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FACULTY OF HEALTH SCIENCES
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TOWARDS UNAIDS 90-90-90 HIV TARGETS: DETERMINANTS OF KNOWING ONE'S HIV STATUS IN SOUTH AFRICA IN 2012

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of MSc in Epidemiology (Biostatistics)

October 2021

Declaration

I, Mary Pomaa Agyekum, declare that this Research Report is my work. It is being submitted for the Degree of Master of Science in Epidemiology (Biostatistics) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Signature 

Date: 13th October 2021

Dedication

I wish to express my deepest gratitude to God for His divine wisdom and guidance throughout this program.

I also dedicate this research work to my husband Enoch Oti Agyekum and my son Papa Kwaku Oti Agyekum for their love, support, and prayers in my life's achievement.

I finally dedicate this work to my parents and siblings for their support given to me while I was away from home for my studies.

Presentation arising from this study

Title: “A survey-weighted multinomial analysis of awareness of HIV status and willingness to accept an HIV test.”

Venue: Oral presentation at DELTAS Africa SSACAB virtual scientific conference

Date: 23rd October 2020

Abstract

This study, a secondary data analysis of a national population-based survey, aimed to estimate the proportions of HIV infected people aged 15 years and older who were aware of their HIV status and were exposed to ART. It also sought to determine the factors associated with awareness of HIV status and willingness to provide a blood sample for an HIV test among individuals aged 15 years and older in South Africa. Data for this analysis was from the 2012 South Africa national HIV prevalence, incidence, behaviour, and communication survey (SABSSM). Survey-weighted multinomial logistic regression models were fitted, and adjusted predicted probabilities were used to interpret the association between explanatory variables and outcomes.

Out of 26,807 individuals who participated in the study, a weighted percentage of 12.2% people were infected with HIV. Among the people infected with HIV, a weighted 73.9% were aware of their HIV status, and 36% were exposed to ART. In the study population, a weighted 9.5% were unaware of their HIV status and refused an HIV test, 29.9% were unaware of their HIV status and agreed to test for HIV, 14.0% were aware of their HIV status and refused an HIV test, and 46.6% were aware of their HIV status and agreed to test for HIV.

Education level, employment status, engagements in HIV related activities, attitude towards HIV infected people and frequency in the use of health services were significant predictors of awareness of HIV status and willingness to provide a blood sample for an HIV test, by adjusting for age-group, sex, race, geotype and province.

The study suggests that almost three out of every four HIV infected people were aware of their HIV status, and 36% were on ART before the UNAIDS 90 90 90 targets were set. This study affirms that engaging in HIV related activities and a positive attitude towards people living with HIV could increase HIV testing, thereby increasing awareness of HIV status.

Keywords: HIV, testing, awareness of HIV status, 15 years and older

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List of Abbreviations

Abbreviation	Definition
AIDS	Acquired Immune Deficiency Syndrome
ANC	Antenatal Care
ART	Antiretroviral Therapy
ARV	Antiretroviral drug
HCTC	HIV Counseling and Testing Centre
HIV	Human Immunodeficiency Virus
HSRC	Human Sciences Research Council
PLHIV	People Living With HIV
PMTCT	Prevention of Mother To Child Transmission
PSU	Primary Sampling Unit
SABSSM	South Africa National HIV Prevalence, HIV Incidence, Behavior and Communication Survey
SSA	Sub-Saharan Africa
SSACAB	Sub-Saharan Africa Consortium for Advanced Biostatistics
SSU	Secondary Sampling Unit
TB	Tuberculosis
UNAIDS	United Nations Programme on HIV/AIDS
USU	Ultimate Sampling Unit
VMMC	Voluntary Medical Male Circumcision
VP	Visiting Point
WHO	World Health Organisation

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CHAPTER ONE: INTRODUCTION

This research report is presented in five chapters. CHAPTER ONE introduces the problem to be addressed in this study. It presents the global and country level HIV/AIDS situation, policy initiatives and some material actions being taken to improve people's awareness of their HIV status, particularly among the South African population. It introduces the study objectives and justification for the study.

CHAPTER TWO presents the methodology adopted for the study. It describes the study design, the methods of data collection, management and analysis. The study results are presented in CHAPTER THREE of the report, while CHAPTER FOUR is dedicated to discussions of key findings. CHAPTER FIVE presents the conclusions and key recommendations based on the results of the study.

1.1 Background

Global efforts to control the burden of HIV and the AIDS epidemic have been shown to reduce HIV transmission and AIDS-related deaths (1, 2). The annual number of new HIV infections among all ages has declined by 16% since 2010 (1). Globally, 36.9 million people are living with HIV (2). AIDS-related deaths have declined by 48%, from a peak of 1.9 million in 2005 to 1 million in 2015 (2).

Sub-Saharan Africa (SSA) region accounts for 66% of people living with HIV globally. South Africa is the country with the highest HIV burden in the world. In 2012, about 6.4 million people in South Africa were living with HIV. By the end of 2017, the number of people living with HIV had increased to 7.2 million (2-6). South Africa's HIV prevalence increased from 10.6% in 2002 to 12.2% in 2012 and 14% in 2017 (3, 6, 7). Prevalence is high in females, individuals aged 25 to 34 years, Africans, people in urban informal locations, rural informal locations and the poor (7, 8).

HIV testing strategies including home-based HIV testing and counselling (HBVCT), voluntary client-initiated counselling and testing (VCT) and provider-initiated testing and counselling (PITC) have been introduced in the population to expand the coverage of HIV testing (9). Home-based HIV testing and counselling (HBVCT) is frequently carried out in Eastern and Southern Africa to screen the general population for HIV infections. HBVCT has ensured access to hard-to-reach and marginalised groups, as well as men and women living in rural areas who are less likely to access health service-based testing (9).

In addition to these strategies to increase HIV testing uptake and awareness, other HIV prevention and treatment programs such as combination Antiretroviral therapy (cART), Prevention of Mother to Child Transmission (PMTCT), Voluntary Medical Male Circumcision (VMMC) and Pre-Exposure Prophylaxis (PrEP) have been proven to have the most significant impact on the reduction of new HIV infections. (7, 10, 11).

The UNAIDS 90-90-90 targets set in 2016 have catalyzed the efforts to increase HIV testing and HIV status awareness. In South Africa, 90% of people living with HIV were aware of their HIV status in 2018 but some sub-groups in the population continue to report lower testing coverage (1, 2, 6). Exposure to ART among people infected with HIV improved over the years but the target of 90% has not been achieved (2, 12). Since we have only recently started monitoring the 90-90-90 targets, it is difficult to measure any trends.

With regards to HIV testing and HIV status awareness, 75.2% of individuals aged 15 years and older reported ever been tested for HIV and aware of their status in 2017 in South Africa. Higher proportions who had ever test and aware of their status were recorded in females, adults aged 25 to 49 years, Africans and people living in urban locations (6). However, the number of yearly HIV tests conducted has declined by 2.3% from 2016 to 2018 (13). From a national survey, the proportion of people who accepted to test for HIV declined from 67.5% in 2012 to 61.1% in 2017 (6, 7). The frequency of HIV testing among groups with a high HIV status awareness rate is lower than expected (6, 7). People infected with HIV may decline in subsequent testing, since their status is already known and a positive status will not change.

Knowing factors associated with awareness of HIV status and willingness to test for HIV among the South African population is important. Findings from this study will help understand human behaviour regarding awareness of HIV status and willingness to test for HIV.

1.2 Literature Review

1.2.1 HIV prevalence and incidence

Globally in 2017, a total of 36.9 million people were living with HIV, of whom 35.1 million were adults, 18.2 million were women and 1.8 million were aged 15 years and below (1, 2, 14). The global annual number of new infections declined from 2.1 million in 2010 to 1.7 million in 2018 (12). Out of the estimated 1.8 million new infections globally in 2017, 1.6 million were adults, with the rest aged below 15 years (1, 2, 14). Globally, new infections in children have been prevented by 1.4 million, that is, cases reduced in 2017. In that same year, there were about 90,000 more new infections in men than in women worldwide.

In sub-Saharan Africa, out of 24.6 million people living with HIV, 19.6 million live in Eastern and Southern Africa, of which 56% are women (1, 2, 14). Eastern and southern Africa remains the region most affected by the HIV epidemic, accounting for 45% of the world's HIV infections and 53% of people living with HIV globally. In Eastern and Southern Africa, 800,000 new infections among adults and children were recorded in 2017. However, the reduction in new HIV infections from 2010 to 2017 was strongest in Eastern and Southern Africa (12).

In 2008, South Africa's HIV prevalence was 11.4% and this increased to 12.2% in 2012 (3, 7). By 2017, South Africa's HIV prevalence was 14%, with an estimated 7.2 million people living with HIV (6). HIV prevalence was high among individuals aged 15 to 49 years (20.6%), with a much higher prevalence in females (26.3%) than in males (14.8%). There was a wider disparity in HIV prevalence among 20 to 24-year-olds; prevalence in females (15.6%) was about three times higher than that in males (4.8%) (6). Also, HIV prevalence among Africans in 2012 increased from 15% to 16.6% in 2017; followed by Coloured (3.1% versus 5.3%) and whites (0.3% versus 1.1%). However, HIV prevalence among Indian/Asians remained the same in 2012 and 2017 (0.8%). Variation in HIV prevalence persists across provinces, geographical locations and socioeconomic status (3, 7, 8). The prevalence of HIV was high in urban areas, informal rural locations, and poor households (7, 8).

There were 222,000 new HIV infections in 2018 in South Africa, and HIV incidence was disproportionately higher among young women (13). More new infections occurred in women

aged 15 years or older (131,000) than in men of the same age (80,000). From a mathematical model on HIV epidemic in South Africa (Thembisa model), HIV incidence among children and young women aged 15 to 24 years was 1.5%, which was higher than the total population incidence of 0.49% in 2018. Similarly, from the 2017 SABSSM survey, the total annual incidence in 2017 was 0.48% compared to 1.07% in 2012 (6). The incidence in women (0.51%) was higher than the incidence in men (0.46%).

1.2.2 UNAIDS 90-90-90 targets

The Joint United Nations Program on HIV/AIDS (UNAIDS) developed the 90-90-90 targets to fast track HIV prevention and treatment (1, 2, 15). The target was that "by 2020, 90% of PLHIV should know their HIV status, 90% of PLHIV who know their status should receive treatment (ART), and 90% of people on ART should be virally suppressed" (2). If these targets are achieved, 75% of PLHIV will be virally suppressed by 2030, which modellers predict will be sufficient to end the AIDS epidemic (2). Many countries have measured their progress towards meeting these targets and have put in extra efforts to fill the gaps (8, 15-19).

Globally, the proportions of PLHIV aware of their HIV positive status in 2005 was 10% and increased to 55% in 2015, then to 75% by the end of 2017 (2-4, 12, 20). By 2018, 80% of PLHIV globally were aware of their HIV status, 78% of them were accessing antiretroviral therapy treatment and 86% were virally suppressed (2, 12). Continual ART treatment among PLHIV has led to the achievement of viral load suppression (2). HIV viral load (VL) suppression, is defined as a VL of <1000 copies HIV RNA/mL of blood and it measures the efficacy of ART and risk of HIV transmission (2).

In sub-Saharan Africa, HIV testing coverage remains a specific challenge in several regions, especially in western and central Africa, where only an estimated 48% of people living with HIV knew their HIV status in 2017 (12). In Eastern and Southern Africa, 20.6 million people were living with HIV, awareness of HIV positive status increased from 77% in 2015 to 85% in 2018 (12, 14). However, the region has 1.1 million more people living with HIV to be diagnosed to achieve the first 90 of the 90-90-90 UNAIDS targets (2, 12). In the Middle East and North Africa, treatment coverage and viral suppression gaps remain the largest, 29% of all people living with HIV were accessing antiretroviral therapy and 22% of all people living with HIV were virally suppressed (12).

South Africa is one of the countries to achieve the UNAIDS 1st 90 target by 2018 (12). However, there is a great discrepancy between the 1st 90 and the 2nd 90 target and the 3rd 90 is almost reached. By the middle of 2015, 85% of PLHIV were aware of their HIV status, although only 49% of those aware of their HIV positive status were on treatment (21). In 2018, the Thembisa model estimated that 90% of PLHIV were aware of their HIV status and also evidence from a cross-sectional population survey confirmed the country's achievement of the 1st 90 target (12, 13, 22). From UNAIDS 90-90-90 model estimates, 68% of PLHIV who knew their HIV status were on treatment and 87% of PLHIV who were on treatment were virally suppressed in 2018 (12).

1.2.3 Factors associated with HIV testing

HIV status awareness depends on HIV testing, which remains a major prevention strategy for HIV and an entry point to HIV treatment to suppress viral load. HIV testing includes pre-test counselling and post-test counselling (2, 12). The purpose of these counselling sessions is to inform the client how to manage an outcome of an HIV test which can translate to behaviour change.

Globally, three out of four people living with HIV have been tested for HIV and are aware of their HIV status (14). Factors associated with HIV testing vary by gender, age and geographical location. Adolescent girls, young women, children less than 15 years, poor, and rural dwellers are associated with low testing coverage (2).

Although HIV testing capacity has increased over time to enable more people to know their HIV status, there remain people living in sub-Saharan Africa who do not know their HIV status (12, 23). Several studies in sub-Saharan Africa (SSA) conducted through population-based surveys have determined factors associated with HIV testing (24). Similarly to global factors, men are less likely to test for HIV compared to women (25). Women may be more likely to uptake HIV testing during antenatal care because it appears to be an important component of the overall increase in testing (12, 24). In addition to these factors, the stigma surrounding HIV/AIDS and people living with HIV/AIDS was a major barrier to HIV testing uptake (26). A study conducted in Lesotho found that men and women with stigmatizing beliefs were less likely to be tested (27).

