe from HIV because they have a partner. They tend to forget that the partner may not necessarily be faithful, which increases their chances of contracting HIV.

Education attainment shows significant evidence that it affects greatly on both maternal and child mortality, as a result of the HIV status of the mother. Women with secondary education are more at risk of dying from HIV than those with a higher education level. This may be a result of a lack of understanding among women in secondary education, but further research must be done on the reasons for this disparity.

The last variable of interest was the age of the respondent. Women in the age group 25-29 seem to be at the most risk of being affected by mortality (child or maternal), as a result of their HIV status (1.531 times at risk). There is evidence to support this at the five percent level of significance. This may be due to the fact that this age group is a mobile group who seeks for stability, even if it means they must do commercial sex work to survive. They are the carefree group who take many risks, and they do not care about their wellbeing. The results for age groups 20-24 and 30-34 also indicate significant evidence to support the claim that maternal

HIV status has an impact on both child and maternal mortality at the 10 percent significance level.

Therefore, the variables that contribute significantly towards the claim that maternal HIV status has an impact on both child and maternal mortality, are the place of residence; education attainment; and the age of the respondent. The other variable, marital status, does not show significant evidence to support our claim, and thus, does not bring any significant impact to the models of the regression analysis that one could expect to create, given the specific outcomes that they can expect to get from the data.

5.3 Concussion and possible future research

This section gives the conclusion pertaining to the results and findings of the research. The study revealed that 26.7 percent of women are indeed HIV positive. This results in about 27 percent of their mortality and 24.7 percent of the child's mortality being a consequence of the mother's HIV status. These mortality rates are more prevalent in certain age groups and categories of educational attainment, which include age groups 25-29 and 45-49.

The results of this study show that there is significant proof that maternal HIV status does have an impact on child and maternal mortality. The results point out that women and children who live in the rural areas are more at risk of dying due to the HIV status of the mother, compared to women and children living in the urban areas, namely, 1.2 times at risk. The results show that there is an association between maternal HIV status, maternal mortality and child mortality.

The level of education has a significant impact on maternal and child mortality as a result of the HIV status of the mother. Marital status has no impact on maternal and child mortality due to maternal HIV status; thus, it is an insignificant variable in the study. Place of residence is important in the study, since it has a significant impact on the level of maternal and child mortality. Therefore, the variables that have an impact on maternal mortality and child mortality based on the mother's HIV status are the age group of the mother; education attainment; and place of residence.

According to this study, mother-to-child HIV transmissions are more prevalent at the younger ages, that is, at ages 15-19, and it is at these ages that maternal mortality rates are high. In addition, children born of mothers within the younger age groups are more prone to mortality than those born of mothers within the other age groups. This is the case for other countries, as shown in the research how HIV affects maternal and child mortality.

The reasons behind the continuous increase in maternal mortality, even though efforts have been made to reduce it, are a lack of knowledge about mother-to-child transmissions in the rural areas. This increases the rate of HIV infections among children, thus increasing their mortality. Therefore, to minimise HIV mother-to-child transmissions, women should be taught its impacts on both themselves and their children. Women should also be made aware of the problems they impart to their babies' health, and their own health, by refusing to test for HIV during pregnancy.

Research in the future should be directed towards making sure that more women are taught about the dangers of mother-to-child HIV transmissions on their children, in order to reduce the risk of more children being infected by the virus, and thus decreasing child mortality. To assist in attaining a decline in both maternal and child mortality as a result of the HIV status of the mother in Lesotho, the government should encourage contraceptive use among women, specifically the condom, as it helps reduce the risk of getting new infections. They should do this by:

(a) Showing a strong commitment, both politically and financially, to limiting new HIV infections of both mothers and children,
(b) Expanding women's educational and economic opportunities, and
(c) Creating policies that enforce HIV testing among all women, especially pregnant women.

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Appendices

Appendix A: Programming Code

```
FREQUENCIES VARIABLES=V151 V025 HIV03 V013
  /ORDER=ANALYSIS.

FREQUENCIES VARIABLES=V501
  /BARCHART PERCENT
  /ORDER=ANALYSIS.

FREQUENCIES VARIABLES=V149
  /PIECHART PERCENT
  /ORDER=ANALYSIS.

* Custom Tables.
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  /TABLE V151 BY HIV03 [C][COUNT F40.0, ROWPCT.COUNT PCT40.1, COLPCT.COUNT PCT40.1, TABLEPCT.COUNT
    PCT40.1]
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  /CATEGORIES VARIABLES=HIV03 [0, 1] EMPTY=INCLUDE TOTAL=YES POSITION=AFTER.

* Custom Tables.
CTABLES
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  /TABLE V025 BY HIV03 [C][COUNT F40.0, ROWPCT.COUNT PCT40.1, COLPCT.COUNT PCT40.1, TABLEPCT.COUNT
    PCT40.1]
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  /CATEGORIES VARIABLES=HIV03 [0, 1] EMPTY=INCLUDE TOTAL=YES POSITION=AFTER.

* Custom Tables.
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TABLEPCT.COUNT
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POSITION=AFTER
 /CATEGORIES VARIABLES=HIV03 [0, 1] EMPTY=INCLUDE TOTAL=YES POSITION=AFTER.

* Custom Tables.
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   TABLEPCT.COUNT PCT40.1]
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POSITION=AFTER
 /CATEGORIES VARIABLES=HIV03 [0, 1] EMPTY=INCLUDE TOTAL=YES POSITION=AFTER.

* Custom Tables.
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TABLEPCT.COUNT
   PCT40.1]
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POSITION=AFTER
 /CATEGORIES VARIABLES=HIV03 [0, 1] EMPTY=INCLUDE TOTAL=YES POSITION=AFTER.

* Custom Tables.
CTABLES
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   COLPCT.COUNT PCT40.1]
 /CATEGORIES VARIABLES=V151 V025 V501 V149 V013 HIV03 ORDER=A KEY=VALUE
EMPTY=INCLUDE TOTAL=YES
   POSITION=AFTER
 /TITLES
   TITLE="Percentage distribution of the respondents' characteristics with HIV status"
 /SIGTEST TYPE=CHISQUARE ALPHA=0.05 INCLUDEMRSETS=YES CATEGORIES=ALLVISIBLE.

DATASET ACTIVATE DataSet1.
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  /FORMAT=AVALUE TABLES
  /STATISTICS=PHI
  /CELLS=COUNT ROW
  /COUNT ROUND CELL.

CROSSTABS
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  /FORMAT=AVALUE TABLES
  /STATISTICS=BTAU
  /CELLS=COUNT ROW
  /COUNT ROUND CELL.

* Custom Tables.
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  /TABLE deaths_edit [C] BY HIV03 [C][COUNT F40.0, COLPCT.COUNT PCT40.1]
  /CATEGORIES VARIABLES=deaths_edit ORDER=A KEY=VALUE EMPTY=INCLUDE TOTAL=YES POSITION=AFTER
  /CATEGORIES VARIABLES=HIV03 [1] EMPTY=INCLUDE.

DATASET ACTIVATE DataSet1.
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  /CONTRAST (V025)=Indicator(1)
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  /CONTRAST (V013)=Indicator(1)
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  /CRITERIA=PIN(0.05) POUT(0.10) ITERATE(20) CUT(0.5).
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