Furthermore, apart from women where age was a significant factor for uptake of HIV testing, higher uptake of HIV testing in men was associated with age, secondary education vs no education and being Catholic vs Muslim (27). Urban and rural disproportions in HIV testing remain high in most sub-Saharan countries. In Madagascar, Ethiopia, Mozambique and Nigeria, urban women and men are more than twice as likely to have been tested for HIV compared with rural women and men (24).

South Africa has made significant progress in expanding access to HIV testing services (21). Since the introduction of voluntary counselling and testing, many people living with HIV have been tested and started treatment. At the end of 2017 in South Africa, about three-quarters (75.2%) of individuals aged 15 years and older had ever tested for HIV with a high testing prevalence in females, adults aged 25 to 49 years, Africans and people living in urban locations (6). In addition, a proportion of 66.8% tested within the past one year, 27.5% tested in the last three months, and 17.0% tested within 4–6 months before the study (6).

Factors associated with uptake of HIV testing in South Africa are not different from the factors found elsewhere. Including the factors are individual and health system factors that prevent people, especially young men, from testing for HIV, despite the universal 'test and treat' policy being implemented in South Africa (28). Cost of health facility attendance and inconveniently designed services contributes to low HIV testing services among men than women (12). Among the reasons people do not test for HIV was fear of testing positive for HIV, fear of needles and self-belief that they were not at risk of HIV infection (6, 22). Furthermore, older people, the number of sexual partners and distance to HIV counselling and testing centres were associated with HIV testing (29-31). Other factors associated with HIV testing were being employed, residing in an urban area, higher education, knowing where one could have an HIV test, the impact of HIV on the household and not using a condom at last sex (30). Likewise, individuals with high knowledge of HIV were more willing to test for HIV than those with low knowledge (6, 7)

1.3 Problem Statement

Despite South Africa's progress towards meeting the 90-90-90 HIV target, there exists a significant socio-demographic and geographical variation in HIV testing and HIV status awareness (8). For example, awareness of HIV status, which an HIV test can only determine, differs across age, sex, race, locality type, and province. Unfortunately, there has been no study to explore the UNAIDS 90-90-90 targets in South Africa before the setup as baseline information to measure progress.

By the end of 2018, South Africa had recorded a cumulative number of over 44 million people who had ever taken an HIV test since 2010 (2, 12). Thus, South Africa's HIV testing numbers exceeded the country's 10 million annual targets. However, a decline of 2.3% in the number of tests conducted annually was observed from 2016 to 2018 (13). Similarly, from two national surveys, the proportions of people who agreed to provide a blood sample to test for HIV declined from 67.5% in 2012 to 61.1% in 2017.

As more people become aware of their HIV positive status, this decline is likely to occur. But for people who test negative and people unaware of their status, testing is beneficial to prevent infection or reduce the risk of HIV transmission in the population (2). Therefore, it is important to identify the groups likely to refuse HIV testing based on one's awareness of HIV status. Therefore, in addition to findings from the primary study, this study will identify the willingness to test for HIV among populations aware or unaware of their HIV status.

1.4 Justification

The primary study which forms the basis and provides the data for this research project was entitled "South African national HIV prevalence, HIV incidence, behaviour and communication survey".

The aims of the primary study were:

- To determine the prevalence and incidence of HIV infection in South Africa
- To obtain a better understanding of the factors driving HIV epidemics
- To collect data for monitoring the National Strategic Plan (NSP)

Though the primary study collected data on the first and second 90 targets, these data have not been analysed because the targets were not in existence. Therefore, in this secondary data analysis, estimating the first and second 90 targets presents baseline information to measure the progress of UNAIDS 90-90-90 targets in South Africa.

Furthermore, willingness to test for HIV and awareness of HIV status has been studied disjointedly in previous studies in South Africa. In this secondary data analysis, exploring the factors associated with willingness to test for HIV and awareness of HIV status jointly will help identify groups that need to be targeted for HIV testing services. For example, groups that are unaware of HIV status and untested for HIV and those who are aware of HIV status (especially HIV non-infected) and refuse to test for HIV. Lastly, this analysis can present the enabling factors that encourage HIV testing among groups.

HIV testing is the first step to knowing one's HIV status (1^{st} 90), the entry point to HIV treatment. People who are HIV infected and doing well on treatment have better outcomes, including low morbidity and low mortality and thus improved quality of life. Besides this benefit to themselves, if people test for HIV and are put on treatment and have undetectable viral loads, they become less infectious and reduce transmission.

1.5 Research Question

There are two research questions this analysis will be answering:

1. What are the proportions of people infected with HIV who are aware of their status and are on ART among children and adults aged 15 years and older in South Africa in 2012?
2. What factors are associated with knowing one's HIV status among children and adults aged 15 years and older in South Africa in 2012?

Knowing one's HIV status is a four-level composite variable defined as awareness of HIV status and willingness to provide a blood sample to test for HIV. In this analysis, knowing one's HIV status and awareness of HIV status means the same and are used interchangeably. It means whether an individual has ever been told of his or her HIV status after a test.

1.6 Aim

To estimate the proportions of people infected with HIV who know their status and are on ART and determine factors associated with knowing one's HIV status among children and adults aged 15 years and older in South Africa in 2012.

1.7 Objectives

1. To estimate the proportions of HIV infected people who are aware of their HIV status and are exposed to ART.
2. To estimate the proportions of people aware of their HIV status and willing to provide a blood sample for an HIV test.
3. To determine factors associated with awareness of HIV status and willingness to provide a blood sample for an HIV test.

CHAPTER TWO: METHODOLOGY

2.1 Study design

This study carried out secondary data analysis on the 2012 South African national HIV prevalence, incidence, behaviour, and communication survey (SABSSM). The SABSSM was a multi-stage stratified survey (7). A total of 1000 enumeration areas (EAs) were randomly selected using probability proportional to size from 86,000 EAs as defined by the South African population mapping of EAs in 2001 (7). The selected EAs were stratified by province, locality type and race in the urban areas. Selected EAs formed the primary sample units (PSUs), and from each of the 1000 EAs, 15 visiting points (VPs) which were the secondary sampling units (SSUs) were randomly selected. A Kish grid was used to select one household from a selected VP if more than one household exist in the VP. A total of 15,000 households were sampled for the survey. Every member of the selected household was invited to participate in the survey, and they were the ultimate sampling units (USU). To meet the required minimum sample size for each race group, Coloured and Indian/Asian race groups were oversampled in the study.

In the primary study (7), sample weights were calculated at the levels of sampling enumeration areas (EAs), visiting points (VPs) and the individual level in a selected household. The EAs sample weights were calculated due to unequal sampling probabilities of EAs by race, province and geographic type. The sampling weights for the VP's were calculated as the counted number of valid VPs in an EA, divided by the number of VPs participating in the survey. A final VP sampling weight was computed as the product of the EA sampling weight and the VP sampling weight. To calculate individual sample weights, demographic and HIV testing information of individuals in the household and their EAs were used. These individual sample weights were adjusted for HIV testing non-response. The final sampling weight for each data record was calculated as the final VP sampling weights multiplied by the selected person's sample weight per VP per age group. This process produced a final sample representative of South Africa's population in 2012 for sex, age, race, geographic type and province.

HIV testing comprised part of the survey. A finger-prick or heel-prick for infants was used to draw blood for HIV testing in recommended laboratories. The collected blood samples were assessed for exposure to ART. Bar codes on blood samples of people who tested for HIV were linked to their respective questionnaires by data merging (7). There was no way of identifying an individual when the HIV result was merged with the questionnaire because the questionnaire and laboratory results were anonymised. An HIV specimen result request form was given to those who provided blood samples to visit a nearby HIV counselling and testing centre (HCTC) for the collection of results.

This report contains results from a secondary data analysis of the survey to answer questions that were not addressed in the original report.

2.2 Study site

The survey for the primary study was carried out in South Africa. South Africa's population in 2012 was 52.3 million, with 14.2 million households (32). There are nine provinces, and the largest population is in Gauteng, followed by KwaZulu-Natal, Western Cape, Eastern Cape with Northern Cape being the least populated province (32). Among individuals five years or older living in South Africa in 2018, 32.2% attended an educational institution. Among individuals attending an educational institution, 87.7% were in schools up to grade 12, 4.5% in tertiary institutions and 2.3% attended Technical/Vocational colleges (32).

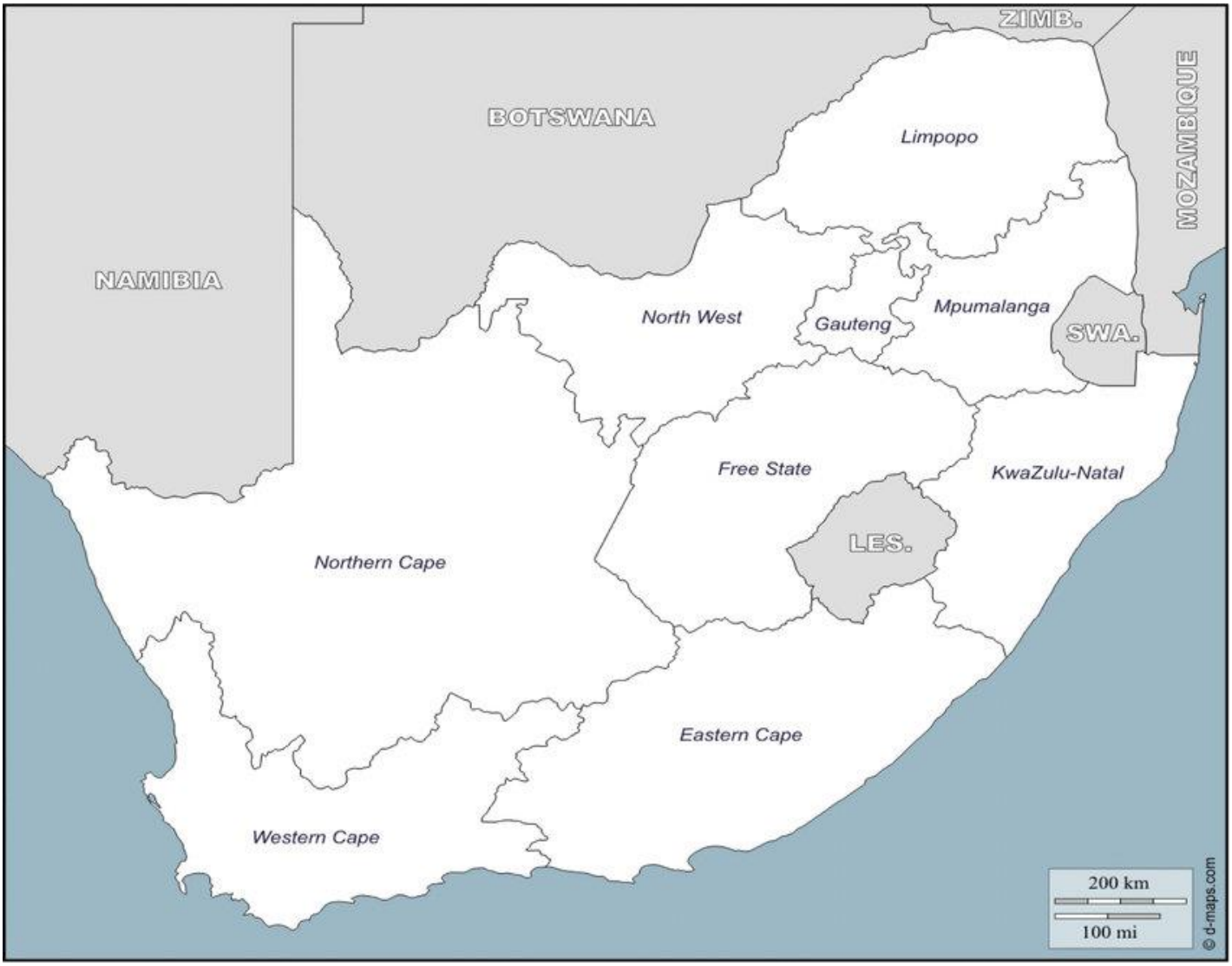


Figure 2.1: Map of South Africa

2.3 Study population

The study involved children and adults aged 15 years and older living in South Africa from January to November 2012, who had no intention of migrating within the next six months after the survey. The primary study excluded people in institutions such as older people's homes, prisons, hospitals, and tertiary residential institutions.

2.4 Sampling

The sampling scheme used in the primary study is described in the study design. Analysis for objective 1 was restricted to people who tested positive for HIV in the study. The analyses for objective 2 and 3 include all the study population regardless of their HIV status.

2.5 Data collection

The individual questionnaire for 15 years and older was used to gather information on behavioural indicators such as consistency of condom use, multiple sexual partnerships, awareness of HIV status, perception of risk of HIV infection, attitudes towards people living with HIV, knowledge of HIV transmission and prevention, health status and health service utilisation. The various questions contained in the questionnaire are shown in appendix 1.

All participants who agreed to be part of the survey were required to give written informed consent for both the interview and provision of a blood sample for HIV testing. Individuals aged below 18 years required consent from a parent or guardian before taking part in the interview or providing a blood sample. Children 7 to 17 years gave an assent to be included in the survey after their parent or guardian had consented. A parent or guardian responded to interviews on behalf of children aged 11 years and below. Participants aged 12 years and above responded to the interviews by themselves.

2.6. Data Management

2.6.1 Outcome variable

Secondary data analysis was conducted. The outcome variable was a four-level composite nominal variable formed from two variables; awareness of HIV status and willingness to provide a blood sample to test for HIV. The four-level outcome variable was assigned numbers 1 to 4, which are just assigned codes without any weighted meaning.

The four-level constructs, which described the awareness of HIV status and willingness to provide a blood sample for an HIV test were:

1= Unaware of HIV status and refused to test for HIV
2 = Unaware of HIV status and agreed to test for HIV
3 = Aware of HIV status and refused to test for HIV
4 = Aware of HIV status and agreed to test for HIV

Unaware of HIV status and refused to test for HIV was coded as 1 and defined as "never *tested for HIV or ever tested for HIV and did not receive the results and did not provide a blood sample to test for HIV in the survey."*

Unaware of HIV status and agreed to test for HIV was coded as 2 and defined as *"never tested for HIV or ever tested for HIV and did not receive the results and provided a blood sample to test for HIV in the survey."*

Aware of HIV status and refused to test for HIV was coded as 3 and defined as "*ever tested for HIV and told of your results and refused to provide a blood sample to test for HIV in the survey*".

Aware of HIV status and agreed to test for HIV was coded as 4 and defined as "*ever tested for HIV and told of your results and agreed to provide a blood sample to test for HIV in the survey*".

2.6.2 Explanatory variables

Explanatory variables that were explored for a possible association with the awareness of HIV status and willingness to provide a blood sample for an HIV test were educational status, marital status, employment status, frequency of communication use, and the number of useful HIV information sources. In addition, the number of engagements in HIV related activities, HIV knowledge, attitude and perceptions, sexual activeness, use of a condom, participants risk perception of getting infected with HIV, self-rated health status and frequency of health care utilisation were also explored.

2.6.3 Confounding variables

Variables such as age group, sex, race, geotype and province were kept in the final model. Studies have found these sociodemographic variables to be important predictors of HIV prevalence, awareness of HIV status and HIV testing (6, 33-35).

2.6.4 Definition of variables

Age groups were categorised as 15 to 24 years, 25 to 34 years, 35 to 44 years, 45 to 54 years, 55 to 64 years and 65 years and older.

Sex was coded as 0 = male and 1 = female. Race was in four categories, namely African, White, Coloured and Indian/Asian. Geotype was categorised as urban formal, urban informal, rural formal or rural informal (tribal authority areas). All nine provinces in South Africa were used in the analysis.

Educational status was categorised into four levels which were grades 0 to 7, grade 8 to 11, grade 12 and studies above grade 12. Employment status was defined as unemployed, employed, student and other. Marital status was in five groups, namely married, living together, single, separate/ divorced, and widowed.

Communication use was defined as the frequency in the use of radio, tv, phone, newspaper, internet, and magazine. Each item's responses were 1= Never, 2= Once a week, 3= 2 – 6 days a week and 4=Everyday. The mean over the six communication media was computed and then multiplied by 6 and a score in the range of 6 – 24 was generated.

Receipt of useful HIV information from different sources was defined as 1= Yes if useful information on HIV was received and 0 = No if no useful information was received. The sources where information was received included learner or child, religious institution, workplace, community meeting, traditional healer, AIDS welfare organisation, clinic/ hospital/ doctors office, telephone helpline, pharmacy or chemist, family or caregiver and friends. The final score was computed as the number of different sources from which useful HIV information was received.

Engagements in HIV related activities was defined as whether participants had ever engaged in the following HIV related activity in the past 12 months before the survey (i.e. responded yes =1 or no = 0 to the following questions). Respondents were asked to state yes or no if they had attended or engaged in:

- training workshop on HIV/AIDS
- community meeting on HIV/AIDS
- HIV/AIDS play or educational event
- been told by someone who is HIV positive
- attend the funeral of someone who died of AIDS
- cared for a person who is sick with AIDS
- helped care for a child whose parent has died of AID

The seven items were calculated as the total number of HIV related activity/activities a participant was engaged in 12 months before the survey.

HIV knowledge was measured using eight items. An item was scored 1, if the participant responded yes to each of the following statements or 0 if the response was no:

- AIDS cannot be cured
- Risk of HIV can be reduced by having fewer sexual partners
- A healthy-looking person can have HIV
- HIV can be transmitted from mother to unborn child
- HIV can be reduced by having sex with one uninfected sexual partner
- HIV cannot be acquired by sharing food with an infected person
- HIV risk can be reduced by using a condom for sex
- Medical male circumcision reduces the risk of HIV infections in males

The final HIV knowledge score was the total computed from the above items.

Attitude towards people living with HIV was measured using five items. A score of 1 was given if the participant stated “yes” to the following statements or 0 if the response was “no”:

- Will you buy food from an HIV infected food seller
- Willing to care for an infected family member
- Allow infected teacher to teach
- Comfortable talking about HIV/AIDS to at least one family member
- It is safe for people who have HIV/AIDS to work with children

The final attitude score was the total of these five items.

Stigma feelings towards people living with HIV was measured using six items. A score of 1 was given if the participant responded “yes” to the following:

- It is a waste of time to train or promote HIV infected persons
- Keep family member HIV positive status secret
- People who have AIDS are dirty
- People who have AIDS should be ashamed
- People with AIDS must be restricted on their freedom
- AIDS is a punishment

The final perception score was the total of the six items.

Sexually active was coded as Yes= 1 if a participant had sex in the past three months before the interview and No=0 if a participant did not have sex.

Use of a condom was coded a Yes=1 if a participant used a condom during his/her last sexual activity and No=0 if a participant did not use a condom.

Participants perceived risk of getting infected with HIV was coded as 1 = will get infected, and 0 = will not get infected.

Participants perceived health status was categorised as excellent, good, fair or poor.

Frequency in seeking health service was grouped into three categories: less than a year, more than a year and never sought health care.

2.7 Statistical Analysis

2.7.1 Descriptive analysis

Weighted and unweighted frequencies with linearised standard errors to take into account the clustering in the sample design were used to describe the study population's sociodemographic characteristics. Weighted percentages with 95% confidence intervals were reported for HIV infected people who were aware of their HIV positive status and on ART by age, sex, race, geotype and province.

2.7.2 Inferential analysis

The Rao-Scott adjustment to the chi-square statistic was used to report the four-level outcome distribution and test independently the association between categorical variables and the outcome (36). Results were presented in a table with weighted percentages and 95% confidence interval (95% CI).

2.7.3 Multinomial Logistic Regression

Firstly, univariable multinomial logistic regression models were fitted to determine the association between each explanatory variable and the four-level outcome. The reference category by which other levels of the outcome was compared was "aware of HIV status and agreed to test for HIV". For each categorical variable, one response was selected as the reference for comparison.

After fitting a model for each variable, the command "testparm" was used to check for its significance in the model. The Wald's P-value derived after the "testparm" command considered a variable significant at a P-value < 0.05 and marginally significant if P-value is < 0.1.

Secondly, a multivariable multinomial logistic regression model was fitted to determine factors associated with the four-level outcome by adjusting for other factors. This model was fitted by carrying out a backward elimination strategy which guided the selection of variables (37). This approach was used to verify the study's potential confounding variables on the outcome. This was achieved by fitting a stepwise regression model using backward elimination with a liberal P-value (0.2) and the potential confounding variables (age group, sex, race, geotype and province) as candidates.

A final stepwise regression model was fitted using backward elimination with a stricter P-value (0.1) with the explanatory variables as candidates and adjusting for the selected potential confounding variables. This step was done to maintain variables in the final model which could predict the outcome.

A multivariable multinomial logistic regression model was then fitted with the selected variables by adjusting for the potential confounding variables. The significance of an explanatory variable in the model was decided by carrying out a Wald test using the post-estimation command "testparm". The final model was interpreted using the adjusted predicted probabilities (predictive margins) of the four-level outcome. These probabilities were derived by running the "margins" command after the fitted model. Data were analysed using STATA 15.1 software (38).

2.8 Ethical considerations

The study protocol was submitted to the University of the Witwatersrand Human Research Ethics Committee for ethical clearance. The study received approval with a clearance certificate number M200210.

The primary study was approved by the Research Ethics Committee (REC: 5/17/11/10) of the Human Sciences Research Council (HSRC) and the associate director of science of the National Center for HIV and AIDS, Viral Hepatitis, STD and TB Prevention at the Centers for Disease Control and Prevention (CDC) in Atlanta, USA.

The SABSSM data is public and accessible based upon request on the HSRC website. Approval was sought from the HSRC to use the data.

The data made available by the HSRC was only accessible to the student and her supervisors.

2.9 Limitation

The limitation of the study is that “willingness to undergo a test” was based solely on whether a participant provided a blood sample to test for HIV in the survey. Some people might be willing to undergo a test which they believe is private and provide instant results. However, providing a blood sample does not ensure that the participant becomes aware of the test results.

HIV infected people who are aware of their HIV positive status may see no value in testing since a positive status do not change. However, this analysis could not exclude HIV infected people who are aware of their HIV positive status from the group “aware of HIV status and refused to test for HIV”. This was because the variable “are you aware of your HIV status” was self-reported as a “yes” or “no”, and an HIV status could only be determined by testing in the survey.

Other limitation to this study is that, causality could not be determined, recall bias and social desirability may have occurred in the primary study, which may affect the data.

The data excluded homeless people, people in educational institutions, prisons, uniformed personnel and people in older people’s homes. This exclusion may pose a greater limitation to the study because, some of the excluded people may be at a higher risk of HIV infections.

Also, the factors associated with awareness of HIV status and willingness to provide a blood sample for an HIV test determined from this study may not apply to individuals aged less than 15 years.

CHAPTER THREE: RESULTS

This chapter presents the results of the study in three main parts. The first section presents descriptive results of the characteristics of study participants. Estimating the proportions of HIV infected people who knew their HIV status and on ART, were presented by age, sex, race, geotype and province in this section. Weighted percentages were reported.

The second section shows results from a Rao-Scott designed-based adjustment to the chi-square test which measured the association of categorical explanatory variables with the four-level outcome. Results were presented as tables with proportions (weighted), 95% confidence intervals and P-values.

The third section of the chapter presents results from survey-weighted multinomial logistic regression models, predicting factors associated with the four-level outcome. Relative risk ratios with 95% confidence interval and P-value were reported. Adjusted predicted marginal probabilities with 95% confidence interval were used to interpret the association between the explanatory variables and the outcome. Level of significance was defined as a p-value less than 0.05.

3.1 Descriptive Analysis

3.1.1 Characteristics of the study participants

Table 3.1 presents the characteristics of the study participants. A total of 26,807 (unweighted) children and adults aged 15 years and older agreed to participate in the study. This sample represented a weighted population of 36 million children and adults aged 15+ years in South Africa in 2012. Adolescents and young adults aged 15 to 24 years formed a little above a quarter (27.5%) of the study population. More than half (51.9%) of the study participants were females and about three out of every four participants were African (77.7%). Most (52.0%) participants were from an urban formal location, and little above one-third (34.7%) were from a rural informal location.

Most (41.7%) of the participants had completed grade 8 to 11 and 15.8% were students. Unemployed participants formed 41.3% of the study population. There were 34.3% of participants living together, 31.5% were married and 24.7% were single.

Table 3.1: Characteristics of the study participants

Factor	Level	Proportion (%) ± Linearized SE	Unweighted sample size (n = 26 807)	Weighted sample size (N = 36 872 643)
*Age group	15 to 24	27.5 ± 0.5	7 220	10 145 305
	25 to 34	24.5 ± 0.6	5 322	9 026 127
	35 to 44	19.1 ± 0.5	4 425	7 050 058
	45 to 54	13.1 ± 0.4	3 937	4 846 062
	55 to 64	8.6 ± 0.3	3 180	3 165 483
	65 and older	7.2 ± 0.3	2 723	2 639 608
*Sex	Male	48.1 ± 0.5	11 603	17 723 655
	Female	51.9 ± 0.5	15 203	19 148 543
*Race	African	77.7 ± 1.3	15 388	28 590 878
	White	10.3 ± 0.9	2 900	3 790 550
	Coloured	9.3 ± 0.7	4 979	3 408 958
	Indian/Asian	2.8 ± 0.3	3 467	1 024 760
Geotype	Urban formal	52.0 ± 2.3	15 835	19 182 770
	Urban informal	7.8 ± 1.0	2 718	2 870 765
	Rural informal	33.7 ± 2.2	5 662	12 796 331
	Rural formal	5.5 ± 0.9	2 591	2 022 776
Province	Western Cape	12.2 ± 0.9	3 286	4 500 889
	Eastern Cape	11.9 ± 1.1	3 355	4 376 613
	Northern Cape	2.2 ± 0.3	2 061	799 272
	Free State	5.5 ± 0.6	1 998	2 000 105
	KwaZulu Natal	18.5 ± 1.7	6 261	6 813 998
	North West	6.9 ± 0.7	1 850	2 549 568
	Gauteng	25.5 ± 1.9	3 696	9 401 050
	Mpumalanga	7.6 ± 0.9	1 941	2 784 141
	Limpopo	9.9 ± 1.0	2 359	3 647 006
*Education level	Grade 0 to 7	18.0 ± 0.7	4 330	5 588 750
	Grade 8 to 11	41.7 ± 0.8	9 457	12 965 163
	Grade 12	29.0 ± 0.7	6 655	9 005 929
	Above Grade 12	11.3 ± 0.8	2 288	3 500 123

*Employment status	Unemployed	41.3 ± 0.8	10 501	14 822 052
	Employed	37.1 ± 0.9	9 943	13 326 531
	Student	15.8 ± 0.4	3 761	5 657 160
	Other	5.8 ± 0.3	1 841	2 070 430
*Marital status	Married	31.5 ± 0.8	9 390	11 399 784
	Living together	34.3 ± 0.7	7 492	12 423 773
	Single	24.7 ± 0.6	6 283	8947 617
	Separated/Divorced	3.0 ± 0.2	899	1 071 422
	Widowed	6.4 ± 0.2	2 204	2 327 453

* n not constant due to missing values

3.1.2 Awareness of HIV status among people who tested positive for HIV

The analysis presented in this section included all children and adults aged 15 years and older who tested positive for HIV in the study. Awareness of HIV status among this group is described by age group, sex, race, geotype and province.

Among participants aged 15 years and older, 2,632 participants (unweighted) tested positive for HIV, representing a weighted population of 6 million. Among this group, 73.9% (4.4 million, weighted) were aware of their HIV status.

The proportion of people who tested positive for HIV and aware of their HIV status was higher in group 35 to 44 years (78.8%), followed by 25 to 33 years (75.3%). Equal proportions (67%) of participants aged 15 to 24, 45 to 54 and 55 to 64 were aware of their HIV status. Participants aged 65 years and older recorded the least proportion (39%) of people who tested positive and were aware of their HIV status.

A higher proportion of females (81.7%) were aware of their status than males (61.5%).

More than 70% of participants in the different race groups were aware of their HIV status with the exception of Whites (62.0%).

The rural formal location had the least proportion (59.5%) of people who knew their HIV status.

By province, higher proportions of people who knew their HIV status were in the Eastern Cape (84.5%), followed by KwaZulu Natal (77.0%), Western Cape (76.2%) and Northern Cape (75.0%). The remaining provinces had about 70% to 74% of people aware of their HIV status except for Free State (67.1%) and North West (64.6%).

Table 3.2: Awareness of HIV status in PLHIV

Factor	Level	HIV population size (Weighted)	Aware of HIV status Weighted (%), 95% CI
Total		6 036 255	73.8% (70.4 , 77.0)
Age group	15 to 24	720 269	67.2% (59.8 , 73.9)
	25 to 24	2 398 306	75.3% (68.8 , 80.9)
	35 to 44	1 875 388	78.8% (72.6 , 83.9)
	45 to 54	773 559	67.3% (59.2 , 74.4)
	55 to 64	226 546	67.2% (58.4 , 75.0)
	65 and older	42 187	39.0% (17.2 , 66.3)
Sex	Male	2 347 789	61.5% (54.6 , 67.9)
	Female	3 688 466	81.7% (78.5 , 84.6)
Race	African	5 871 309	73.8% (70.2 , 77.1)
	White	13 980	62.0% (14.5 , 94.0)
	Coloured	138 359	76.9% (60.9 , 87.7)
	Indian/Asian	9 250	76.0% (54.3 , 89.4)
Geotype	Urban formal	2 439 604	71.2% (64.3 , 77.3)
	Urban informal	811 813	79.3% (71.9 , 85.2)
	Rural informal	2 510 451	76.2% (72.0 , 79.9)
	Rural formal	274 387	59.5% (51.5 , 67.0)
Province	Western Cape	286 938	76.2% (65.4 , 84.5)
	Eastern Cape	746 904	84.5% (78.4 , 89.1)
	Northern Cape	81 330	75.0% (62.2 , 84.6)
	Free State	376 931	67.1% (56.1 , 76.4)
	KwaZulu Natal	1 588 403	77.0% (70.8 , 82.2)
	North West	456 341	64.6% (54.9 , 73.2)
	Gauteng	1 500 330	69.9% (59.7 , 78.4)
	Mpumalanga	551 527	72.2% (65.0 , 78.4)
	Limpopo	447 552	73.5% (63.8 , 81.3)

3.1.3 Exposure to ART among people who tested positive for HIV and knew their status

Out of the estimated 4.4 million people who tested positive for HIV and knew their HIV status, 36 % were on ART. The proportion of people on treatment who tested positive for HIV and knew their HIV status was higher in the age group 65 and older (73.3%), and the least was in the age group 15 to 24 years (16.9%).
The proportion of females (37.6%) on treatment was higher than males (31.7%). Africans (35.7%) reported the least proportion of people on treatment. The rural informal location (40.4%) had the highest proportion of people on treatment.

North West province (42.45%) reported the highest proportion of people on ART, and the least proportion was in the Northern Cape (15.48%).

Detailed proportions of exposure to ART among people who tested positive for HIV and knew their status are presented in Table 3.3.

Table 3.3: Awareness of HIV status and exposure to ART

Factor	Level	PLHIV aware of HIV status (weighted)	Aware of HIV status and on ART W(%), 95% CI
Total		4 456 462	36.0% (32.5 , 39.7)
*Age group	15 to 24	484 280	16.9% (11.6 , 23.9)
	25 to 24	1 806 857	25.4% (21.3 , 30.0)
	35 to 44	1 477 365	48.0% (40.9 , 55.2)
	45 to 54	519 796	49.4% (41.3 , 57.6)
	55 to 64	151 711	56.6% (46.1 , 66.4)
	65 and older	16 453	73.3% (41.7 , 91.3)
*Sex	Male	1 441 879	32.7% (26.5 , 39.6)
	Female	3 014 583	37.6% (33.7 , 41.6)
*Race	African	4 333 648	37.5% (32.1 , 39.5)
	White	8 671	80.4% (27.9 , 97.8)
	Coloured	106 428	43.3% (29.3 , 58.4)
	Indian/Asian	7 028	38.7% (15.1 , 69.3)
Geotype	Urban formal	1 737 390	32.1% (25.3 , 39.9)
	Urban informal	643 538	32.9% (27.3 , 39.1)
	Rural informal	1 913 039	40.4% (36.0 , 45.0)
	Rural formal	162 495	37.7% (27.1 , 49.7)
Province	Western Cape	218 742	31.2% (22.2 , 41.8)
	Eastern Cape	631 218	36.1% (29.1 , 43.7)
	Northern Cape	60 992	15.5% (5.7 , 35.6)
	Free State	252 774	37.6% (30.1 , 45.8)
	KwaZulu Natal	1 223 365	39.2% (33.5 , 45.3)
	North West	294 712	42.4% (32.4 , 53.2)
	Gauteng	1 048 330	33.6% 23.5 , 45.5)
	Mpumalanga	398 068	39.1% (29.5 , 49.7)
	Limpopo	328 260	28.0% (18.9 , 39.4)

3.2 Inferential Statistics

3.2.1 Awareness of HIV status and willingness to provide a blood sample to test for HIV

Table 3.4 summarises the proportions of HIV status awareness and willingness to provide a blood sample for an HIV test (the four-level outcome) among children and adults aged 15 years and older.

Variables which were found to be associated with the four-level outcome were age group (P<0.0001), sex (P<0.0001), race (P<0.0001), geotype (P<0.0001), province (P<0.0001), educational level (P<0.0001), employment status (P<0.0001), marital status (P<0.0001), participant perception of risk of being infected with HIV (P=0.0001), frequency of utilising health service (P<0.0001) and participants' perceived health status (P=0.0001). Being sexually active (P=0.14) and using a condom (P=0.37) were not associated with the outcome.

Outcome level 1: Unaware of HIV status and refused to test for HIV

A weighted percentage of 9.5% of the participants were in the category "unaware of their HIV status and refused an HIV test". Older participants, 65 years and above (18.4%) recorded a higher proportion of participants unaware of their HIV status and refused an HIV test compared to other age groups.

Higher proportions of being unaware of HIV status and refused to test for HIV were observed in males (10.8%), whites (22.1%), people living in an urban formal location (11.7%) and Gauteng province (13.2%).

People with grade 12 (9.8%) and grade 12 and above (9.6%) recorded similar proportions of being unaware of their HIV status and refused an HIV test compared to those with lower educational levels.

Similar proportions of being unaware of HIV status and refused an HIV test were reported in single (11.1%), married (10.7%), and widowed (10.9%) participants.

A higher proportion of being unaware of HIV status and refused an HIV test was found in people with the perceived risk of being infected with HIV (10.1%) than those with no risk perception (5.7%).

People who had never utilised a health service (12.8%) and those who perceived their health status as excellent (11.0%) had higher proportions of being unaware of their HIV status and refused an HIV test.

Outcome level 2: Unaware of HIV status and agreed to test for HIV

There were 29.9% of the participants in the category “unaware of HIV status and agreed to test for HIV”. The proportion unaware of HIV status and agreed to test for HIV was lower in people aged 35 to 44 years (18.1%) compared to other age groups. Higher proportions of participants aged 65 years or older (52.5%) and 18 to 24 years (42.1%) were unaware of their HIV status and agreed to test for HIV.

Lower proportions of being unaware of HIV status and agreed to test for HIV were found in females (25.2%), whites (23.6%) and people living in urban formal locations (25.8%).

Lower proportions of belonging to the group unaware of HIV status and agreeing to test for HIV were recorded in Gauteng province (24.4%), people with an educational level above grade 12 (15.5%), employed people (21.7%) and married participants (22.0%).

People who did not perceive themselves to be at risk of being infected with HIV (24.0%) and people who had utilised the health services in the year before the study (25.0%) recorded lower proportions of being unaware of HIV status and agreed to test for HIV.

Outcome level 3: Aware of HIV status and refused to test for HIV

There were 14% of participants in the category “aware of HIV status and refused to test for HIV”.

A higher proportion of being aware of HIV status and refused to test for HIV was observed in people aged 35 to 44 years (19.0%), followed by 25 to 34 years (17.6%) compared to other age groups.

The proportions of being aware of HIV status and refused to test for HIV were similar in males (14.3%) and females (13.7%).

Higher proportions of being aware of HIV status and refused to test for HIV were reported in whites (26.0%), followed by Indians/Asians (23.7%), people living in urban formal locations (18.8%), Gauteng province (21.3%), people with an educational level above grade 12 (29.1%), employed people (20.4%) and married people (19.8%).

People with the risk perception of being infected with HIV (14.9%), people who perceive their health status as excellent (15.7%) and people who utilised health service in less than a year (15.6%) before the study had higher proportions of being aware of HIV status and refused to test for HIV.

Outcome level 4: Aware of HIV status and agreeing to test for HIV

From the study, 46.6% of the participants were in the category "aware of HIV status and agreed to test for HIV". People aged 65 years or older (21.5%) had the least proportion of participants aware of their HIV status and agreed to test for HIV compared to other age groups.

Lower proportions of being aware of HIV status and agreed to test for HIV were observed in males (39.9%), whites (28.4%) and people from rural formal location (42.8%), followed by urban formal (43.7%).

The following provinces reported less than half of people aware of their HIV status and agreed to test for HIV; Free State (47.3%), North West (44.4%), Gauteng (41.2%). Mpumalanga (42.6%) and Limpopo (43.2%).

People with an educational level above grade 12 (45.8%) and single people (35.7%), recorded lower proportions of being aware of HIV status and agreed to test for HIV.

Lower proportions of being aware of HIV status and agreed to test for HIV were observed in people with a perceived risk of being infected with HIV (43.4%), people who had never utilised health services (33.0%) before the study and people who perceived their health status as excellent (42.4%).

Table 3.4: Proportions of awareness of HIV status and willingness to provide a blood sample for an HIV test

Factor	Level	Outcome level 1 ,n (W%)	Outcome level 2 , n (W%)	Outcome level 3 , n (W%)	Outcome level 4 , n (W%)
Total		2 651 (9.5%)	8 615 (29.9%)	3 449 (14.0%)	12092 (46.6%)
Age group	15-24	794 (10.5%)	3 149 (42.1%)	536 (8.1%)	2 741 (39.3%)
	25-34	368 (6.8%)	1 042 (20.7%)	913 (17.6%)	2 999 (54.9%)
	35-44	316 (7.1%)	817 (18.1%)	805 (19.0%)	2 487 (55.9%)
	45-54	353 (10.1%)	1 031(24.1%)	615 (15.8%)	1 938 (50.0%)
	55-64	347 (11.2%)	1 153 (33.3%)	387 (14.3%)	1 293 (41.3%)
	65 and more	473 (18.4%)	1 423 (52.5%)	193 (7.5%)	634 (21.5%)
Sex	Male	1 322 (10.8%)	4 229 (32.1%)	1 524 (14.3%)	4 528 (39.9%)
	Female	1 328 (8.3%)	4 386 (25.2%)	1 925 (13.7%)	7 564 (52.8%)
Race	African	1 135 (7.9%)	5 131 (30.9%)	1 706 (12.1%)	7 416 (49.1%)
	White	612 (22.1%)	758 (23.6%)	681 (26.0%)	849 (28.4%)
	Coloured	274 (6.4%)	1 593 (30.0%)	503 (13.7%)	2 609 (49.9%)
	Indian/Asian	616 (18.5%)	1 114 (25.4%)	553 (23.7%)	1 184 (32.3%)
Geotype	Urban formal	1 937 (11.7%)	4 613 (25.8%)	2 541 (18.8%)	6 744 (43.7%)
	Urban informal	163 (6.5%)	845 (29.6%)	304 (11.8%)	1 406 (52.1%)
	Rural informal	382 (7.0%)	2 148 (35.6%)	411 (7.3%)	2 721 (50.2%)
	Rural formal	168 (9.4%)	1 009 (33.7%)	193 (14.1%)	1 221 (42.8%)
Province	Western Cape	223 (8.5%)	944 (25.8%)	413 (16.1%)	1 706 (49.5%)
	Eastern Cape	219 (6.1%)	1 218 (33.5%)	322 (8.7%)	1 596 (51.6%)
	Northern Cape	124 (6.2%)	625 (29.5%)	224 (10.9%)	1 088 (53.5%)
	Free State	217 (10.4%)	578 (28.0%)	303 (14.2%)	900 (47.3%)
	KwaZulu Natal	551 (7.4%)	2 157 (30.1%)	682 (10.3%)	2 871 (52.2%)
	North West	213 (9.9%)	581 (34.8%)	253 (10.9%)	803 (44.4%)
	Gauteng	682 (13.2%)	919 (24.4%)	762 (21.3%)	1 333 (41.2%)
	Mpumalanga	195 (8.5%)	752 (39.8%)	198 (9.1%)	796 (42.6%)
	Limpopo	227 (10.2%)	841 (34.4%)	292 (12.3%)	999 (43.2%)
Education level	Grade 0 to 7	298 (7.0%)	1 752 (38.8%)	260 (6.1%)	2 020 (48.0%)
	Grade 8 to 11	890 (9.2%)	3 399 (33.6%)	880 (9.6%)	4 288 (47.5%)
	Grade 12	731 (9.8%)	1 499 (21.4%)	1 171 (19.3%)	3 254 (49.5%)
	Above Grade 12	271 (9.6%)	385 (15.5%)	638 (29.1%)	994 (45.8%)

Employment status	Unemployed	809 (7.2%)	3 239 (27.5%)	1 108 (12.2%)	5 345 (53.1%)
	Employed	880 (9.0%)	2 305 (21.7%)	1 920 (20.4%)	4 838 (48.9%)
	Student	487 (12.0%)	2 038 (50.8%)	194 (5.6%)	1 042 (31.6%)
	Other	312 (17.9%)	773 (41.2%)	155 (10.0%)	601 (30.9%)
Marital status	Married	984 (10.7%)	2 383 (22.0%)	1 666 (19.8%)	4 357 (47.5%)
	Living together	437 (6.2%)	1 928 (25.2%)	889 (12.2%)	4 238 (56.4%)
	Single	739 (11.1%)	2 826 (42.6%)	557 (10.6%)	2 161 (35.7%)
	Separated/Divorced	77 (7.7%)	244 (25.3%)	129 (15.7%)	449 (51.3%)
	Widowed	268 (10.9%)	1 012 (43.0%)	165 (9.6%)	759 (36.4%)
Sexually active	Yes	984 (7.0%)	3 214 (21.5%)	2 290 (16.9%)	7 784 (54.6%)
	No	64 (5.7%)	315 (25.1%)	151 (13.4%)	640 (55.8%)
Used condom	Yes	260 (6.4%)	843 (21.2%)	617 (16.1%)	2 315 (56.3%)
	No	712 (7.2%)	2 341 (21.6%)	1 648 (17.5%)	5 379 (53.7%)
Risk perception	Not get infected	270 (5.7%)	1 270 (24.0%)	526 (11.6%)	2 845 (58.6%)
	Will get infected	2 199 (10.1%)	7 117 (31.6%)	2 888 (14.9%)	9 121 (43.4%)
Frequency health care utilisation	Less than a year	1 578 (8.4%)	5 021 (25.0%)	2 607 (15.6%)	8 693 (51.0%)
	More than a year	737 (10.0%)	2 754 (37.1%)	706 (11.6%)	2 930 (41.4%)
	Never	170 (12 8%)	660 (44.2%)	115 (10.0%)	422 (33.0%)
Health status	Excellent	730 (11.0%)	2 048 (30.9%)	948 (15.7%)	2 580 (42.4%)
	Good	1 289 (8.7%)	4 571 (29.2%)	1 923 (14.3%)	7 006 (47.8%)
	Fair/Poor	474 (8.0%)	1 825 (29.7%)	566 (11.9%)	2 467 (50.4%)

3.2.2 Awareness of HIV status and willingness to provide a blood sample for an HIV test by HIV status

Participants HIV status was determined by testing in the study. Unknown HIV status describes the status of people who refused to test for HIV in the study.

People who agreed to test for HIV and tested positive recorded a higher proportion of people (74.8%) aware of their HIV status than those who tested negative for HIV. Among people who did not agree to test for HIV, 40.5% of participants were unaware of their HIV status. A quarter (25.2%) of people who tested positive for HIV were unaware of their HIV status.

Table 3.5: The four-level outcome by HIV status

Factor	Level	Outcome level 1, n (W%)	Outcome level 2, n (W%)	Outcome level 3, n (W%)	Outcome level 4, n (W%)
Total		2 651 (9.5%)	8 615 (29.9%)	3 449 (14.0%)	12 092 (46.6%)
HIV status	Negative Positive Unknown status	0 (0%) 0 (0%) 2 651 (40.5%)	7 945 (41.9%) 670 (25.2%) 0 (0%)	0 (0%) 0 (0%) 3 449 (59.5%)	10 130 (58.1%) 1 962 (74.8%) 0 (0%)

3.3 Survey-weighted multinomial logistic regression

This section presents results from survey-weighted univariable and multivariable multinomial logistic regression models. Univariable multinomial logistic models determined the unadjusted association of each explanatory variable with the four-level outcome. A multivariable multinomial logistic model determined the association of explanatory variables with the outcome by adjusting for other factors.

3.3.1 Univariable Multinomial Analysis

Factors associated with the four-level outcome were: age group, sex, race, geotype, province, educational level, marital status, employment status, frequency of communication use, number of sources to useful HIV information, engagements in HIV related activities, HIV knowledge, attitude towards PLHIV, participants perceived risk of getting infected with HIV, self-rated health status and frequency of health service utilisation.
The association between being sexually active and the outcome was marginally significant. Stigma perceptions towards PLHIV and using a condom at last sex were not associated with the four-level outcome.

Table 3.6 summarises results from univariable multinomial models fitted for each study variable and some of the findings have been interpreted as below. The relative risk ratios in the table are with respect to outcome level 4 (being aware of HIV status and agree to provide a blood sample).

The risk of persons aged 15 to 24 years belonging to outcome level 1 (being unaware of HIV status and refuse to provide a blood sample) relative to outcome level 4 is 2.1 times the risk for a person aged 35 to 44 years (95% CI: 1.6 , 2.7). This effect was similar in persons aged 55 to 64 years (95% CI: 1.5 , 3.0).
In males, the risk of belonging to outcome level 1 relative to outcome level 4 is 1.7 times the risk in females (95% CI: 1.5 , 2.0).
The risk for Whites and Indians/Asians belonging to outcome level 1 relative to outcome level 4 is 4.8 and 3.6 times the risk for an African. (Whites 95% CI: 3.6 , 6.5 , Indians/Asians 95% CI: 2.5 , 5.0).

By province, the risk of persons living in Gauteng belonging to outcome level 1 relative to outcome level 4 is 1.9 times the risk of persons living in the Western Cape (95% CI: 1.3 , 2.7).
The risk of belonging to outcome level 1 relative to outcome level 4 is 0.8 times for every one-point increase in the number of sources of useful HIV information (95% CI: 0.8 , 0.9).
Considering HIV knowledge, the risk of belonging to outcome level 1 relative to outcome level 4 is 0.9 times for every one-point increase in the scores of HIV knowledge (95% CI: 0.9 , 1.0).
The risk of persons with the perception of being infected with HIV to belong to outcome level 1 relative to outcome level 4 is 2.4 times the risk of persons with no perception of being infected with HIV (95% CI: 1.9 , 3.0).

Among persons aged 65 years and older, the risk of belonging to outcome level 2 (being unaware of HIV status and agree to provide a blood sample) relative to outcome level 4 is 7.5 times the risk for a person aged 35 to 44 years (95% CI: 6.2 , 9.2).
The risk of persons in rural informal and rural formal belonging to outcome level 2 relative to outcome level 4 is respectively 1.2 and 1.3 times the risk for a person in urban formal location (rural informal 95% CI: 1.1 , 1.4 , rural formal 95% CI: 1.1 , 1.7).
The risk of persons with grade 0 to 7 belonging to outcome level 2 relative to outcome level 4 is 2.4 times the risk for a person with an educational level above grade 12 (95% CI: 1.8 , 3.1).
Among persons who perceived their health status as good the risk of belonging to outcome level 2 relative to outcome level 4 is 0.8 times the risk in persons who perceived their health status as excellent. This risk was similar in persons who perceived their health status as fair or poor (95% CI: 0.7 , 0.9).
Among people who never utilise health service before the study, their risk of belonging to outcome level 2 relative to outcome level 4 is 2.7 times the risk of persons who utilised health service before the study (95% CI: 2.2 , 3.3).

The risk of married persons belonging to outcome level 3 (being aware of HIV status and refuse to provide a blood sample) relative to outcome level 4 is 1.4 times the risk of single persons (95% CI: 1.1 , 1.7).
In employed persons, the risk of belonging to outcome level 3 relative to outcome level 4 is 1.8 times the risk in unemployed persons (95% CI: 1.5 , 2.1).

The risk of belonging to outcome level 3 relative to outcome level 4 is 0.9 times for every one-point increase in the number of engaging in HIV related activities (95% CI: 0.9 , 1.0).
The risk of belonging to outcome level 3 relative to outcome level 4 is 0.9 for every one-point increase in the scores of attitude towards PLHIV (95% CI: 0.8 , 1.0).

Table 3.6: Univariable analysis of the four-level outcome by explanatory variables

Factor	Level	Outcome level 1 RRR (95% CI)	Outcome level 2 RRR (95% CI)	Outcome level 3 RRR (95% CI)	Wald P-value
Age group	15 to 24	2.1 (1.2 , 2.7)	3.3 (2.8 , 3.9)	0.6 (0.5 , 0.7)	<0.0001
	25 to 34	1.0 (0.7 , 1.3)	1.2 (1.0 , 1.4)	0.9 (0.8 , 1.1)	
	35 to 44	1	1	1	
	45 to 54	1.6 (1.2 ,2.2)	1.5 (1.2 ,1.8)	0.9 (0.7 , 1.2)	
	55 to 64	2.1 (1.5 , 3.0)	2.5 (2.0 , 3.0)	1.0 (0.8 , 1.3)	
	65 or more	6.8 (4.8 , 9.6)	7.5 (6.2 , 9.2)	1.0 (0.7 , 1.5)	
Sex	Male	1.7 (1.5 , 2.0)	1.8 (1.7 , 2.0)	1.4 (1.2 , 1.6)	<0.0001
	Female	1	1		
Race	African	1	1	1	<0.0001
	White	4.8 (3.6 , 6.5)	1.3 (1.1 , 1.6)	3.7 (2.9 , 4.8)	
	Coloured	0.8 (0.6 , 1.1)	1.0 (0.8 , 1.1)	1.1 (0.9 , 1.4)	
	Indian/Asian	3.6 (2.5 , 5.0)	1.3 (1.1 , 1.5)	3.0 (2.2 , 4.1)	
Geotype	Urban formal	1	1	1	<0.0001
	Urban informal	0.5 (0.2 , 0.9)	1.0 (0.8 , 1.2)	0.5 (0.4 , 0.7)	
	Rural informal	0.8 (0.4 , 0.7)	1.2 (1.1 , 1.4)	0.3 (0.3 , 0.4)	
	Rural formal	0.8 (0.5 , 1.5)	1.3 (1.1 , 1.7)	0.8 (0.4 , 1.4)	
Province	Western Cape	1	1	1	<0.0001
	Eastern Cape	0.7 (0.4 , 1.1)	1.2 (1.0 , 1.5)	0.5 (0.4 , 0.8)	
	Northern Cape	0.7 (0.4 , 1.1)	1.1 (0.9 , 1.3)	0.6 (0.4 , 0.9)	
	Free State	1.3 (0.8 , 2.2)	1.1 (0.9 , 1.4)	0.9 (0.6 , 1.4)	
	KwaZulu Natal	0.8 (0.5 , 1.2)	1.1 (0.9 , 1.3)	0.6 (0.4 , 0.9)	
	North West	1.3 (0.8 , 2.1)	1.5 (1.2 , 1.9)	0.8 (0.5 , 1.1)	
	Gauteng	1.9 (1.3 , 2.7)	1.1 (0.9 , 1.4)	1.6 (1.1 , 2.2)	
	Mpumalanga	1.2 (0.8 , 1.8)	1.9 (1.4 , 2.2)	0.7 (0.4 , 1.0)	
	Limpopo	1.4 (0.9 , 2.2)	1.5 (1.2 , 1.9)	0.9 (0.6 , 1.3)	
Education	Grade 0 to 7	0.7 (0.5 , 1.0)	2.4 (1.8 , 3.1)	0.2 (0.1 , 0.3)	<0.0001
	Grade 8 to 11	0.9 (0.6 , 1.3)	2.1 (1.6 , 2.7)	0.3 (0.2 , 0.4)	
	Grade 12	0.9 (0.7 , 1.4)	1.3 (1.0 , 1.6)	0.6 (0.5 , 0.8)	
	Above grade 12	1	1	1	
Marital status	Married	0.7 (0.6 , 0.9)	0.4 (0.3 , 0.5)	1.4 (1.1 , 1.7)	<0.0001
	Living together	0.4 (0.3 ,0.4)	0.4 (0.3 , 0.4)	0.7 (0.6 , 0.9)	
	Separate/divorce	0.5 (0.3 , 0.8)	0.4(0.3 , 0.5)	1.0 (0.7 , 1.5)	
	Widowed	1.0 (0.7 , 1.3)	1.0 (0.8 , 1.2)	0.9 (0.6 , 1.3)	
	Single	1	1	1	

Employment status	Employed Student Other Unemployed	1.3 (1.1 , 1.7) 2.8 (2.2 , 3.6) 4.2 (3.1 , 5.8) 1	0.9 (0.8 , 1.0) 3.1 (2.7 , 3.6) 2.6 (2.2 , 3.1) 1	1.8 (1.5 , 2.1) 0.8 (0.6 , 1.1) 1.4 (1.0 , 2.1) 1	<0.0001
Use of communication	Per category increase	1.0 (1.0 , 1.00)	0.9 (0.9 , 1.0)	1.1 (1.1 , 1.1)	<0.0001
Source useful HIVinformation	Per category increase	0.8 (0.8 , 0.9)	0.9 (0.9 , 0.9)	0.9 (0.9 , 1.0)	<0.0001
Engagements in HIV activities	Per category increase	0.7 (0.7 , 0.8)	0.8 (0.8 , 0.9)	0.9 (0.9 , 1.0)	<0.0001
HIV knowledge score	Per category increase	0.9 (0.9 , 1.0)	0.9 (0.9 , 0.9)	1.1 (1.0 , 1.1)	<0.0001
HIV attitude score	Per category increase	0.7 (0.6 , 0.7)	0.7 (0.7 , 0.8)	0.9 (0.8 , 1.0)	<0.0001
HIV stigma score	Per category increase	1.0 (0.9 , 1.1)	1.0 (1.0 , 1.1)	1.0 (0.9 , 1.0)	0.4226
Sexually active	Yes No	1.3 (0.7 , 2.2) 1	0.9 (0.7 , 1.1) 1	1.3 (1.0 , 1.7) 1	0.0611
Use condom at last sex	No Yes	1.1 (0.9 , 1.5) 1	1.0 (0.9 , 1.2) 1	1.2 (1.0 , 1.4) 1	0.3546
Risk perception of HIV infection	Will get HIV Will not get HIV	2.4 (1.9 , 3.0) 1	1.8 (1.6 , 2.0) 1	1.7 (1.5 , 2.0) 1	<0.0001
Health Status	Good Fair/poor Excellent	0.7 (0.6 , 0.9) 0.6 (0.5 , 0.9) 1	0.8 (0.7 , 0.9) 0.8 (0.7 , 0.9) 1	0.8 (0.7 , 1.0) 0.6 (0.5 , 0.8) 1	<0.0001
Frequency of health service utilisation	More than a year Never Within a year	1.5 (1.2 , 1.8) 2.4 (1.7 , 3.3) 1	1.8 (1.7 , 2.0) 2.7 (2.2 , 3.3) 1	0.9 (0.8 , 1.1) 1.0 (0.7 , 1.4) 1	<0.0001

3.3.2 Multivariable Multinomial Analysis

The variable selection procedure described in the method section led to the inclusion of the following variables in the multivariable multinomial model: educational status, marital status, employment status, engagements in HIV related activities, attitude towards PLHIV, condom use at last sex, frequency of communication use, number of sources of useful HIV information, participant's risk perception of being infected with HIV, self-rated health status and frequency in health care utilisation

Age-group, sex, race, geotype and province remained a strong predictor of awareness of HIV status and willingness to provide a blood sample to test for HIV in the multivariable analysis. By adjusting for the variables above, a number of variables were found to be significantly ($P<0.05$) associated with the four-level outcome. The variables were educational status, employment status, engagements in HIV activities, attitude towards PLHIV and health service utilisation. Marital status and use of a condom at last sex were marginally associated with the four-level outcome. The final model results are shown in Table 3.7.

Adjusted predicted probabilities (in percentage) of each outcome level were used to interpret association with the explanatory factors. Adjusted predicted probabilities (predictive margins) were reported for only factors whose association with the outcome were statistically significant or marginally significant. These probabilities have been summarised in Tables 3.8 to 3.11.

Table 3.7: Multiple multinomial analysis of the four-level outcome by explanatory variables

Factor	Level	Outcome level 1, RR(95%CI)	Outcome level 2, RR(95%CI)	Outcome level 3, RR(95%CI)	Wald P-value
Age group	15 to 24	1.2 (0.8 , 2.1)	1.4 (1.1 , 1.9)	0.7 (0.6 , 1.3)	<0.0001
	25 to 34	1.1 (0.7 , 1.8)	1.0 (0.8 , 1.3)	0.9 (0.7 , 1.2)	
	35 to 44	1	1	1	
	45 to 54	1.4 (0.9 ,2.2)	1.4 (1.1 ,1.9)	1.1 (0.8 , 1.4)	
	55 to 64	1.8 (1.0 , 3.2)	2.2 (1.6 , 3.1)	0.9 (0.6 , 1.2)	
	65 or more	3.1 (1.3 , 7.6)	4.5 (2.6 , 8.0)	1.1 (0.5 , 2.1)	
Sex	Male	2.3 (1.8 , 3.0)	2.5 (2.0 , 2.9)	1.4 (1.2 , 1.8)	<0.0001
	Female	1	1		
Race	African	1	1	1	0.0103
	White	2.7 (1.4 , 5.4)	1.5 (1.0 , 2.1)	1.4 (0.8 , 2.5)	
	Coloured	0.8 (0.4 , 1.5)	1.2 (0.9 , 1.6)	0.9 (0.6 , 1.4)	
	Indian/Asian	1.8 (0.9 , 3.8)	1.4 (1.0 , 2.1)	1.2 (0.7 , 2.0)	
Geotype	Urban formal	1	1	1	0.0004
	Urban informal	1.5 (0.8 , 2.7)	0.9 (0.7 , 1.1)	1.5 (1.0 , 2.3)	
	Rural informal	1.2 (0.5 , 2.9)	1.0 (0.7 , 1.3)	1.1 (0.6 , 1.9)	
	Rural formal	1.7 (0.9 , 3.2)	0.9 (0.6 , 1.1)	0.7 (0.4 , 1.2)	
Province	Western Cape	1	1	1	0.0006
	Eastern Cape	1.1 (0.6 , 2.2)	1.1 (0.8 , 1.5)	1.2 (0.8 , 2.0)	
	Northern Cape	1.3 (0.7 , 2.5)	0.9 (0.7 , 1.3)	0.9 (0.6 , 1.3)	
	Free State	2.3 (1.1 , 4.5)	1.3 (0.9 , 1.9)	1.5 (0.9 , 2.6)	
	KwaZulu Natal	1.8 (0.9 , 3.5)	1.1 (0.8 , 1.6)	1.3 (0.8 , 2.2)	
	North West	2.2 (1.0 , 4.4)	1.3 (1.0 , 1.9)	1.6 (0.9 , 2.7)	
	Gauteng	3.3 (1.8 , 5.9	1.2 (0.8 , 1.6)	1.6 (1.0 , 2.5)	
	Mpumalanga	1.9 (0.9 , 3.9)	1.8 (1.2 , 2.3)	1.2 (0.7 , 2.0)	
	Limpopo	2.3 (1.0 , 5.0)	1.2 (0.9 , 1.7)	2.1 (1.2 , 3.5)	
Education	Grade 0 to 7	1.8 (0.9 , 3.5)	2.0 (0.9 , 1.4)	0.5 (0.4 , 0.8)	<0.0001
	Grade 8 to 11	1.6 (0.9 , 2.8)	1.8 (0.9 , 2.2)	0.7 (0.5 , 0.9)	
	Grade 12	1.5 (0.8 , 2.6)	1.6 (1.2 , 2.2)	1.0 (0.8 , 1.3)	
	Above grade 12	1	1	1	

Marital status	Married Living together Separate/divorce Widowed Single	0.6 (0.4 , 1.0) 1.0 (0.5 , 1.8) 0.5 (0.1 , 1.5) 0.2 (0.1 , 0.6) 1	1.1 (0.9 , 1.4) 1.4 (0.9 , 2.2) 0.8(0.4 , 1.4) 0.7 (0.3 , 1.4) 1	0.8 (0.6 , 1.0) 1.1 (0.7 , 1.7) 0.9 (0.4 , 1.8) 1.3 (0.6 , 2.5) 1	0.0553
Employment status	Employed Student Other Unemployed	1.2 (0.9 , 1.6) 1.8 (1.1 , 3.0) 1.5 (0.8 , 2.9) 1	1.0 (0.8 , 1.2) 1.7 (1.2 , 2.4) 1.1 (0.7 , 1.7) 1	1.1 (0.9 , 1.4) 0.5 (0.3 , 0.9) 1.1 (0.6 , 1.8) 1	0.0011
Use of communication	Per category increase	1.0 (1.0 , 1.01)	1.0 (1.0 , 1.0)	1.0 (1.0 , 1.1)	0.2194
Number useful HIVinformation	Per category increase	0.9 (0.9 , 1.0)	1.0 (0.9 , 1.0)	1.0 (0.9 , 1.0)	0.4285
Engagements in HIV activities	Per category increase	0.8 (0.8 , 0.9)	0.9 (0.8 , 1.0)	1.0 (0.9 , 1.0)	0.0007
HIV attitude score	Per category increase	0.7 (0.6 , 0.9)	0.9 (0.8 , 1.0)	0.9 (0.7 , 1.0)	0.0033
Use condom at last sex	No Yes	0.8 (0.6 , 1.1) 1	1.1 (0.9 , 1.3) 1	0.8 (0.6, 1.1) 1	0.0849
Risk perception of HIV infection	Will get HIV Will not get HIV	1.1 (0.8 , 1.5) 1	1.0 (0.8 , 1.2) 1	1.3 (1.0 , 1.6) 1	0.1139
Health Status	Good Fair/poor Excellent	0.8 (0.5 , 1.1) 1.0 (0.6 , 1.5) 1	1.1 (0.9 , 1.3) 1.1 (0.8 , 1.4) 1	0.9 (0.7 , 1.1) 0.9 (0.6 , 1.2) 1	0.5542
Frequency of health service utilisation	More than a year Never Within a year	1.6 (1.2 , 2.1) 2.2 (1.1 , 3.7) 1	1.9 (1.6 , 2.3) 2.3 (1.6 , 3.2) 1	1.0 (0.8 , 1.2) 0.8 (0.5 , 1.4)	<0.0001

Adjusted predicted probabilities of being unaware of HIV status and refused to test for HIV

It can be seen from Table 3.8 that the adjusted predicted probability of belonging to the group "unaware of HIV status and refused to test for HIV" was higher in people who had an educational level of grade 0 to 7 (8.1%, 95% CI: 5.6%, 10.7%), married (8.0%, 95% CI: 6.2%, 10.0%), students (9.3%, 95% CI: 6.1%, 12.5%), people who used a condom during their last sex (7.5%, 95% CI: 5.8%, 9.2%) and those who had never utilised health service before the study (9.2%, 95% CI: 5.0%, 13.4%).

Table 3.8: Adjusted predicted probabilities of being unaware of HIV status and refused to test for HIV

Factor	Level	Margin% (95% CI)
Education	Grade 0 to 7	8.1%(5.6% , 10.7%)
	Grade 8 to 11	7.2% (5.6% , 8.8%)
	Grade 12	6.5% (5.2%, 7.9%)
	Above grade 12	5.0% (2.8%, 7.3%)
Marital status	Married	8.0% (6.2% , 10.0%)
	Living together	5.5% (4.3% , 6.7%)
	Single	7.0% (4.0% , 10.0%)
	Separate/divorce	4.4 (-0.2% , 9.2%)
	Widowed	1.6% (-0.3% , 3.5%)
Employment status	Unemployed	5.9% (4.6% , 7.2%)
	Employed	6.7% (5.4% , 7.9%)
	Student	9.3% (6.1% , 12.5%)
	Other	8.3% (4.1% , 12.4%)
Use condom	Yes	7.5% (5.8% , 9.2%)
	No	6.2% (5.1% , 7.3%)
Frequency of health service utilisation	Within a year	6.0% (5.0% , 7.1%)
	More than a year	7.6% (6.1% , 9.2%)
	Never	9.2% (5.0% , 13.4%)

Additionally, the adjusted predicted probability of being unaware of HIV status and refused an HIV test decreased with a one-unit increase in the number of engagements in HIV related activities and scores of attitude towards PLHIV.

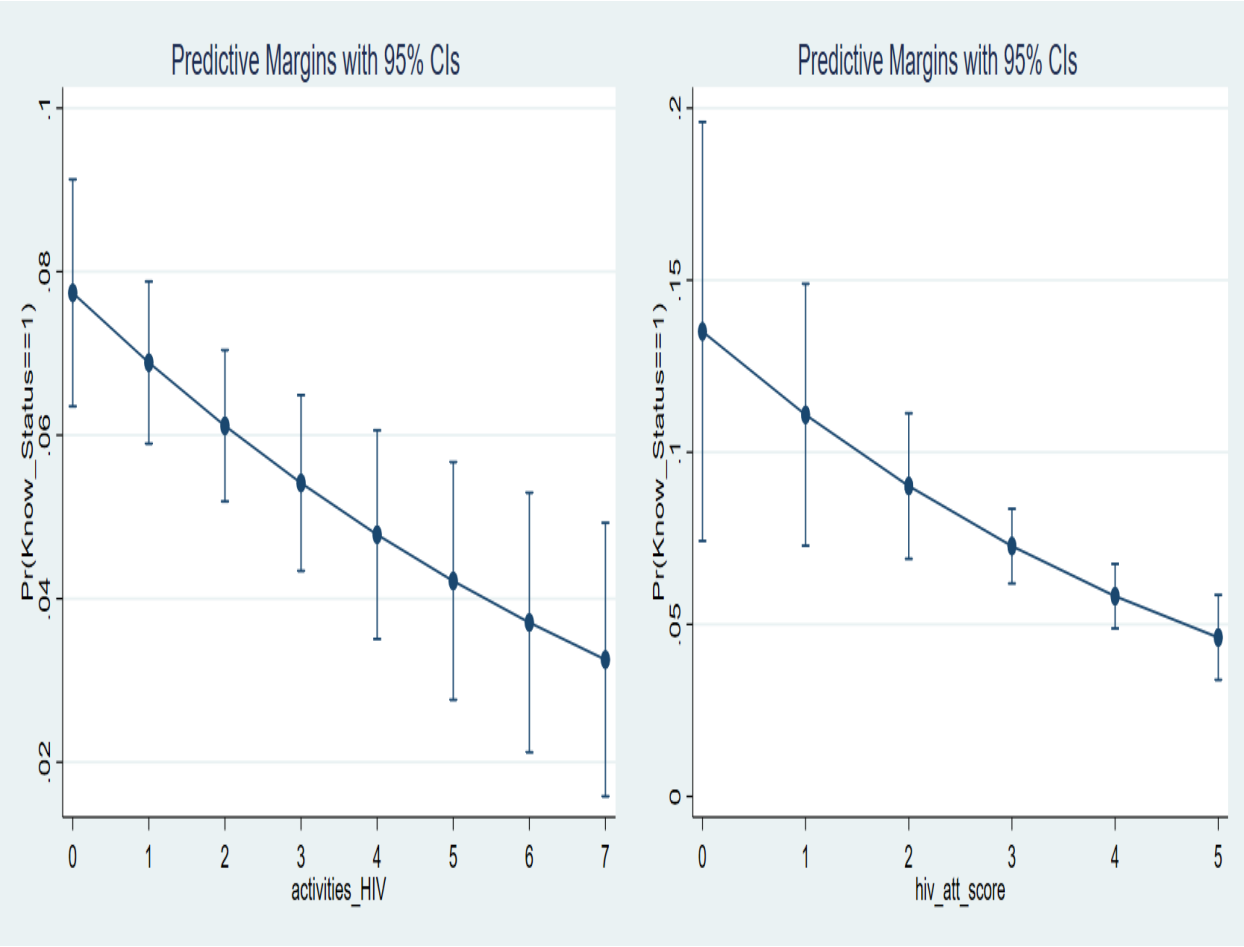


Figure 3.2: Adjusted predicted probabilities of being unaware of HIV status and refused to test for HIV by the number of HIV related activities and scores of attitude towards PLHIV

Adjusted predicted probabilities of being unaware of HIV status and agreed to test for HIV

From Table 3.9, the adjusted predicted probability of being unaware of HIV status and agreed to test for HIV was lower in people with educational status above grade 12 (13.9%, 95% CI: 10.8%, 17.0%), widowed (14.8%, 95% CI: 6.6%, 23.0%), people who used a condom during their last sex (19.2%, 95% CI: 17.2%, 12.5%) and participants who utilised health service in less than a year before the study (17.1%, 95% CI: 15.6%, 18.7%). The adjusted predicted probabilities of being unaware of HIV status and agreed to test for HIV were similar and lower in people who were unemployed 20.1% (18.3%, 22.0%) and employed 19.6% (17.4%, 21.7%).

Table 3.9:Adjusted predicted probabilities of being unaware of HIV status and agreed to test for HIV

Factor	Level	Margin% (95% CI)
Education	Grade 0 to 7	24.5% (21.1% , 28.0%)
	Grade 8 to 11	22.3% (20.5% , 24.2%)
	Grade 12	19.4% (17.1% , 21.6%)
	Above grade 12	13.9% (10.8% , 17.0%)
Marital status	Married	18.6% (16.6% , 20.7%)
	Living together	22.2% (20.3% , 24.0%)
	Single	24.0% (17.8% , 30.1%)
	Separate/divorce	16.7% (10.0% , 23.5%)
	Widowed	14.8% (6.6% , 23.0%)
Employment status	Unemployed	20.1% (18.3% , 22.0%)
	Employed	19.6% (17.4% , 21.7%)
	Student	29.4% (23.0% , 35.8%)
	Other	20.9% (15.3% , 26.5%)
Use condom	Yes	19.2% (17.2% , 12.5%)
	No	21.7% (20.1% , 23.3%)
Frequency of health service utilisation	Within a year	17.1% (15.6% , 18.7%)
	More than a year	26.7% (24.2% , 29.1%)
	Never	29.6% (24.1% , 35.0%)

For every one-unit or score increase in the number of engagements in HIV related activities and scores of attitude towards PLHIV, the adjusted predicted probability of being unaware of HIV status and agreed to test for HIV decrease.

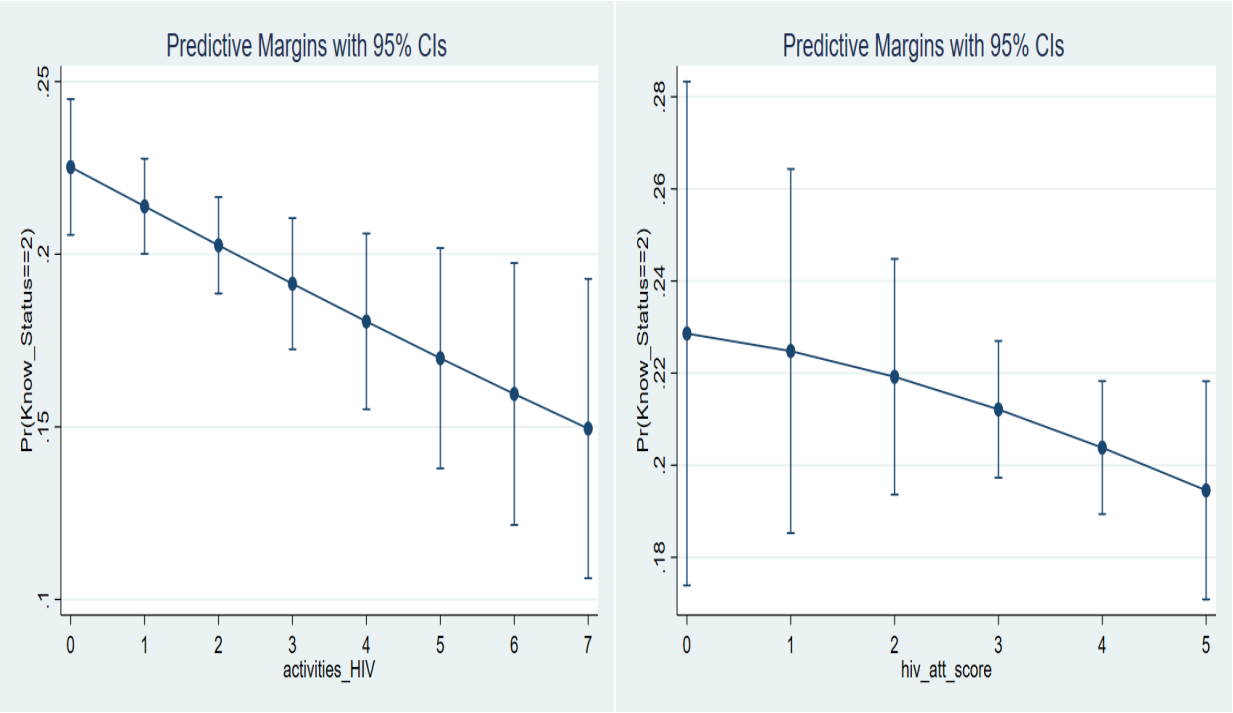


Figure 3.3:Adjusted predicted probabilities of being unaware of HIV status and agreed to test for HIV by the number of HIV related activities and scores of attitude towards PLHIV

Adjusted predicted probabilities of being aware of HIV status and refused to test for HIV

The adjusted predicted probability of being aware of HIV status and refused to test for HIV was higher in people with an educational level above grade 12 (21.2%, 95% CI: 17.5%, 24.9%), participants who were widowed (24.2%, 95% CI: 11.9%, 36.6%), employed participants (18.0%, 95% CI: 15.9%, 20.0%), people who did not use a condom during their last sex (15.8%, 95% CI: 13.8%, 17.8%) and those who utilised health service in less than a year before the study (17.7%, 95% CI: 15.8% , 19.6%).

Table 3.10: Adjusted predicted probabilities of being aware of HIV status and refused to test for HIV

Factor	Level	Margin (95% CI)
Education	Grade 0 to 7	10.8% (8.1% , 13.6%)
	Grade 8 to 11	13.8% (11.7% , 16.0%)
	Grade 12	19.1% (16.6% , 21.7%)
	Above grade 12	21.2% (17.5% , 24.9%)
Marital status	Married	18.1% (15.5% , 20.1%)
	Living together	14.8% (12.7% , 16.7%)
	Single	17.8% (12.8% , 22.9%)
	Separate/divorce	17.7% (8.0% , 27.4%)
	Widowed	24.2% (11.9% , 36.6%)
Employment status	Unemployed	16.5% (14.1% , 18.9%)
	Employed	18.0% (15.9% , 20.0%)
	Student	8.4% (5.0% , 11.8%)
	Other	16.6% (10.3% , 23.0%)
Use condom	Yes	9.3% (15.9% , 20.6%)
	No	15.8% (13.8% , 17.8%)
Frequency of health service utilisation	Within a year	17.7% (15.8% , 19.6%)
	More than a year	15.1% (12.7% , 17.4%)
	Never	12.2% (7.1% , 17.2%)

The adjusted predicted probability of being aware of HIV status and refused to test for HIV did not show a significant change with an increase in the number of engagements in HIV related activities.

However, the adjusted predicted probability of being aware of HIV status and refused to test for HIV decreased for every increase in the scores of attitude towards PLHIV by 1 score.

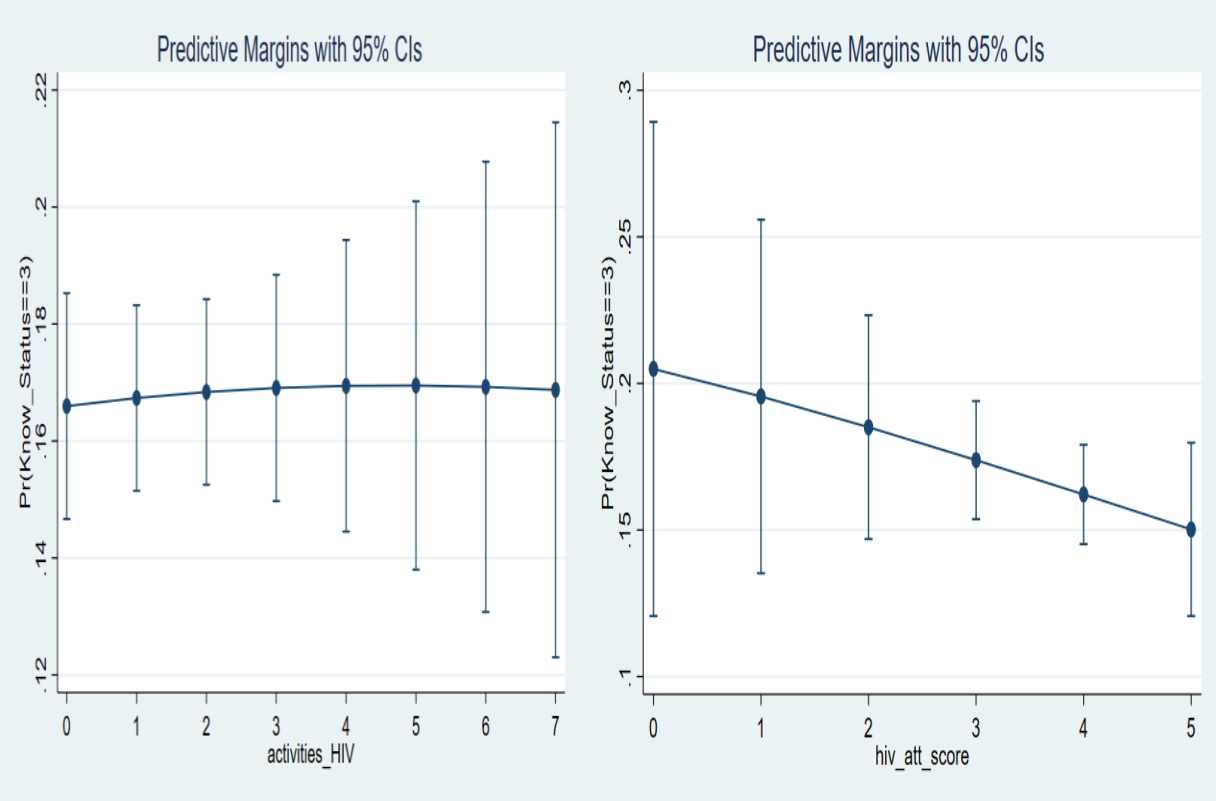


Figure 3.4: Adjusted predicted probabilities of being aware of HIV status and refused to test for HIV by the number of HIV related activities and scores of attitude towards PLHIV

Adjusted predicted probabilities of being aware of HIV status and agreed to test for HIV

From Table 3.11 below, the adjusted predicted probabilities of being aware of HIV status and agreed to test for HIV were similar for people with grade 0 to 7 (56.5% ,95% CI: 52.7% , 60.3%) and grade 8 to 11 (56.6% ,95% CI: 54.1% , 59.2%). People with grade 12 (55.0%,95% CI: 54.1%, 57.9%) recorded the least probability of being aware of HIV status and agreed to test for HIV.
The adjusted predicted probability of being aware of HIV status and agreed to test for HIV was lower among single people (51.2% ,95% CI: 45.2% , 57.2%), students (52.9% 95% CI: 46.5% , 59.3%), people who used a condom during their last sex (55.1%, 95% CI: 6.1% , 12.5%) and people who never utilized health service before the study (49.1% , 95% CI: 42.0% , 56.1%).
Table 3.11: Adjusted predicted probabilities of being aware of HIV status and agreed to test for HIV

Factor	Level	Margin (95% CI)
Education	Grade 0 to 7	56.5% (52.7% , 60.3%)
	Grade 8 to 11	56.6% (54.1% , 59.2%)
	Grade 12	55.0% (52.0% , 57.9%)
	Above grade 12	59.8% (55.3% , 64.4%)
Marital status	Married	55.2% (51.7% , 58.8%)
	Living together	57.6% (55.0% , 60.1%)
	Single	51.2% (45.2% , 57.2%)
	Separate/divorce	61.1% (50.2% , 71.9%)
	Widowed	59.3% (46.8% , 72.0%)
Employment status	Unemployed	57.5% (55.1% , 59.9%)
	Employed	55.8% (53.2% , 58.4%)
	Student	52.9% (46.5% , 59.3%)
	Other	54.2% (46.8% , 61.7%)
Use condom	Yes	55.1% (6.1% , 12.5%)
	No	56.4% (54.1% , 58.6%)
Frequency of health service utilisation	Within a year	59.2% (57.2% , 61.1%)
	More than a year	50.6% (47.8% , 53.5%)
	Never	49.1% (42.0% , 56.1%)

From the figure below, adjusted predicted probabilities increased with a one-unit increase in the number of engagements in HIV related activities and scores of attitude towards PLHIV.

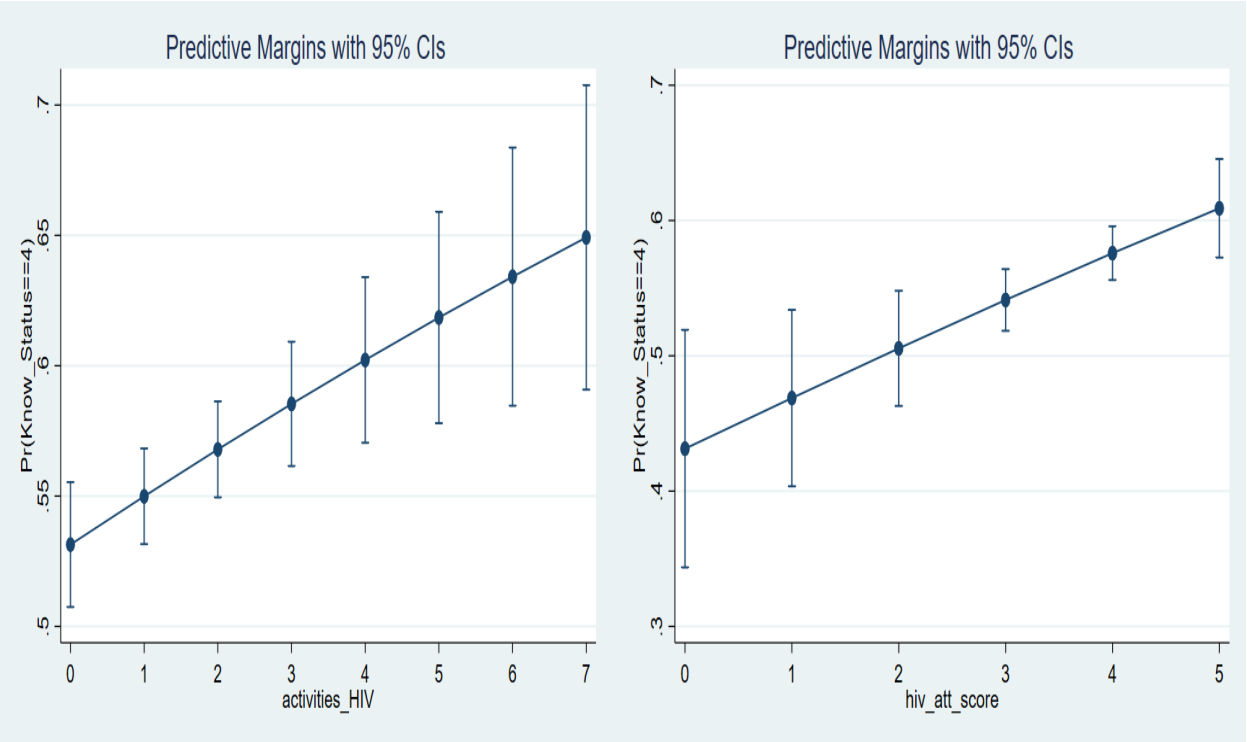


Figure 3.5: Adjusted predicted probabilities of being aware of HIV status and agreed to test for HIV by the number of HIV related activities and scores of attitude towards PLHIV

CHAPTER FOUR: DISCUSSION

This secondary data analysis sought to estimate the proportions of HIV infected people who know their HIV status and determine the factors associated with knowing one's HIV status among children and adults 15 years and older in South Africa.

This analysis suggests that 73.9%, about three out of every four people living with HIV, knew their status in 2012. This proportion exceeded the global percentage of PLHIV who were aware of their HIV status in 2012 (67%) and 2016 (70%). After adopting the UNAIDS 90-90-90 HIV targets, many countries sought to meet the set targets. The quest to meet the set targets was driven by committed efforts to increase HIV testing and treatment coverage countrywide to yield viral suppression (2, 12). South Africa was one of the countries to almost achieve the first 90 target just a year after it was set; 85% of PLHIV knew their HIV status by the end of 2017 (2). However, there remain disparities in some sub-groups within the population towards achieving the 1st 90 target. For example, individuals aged 15 to 24 years, males, residing in rural formal locations and non-African race groups have not met the 90% target (39).

The exposure to ART among PLHIV in South Africa has increased significantly (36% in 2012 to 68% in 2018) after the UNAIDS 90-90-90 targets. Yet, the number of people accessing treatment is not increasing enough to reach the global target of 30 million people in 2020 (12). Despite gains in introducing HIV treatment to PLHIV in recent years, more females infected with HIV continue to access treatment than males (12). In the province of Kwazulu Natal, large gains have been made in HIV prevention have as 84.3% of PLHIV are on ART (22). In this area, ART coverage has increased from 36.7% in 2013 to 74.1% in 2018 among 15 to 29-year-olds.

In addition, we explored the factors associated with knowing one's HIV status. This was achieved by estimating the proportions and determining the factors associated with awareness of HIV status and willingness to provide a blood sample to test for HIV among children and adults aged 15 years and older in South Africa. Four outcome levels were used to measure awareness of HIV status and willingness to provide a blood sample to test for HIV.

The outcome levels were:

- Level 1= unaware of HIV status and refused to test for HIV
- Level 2=unaware of HIV status and agreed to test for HIV
- Level 3= aware of HIV status and refused to test for HIV
- Level 4= aware of HIV and agreed to test for HIV

Almost a third (29.9%) of the study population were unaware of their HIV status and agreed to test for HIV and 46.6% were aware of their HIV status and agreed to test for HIV. This result indicates that more than three-quarters of South Africa's population in 2012 was willing to test for HIV. This high willingness to test for HIV in the population may have contributed to a higher proportion (74%) of HIV status awareness in PLHIV in 2012.

Agreeing to test for HIV is an important step to achieving the UNAIDS 1st 90 target. South Africa's performance in increasing awareness of HIV status has been phenomenal compared to other countries. After adopting the 90-90-90 HIV targets, the quest to meet the set targets was driven by committed efforts to increase HIV testing and treatment coverage countrywide (8, 40, 41). Among these efforts were the increase in expenditure of international donor and domestic investments (2).

A significant proportion (9.5%) of participants were unaware of their HIV status and refused to test for HIV, 14% were aware of their HIV status and refused to test for HIV. Refusing to test for HIV negatively contributes to the UNAIDS 1st 90 target, especially in populations whose HIV prevalence continues to increase (33). Not testing for HIV creates disparities in HIV status awareness which persist in some sub-groups (6, 39). Men, individuals 15 to 24 years and people residing in rural formal locations continually report low rates of HIV testing.

One possible reason people refuse to test for HIV is the fear of being discriminated against or stigmatised if the result is positive; this fear could have deterred people from providing a blood sample to test for HIV in the study (42-44). From common knowledge, people who are HIV positive and aware of their HIV status may see no need to test again. However in this study, being aware of HIV status and agreeing to test for HIV were more prevalent in people who tested positive for HIV than people who tested negative. This high willingness to provide a blood sample to test for HIV among PLHIV may indicate that stigma associated with HIV in South Africa may be reducing (13). As much as a higher proportion of PLHIV were aware of their HIV status and were willing to provide a blood sample to test for HIV, some PLHIV who refused to test for HIV maybe because they wanted to keep their HIV positive status confidential (2).

In this study, participants may also refuse to provide a blood sample for an HIV test because of the long turnaround time taken to receive one's HIV test results (7). According to the study's guidelines, persons who provided a blood sample for an HIV test could access their test results after eight weeks of testing. This period allowed for sufficient time for the samples to be sent to the laboratory for HIV antibody testing and the preparation of HIV results spreadsheets, which were sent to the various clinics so that participants who tested could access their results.

Predictors of awareness of HIV status and willingness to provide a blood sample to test for HIV were educational level, employment status, frequency of utilising health care services, engagements in HIV related activities and attitude towards people living with HIV.

Educational level was strongly associated with the four-level outcome. People with a higher educational level had a slightly higher probability of being aware of their HIV status and agreeing to test for HIV than people with a lower educational level. Generally, people with higher educational level have a higher prevalence of HIV status awareness than those with a lower educational level (7, 35). Albeit a high awareness of HIV status in the highly educated, refusing to test for HIV in the survey was prevalent. Some studies have found that highly educated people embrace voluntary counselling and testing at testing facilities more than those with lower education which may have accounted for a higher proportion refusing to test for HIV (42-44).

People with a lower educational level and unaware of their HIV status were more likely to test for HIV than people with a higher educational level unaware of their HIV status. It was encouraging to know that more people with a lower educational level agreed to test for HIV even though there remained a significant proportion who need to be encouraged to uptake HIV testing.

Employment status was a strong predictor of awareness of HIV status and willingness to provide a blood sample for HIV test in both univariable and multivariable models. Unemployed people were more likely to be aware of their HIV status and agree to test for HIV. Studies have found a high awareness of HIV status in employed persons but this study found otherwise (30). It was also evident that both unemployed and employed persons had similar probabilities of belonging to the group unaware of HIV status and agreed to test for HIV. Moreover, employed people who were aware of their HIV status compared to those unemployed were less likely to agree to test for HIV.

It was reassuring to know that students who are likely to be unaware of their HIV status agreed to test for HIV. This finding confirms that it is possible that the availability home-based HIV testing might encourage more people to find out what their HIV status is (40, 45). However, a significant group of students were unaware of their HIV status and refused an HIV test. Students especially in the case of those aged below 18 years and also for those still living with their parent or guardian, refusing to test for HIV may likely be due to a parent or guardian's decision not to consent for a test to be conducted. Encouraging students who may be sexually active and at risk of HIV to test is very important because HIV diagnosis and treatment may be started early to reduce HIV transmission (33).

Frequency in utilising health services is an important predictor of HIV status awareness and willingness to provide a blood sample for an HIV test. In South Africa, HIV testing services are mainly rendered through public clinics and hospitals, even though other testing places exist (7, 34). From this study, it was observed that a lot more people who never utilised health service before the study were more likely to be unaware of their HIV status but agreed to test for HIV. This important finding signifies that home-based HIV testing can effectively improve HIV status awareness just like facility-based testing in a group which do not seek health care. However, a significant proportion of people who never used health service remained untested and unaware of their HIV status.

People who frequently use health care services were highly likely to be aware of their HIV status and agree to test for HIV, but were also more likely to refuse an HIV test because they might have been recently tested. People who frequently use health care services may have an HIV test at the suggestion of the health care workers or on their own initiative, especially in situations where the results of the HIV test are readily available (2, 12).

Engagements in HIV related activities and attitude towards PLHIV were positive predictors of awareness of HIV status and willingness to provide a blood sample to test for HIV. Engaging in more HIV related activities and having a positive attitude (high scores) towards people with HIV increase the probability of belonging to the outcome levels 2 and 4 which are important contributors to the 1st 90 target. This finding is consistent with a study conducted in South Africa where people who had engaged in HIV related activities either by caring for an HIV infected person or had an encounter with an HIV person reported high acceptance of an HIV test (42, 46). Also, media campaigns on HIV, which took place in the country before the study were found to increase the knowledge, attitude and perception related to HIV (42, 46). This study's findings emphasise the importance of education on HIV prevention programs which improve awareness of HIV status through testing (28, 47).

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

Approximately three out of every four PLHIV knew their HIV status in 2012, and the number of PLHIV on ART has increased significantly but has still not met the 90 target. Achievement of the first and second 90 targets are unevenly distributed in the population.

Educational level, employment status, frequency of utilising health care services, engagements in HIV related activities and attitude towards people living with HIV are important predictors of awareness of HIV status and willingness to provide a blood sample for an HIV test.

Regular HIV testing could be encouraged in the population to have an updated knowledge of HIV status which remains the first step in initiating HIV treatment and minimising further transmission, which is also an essential part of HIV prevention, and hence the elimination of HIV disease.

HIV status awareness among people who are HIV negative can help make decisions that will reduce the risk of becoming HIV positive and enable them to remain HIV free. For HIV positive and untested people, awareness of their HIV status will allow them to protect their sexual partners and access care and treatment.

It is recommended that HIV related activities such as HIV campaigns could be organised regularly. As South Africa has achieved the 1st 90 target, frequent HIV related activities conducted in the population could lead to the achievement of the 2nd and 3rd 90 targets.

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APPENDIX

Appendix 1

Individual Questionnaire (7)

Questionnaire module
Demographics: • Age, sex, race, nationality, employment, marital status
Orphan status: • Parental survivorship (under 19 years) • Age of child at death of a parent
Education: • School attendance • Reasons for missing school
Life education ***Information about sex and exposure***
Media, communication and norms: • Media access and use • Sources of HIV information • Participation in HIV activities
Knowledge, attitudes, beliefs and values about HIV and AIDS and about HIV-related practices and behaviours (KABP)
Sexual history: • Sexual debut • Partner history • Sexual orientation • Concurrency • Age disparate sex • Condom use at last sex and consistent

Questionnaire module
Sexually Transmitted Infections: • Current and previous symptoms
Delivery and care details: • ANC services • Type of delivery services • PMTCT services
Contraception: • Knowledge • Past and current use • Source of current use
Male circumcision: • Circumcision status • Age and place of circumcision • Reasons • Complications
Condoms ***Access*** ***Extent of condom use***
HIV testing and risk perception: • Testing history • Source & testing reason • Risk perception
Drug and alcohol use: • Use & impact • Smoking exposure
Health status: • Hospitalisation

Questionnaire module
Mental health: • Emotional well been • Use of service
Violence in relationships: • Extent of intimate partner violence (IPV)
Health service utilisation ***Access and barriers***

Appendix 2

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Mary Pomaa Agyekum (Student number: 722172) am a student registered for the degree of MSc in Epidemiology (Biostatistics) in the academic year 2021.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature:  Date: 06/04/2021

Appendix3

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Mrs Mary Pomaa Agyekum et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M200210

NAME: (Principal Investigator)	Mrs Mary Pomaa Agyekum et al
DEPARTMENT:	School of Public Health
PROJECT TITLE:	Towards UNAIDS 90-90-90 HIV targets: Determinants of knowing one's HIV status in South Africa in 2012
DATE CONSIDERED:	28/02/2020
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof Jonathan Levin
APPROVED BY:	CB Penny Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	02/03/2020

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **February** and will therefore be due in the month of **February** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

Date 03/03/2020

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES