# 1. INTRODUCTION

## 1.1 Background

Human Immune Deficiency virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) has killed more than 25 million people since it was first recognised in 1981, making it one of the most destructive epidemics in the recorded history. The sub-Saharan Africa remains the hardest-hit and is home to 22 million people living with HIV. The two-thirds (67%) of the global total of 32.9 million people with HIV live in this region, and three-quarters (75%) of all AIDS deaths in 2007 occurred there. The catastrophic impact of HIV and AIDS in sub-Saharan Africa is threatening the development in all sectors of society [1].

### 1.1.1 HIV prevalence in South Africa

South Africa is experiencing one of the most rapidly growing HIV epidemics in the world. In 1990 the prevalence of HIV infection among women attending antenatal clinics was less than one percent. At the end of 2008 national antenatal prevalence had reached 29.3 percent [2]. An estimated 5.2 million people were living with HIV and AIDS in South Africa in 2008, more than in any other country [1]. It is believed that in 2008, over 250,000 South Africans died of AIDS [3].

The national prevalence is around 11%, with some age groups being particularly affected. Almost one-in-three women aged 25-29, and over a quarter of men aged 30-34, are living with HIV [3]. The HIV prevalence among those aged two and older also varies by province with the Western Cape (3.8%) and Northern Cape (5.9%) being least affected, and Mpumalanga (15.4%) and KwaZulu-Natal (15.8%) at the upper end of the scale. HIV in South Africa is transmitted predominantly heterosexually between couples, with mother-to-child transmission being the other main infection route [4].

### 1.1.2 HIV antenatal survey

Due to the extent of the HIV epidemic, the Department of health (DOH) with support from the World Health Organization (WHO) established an HIV surveillance system in 1990. Every year during the month of October, the DOH conducts an anonymous, unlinked HIV and Syphilis antenatal survey among pregnant women attending antenatal care at selected sites in all nine provinces of the country [2, 5].

These surveys form the cornerstone of HIV surveillance in South Africa, and are extremely important for South Africa to monitor the stage the epidemic has reached and assess whether intervention strategies may be impacting on the epidemiological profile of HIV and AIDS [2, 5]. The HIV antenatal survey method is an internationally accepted method of monitoring the magnitude, growth and geographic spread of the epidemic in the heterosexual, sexually active, adult population and many countries have developed and implemented these surveys [1, 2, 5].

## 1.2 Literature review

Accurate surveillance of HIV is essential for monitoring the epidemic, measuring trends, predicting the burden of disease, and assessing the impact of interventions. The most widely used measure of general population HIV sero-prevalence is sentinel surveillance among antenatal clinic (ANC) attendees. However, numerous studies have demonstrated that data from these surveillance systems are potentially subjected to bias. The antenatal clinic attendance of women are likely to vary by age, locality, socioeconomic status, education level, parity, ethnic group, religion and other factors associated with HIV infection [5, 6, 7].

### 1.2.1 HIV prevalence and associated factors

The epidemiological studies in Africa and sub-Saharan, have described the socio-demographic correlates of HIV infection [8 -13]. For example in Yaoundé, Cameroon and Ndola, Zambia, the HIV prevalence in antenatal clinic attendees was lower than those in women in the population overall, and for age groups over 20 years. In Kisumu, Kenya, the HIV prevalence in antenatal clinic attendees was similar to that in women in the population at all ages [8].

The only factors identified that influenced the results were age, marital status, parity, schooling, and contraceptive use [8]. There is therefore a need to adjust for these demographic and epidemiological circumstances of a particular population in order to maximise the use of antenatal clinic data as suggested by the study and other findings [8, 14]

A study from South Africa, Zimbabwe and Malawi also shows that HIV-1 infection was found to be associated with age, marital status and location among women attending antenatal clinics [11, 13, 15]. The unadjusted overall figures for HIV prevalence from the antenatal clinics were shown to provide a poor indication of the relative levels of prevalence of infection in the two study areas because of differences in the age structure and religious affiliations among women attending antenatal clinics [14, 15].

Similar findings were also reported in a case control analysis of secondary data consisting of cases selected from a cohort of HIV infected women and it was found that factors associated with HIV infection are not the same for all women [7].

However a systemic review by Hargreaves *et al*., shows that the association between educational attainment and the risk of HIV infection is changing over time in sub-Saharan Africa [16]. Studies on data collected prior to 1996 generally found either no association or the higher risk of HIV infection among the most educated [16].

Studies conducted from 1996 onwards also supported by Dorrington *et al., in 2008,* were more likely to find a lower risk of HIV infection among the most educated. Where the data over time were available, HIV prevalence fell more consistently among highly educated groups than among less educated groups, in whom HIV prevalence sometimes rose while overall population prevalence was falling [16, 17].

Most antenatal clinics routinely collect data on the rank order of the pregnancy and occasionally report such data in HIV sentinel surveillance. Pregnancies can be classified by a woman's parity or gravidity, so it should be possible to obtain HIV prevalence categorized by parity or gravidity. Studies by Zaba B *et al.,* shows that women at their first and second pregnancy usually account for slightly less than half of all pregnant women, and that HIV prevalence typically peaks at the second pregnancy [10].

Many studies have investigated the risk factors for HIV infection among adults in sub-Saharan countries and the most important risk factors that have been identified include risky sexual behaviour and the presence of sexually transmitted infections (STIs) such as syphilis [11, 12, 18, 19].

Syphilis is thought to facilitate HIV infection because it causes genital ulcers; the lesions may be painless and, therefore, can remain undetected and untreated, leading to increased virus shedding (increasing transmission) and/or presentation of target cells (increasing acquisition). Recent data suggest that individuals are 3 to 5 times more likely to acquire HIV if exposed to the virus through sexual contact when they are already having STIs like syphilis [11, 13].

## 1.3 Problem statement and rationale

HIV has become a serious problem for many countries around the world. This is especially a real problem in South Africa. Statistical evidence on the socio-demographic factors associated with HIV infection amongst pregnant women in South Africa is limited.

Although data from the antenatal care (ANC) surveys remain the primary source of information for measuring the HIV trends in South Africa [2], there are some limitations in the national ANC survey report and this prompted this study.

- Firstly, the report does not provide information about age-specific HIV prevalence by province. This type of information is aggregated and reported as national estimates, and is very likely to pose a challenge when looking at the epidemiological provincial pattern.

- Secondly, the ANC survey collected information related to a woman's demographic profile such as age, partner's age, parity, gravidity and education. However, such data were also not reported in the national HIV survey report and their effects may remain unknown.

- Finally, it was not attempted in the report to correlate syphilis sero-status with HIV sero-status to give more understanding on the epidemiological pattern of HIV infection relative to syphilis in all provinces.

Nevertheless, it is essential that these limitations be acknowledged whenever ANC prevalence estimates are interpreted. It must be remembered that the data were collected for estimating HIV and syphilis prevalence among pregnant women attending public sector antenatal clinics and not intended to identify factors associated with HIV infections.

## 1.4 Study Objectives

The main aim of the study is to assess the socio-demographic factors associated with HIV infection in pregnant women attending antenatal clinic across all provinces in South Africa using data collected in 2005.

Specific objectives in each province are to:

- Determine age-specific HIV prevalence rate.
- Identify and compare factors associated with HIV prevalence.
- Determine the association between HIV and syphilis sero-status.

## 1.5 Study Questions

- What are socio-demographic factors associated with HIV infection in pregnant women attending public sector antenatal clinic in 2005?
- Does sero-prevalence of syphilis among pregnant women attending antenatal clinic in 2005 covaries with HIV infection?

# 2. METHODOLOGY

## 2.1 Design and Settings

This study was a secondary analysis and made use of the 2005 National antenatal HIV survey [2, 3].

### 2.1.1 Description of the 2005 National Antenatal HIV survey

#### 2.1.1.1 Survey design

This survey was conducted concurrently across all the nine provinces from the 1st to 31st October 2005. The study design was an anonymous, unlinked, cross-sectional survey among pregnant women attending public sector antenatal clinics. The primary aim of this study was to determine HIV prevalence and trends in South Africa [2, 5].

#### 2.1.1.2 Study administration

The National Department of Health (NDOH) department's co-ordinating Office ensured the overall co-ordination of the survey including support visits to the all nine provinces, conducting the procedural audit of the survey countrywide, re-processing provincial estimates, processing of the national data set, modelling further HIV estimates and compiling a singular national report [2].

#### 2.1.1.3 Sentinel population

The study population are pregnant women attending a public sector antenatal clinic for the first time during the current pregnancy. The choice of the first antenatal visit was made to minimise the chance for one woman attending two clinics and being included in the study more than once. The clients were given the choice to participate and the numbers of non-responders were noted by age [2].

#### 2.1.1.4 Sampling methodology

The probability proportional to size (PPS) sampling method was used to determine the sample size for the 2005 antenatal HIV survey. The provinces with the biggest population sizes (of women in the reproductive age) yielded the biggest sample sizes, whereas those with smaller population sizes had smaller sample sizes [2, 5].

The facility or clinic formed the primary sampling unit (PSU) in the sampling frame. This method was adopted to ensure a representative sample that is weighted for rural urban distribution [2, 5].

The same clinics as had participated in the previous surveys were used. The clinics were also selected using PPS sampling method based on the first time ANC obtained from the District Health Information Systems (DHIS) as a measure of size. This allowed for establishing the plausibility of the number of proposed samples to be collected at facility level. A total of 399 sentinel sites were selected, thus giving a total sample of 16 510 pregnant women participated in the 2005 survey [2, 5].

#### 2.1.1.5 Specimen collection

During the survey, an additional vacutainer of blood was taken as part of the routine screening done for pregnant women when they attend the clinic for their "booking visit". This blood sample is labelled with a barcode label, at the same time demographic information such as age, race, education, gravidity, parity and age of the partner are completed on a data capture sheet, which is labelled with a second barcode label with the same number. The specimen and data capture sheet are sent to the participating laboratory in the province [2].

### 2.1.1. 6 Laboratory testing

In accordance with the recommendations of the World Health Organisation (WHO) on HIV screening for surveillance purposes, blood samples were tested with one Enzyme-linked Immunosorbent Assay (ELISA) (Abbot Axysm System for HIV-1/HIV-2) assay. The samples were also screened for active syphilis using the Rapid Plasma Reagin (RPR –RF latex) test. Participating laboratories included the NHLS laboratories in Bloemfontein, Johannesburg, Kimberley, Middleburg, Port Elizabeth and Stellenbosch, MEDUNSA and the Virology laboratory of the University of KwaZulu-Natal [2, 20].

### 2.1.1.7 Quality Assurance

In the course of this survey, careful laboratory and data management quality assurance was conducted. For each of the participating laboratories, the ELISA and RPR tests for HIV and syphilis testing were internally quality assured. The National Institute for Communicable Diseases (NICD) performed external quality control for the HIV testing and the Medical University of Southern Africa (MEDUNSA) Microbiology laboratory conducted quality control for the syphilis testing [2].

## 2.2 Data Management

According to the original study, all participating laboratories did the initial data entry. All laboratories transferred the data into an Excel spreadsheet, which together with the original data capture forms, were sent to all Provincial Coordinators for second data entry and checking. The data was then sent to the National Epidemiology directorate where it was re-checked and cleaned, merged into a single national file and analysed in STATA 7 [2] .

### 2.2.1 Data processing

The study was examined with the Data Manager responsible for HIV Surveillance data (NDOH) to clear up issues around the database. These include variable coding & extraction, assumptions used in making the estimate or scenarios, confidentiality, cleaning, analysis and interpretation.

#### 2.2.1.1 Data variables

In this analysis the primary outcome or dependent variable was HIV sero-status and the independent variables were socio-demographic characteristics as well as HIV and AIDS related biomedical factors. The socio-demographic factors or variables available for this analysis were province, age, education, race, gravidity, parity and age of the partner. The only biomedical factor variable available was syphilis sero-status [2].

##### 2.2.1.1.1 Socio-demographic factors

Age of the women was categorised into four groups (15–19, 20–24, 25–29, 30-34 and 35+ years old) for the analyses. Educational level was assessed in three categories; illiteracy/primary (*Grade 0–7*), junior-secondary (*Grade 8-10*) and senior-secondary or higher (*Grade 11+*). The difference between the age of the male partner and that of participants were assessed in three categories: *same age* (±5 years old), *younger* (> 5 years) and *older* (> 5 years).

The number of pregnancies (*gravidity*) was assessed in three categories; primigravida (*gravida 1*) or first time pregnant, multigravida (*gravida 2*) or second time pregnant and multigravida (*gravida 3*) or third time or more pregnant. Parity was grouped into three categories; nullipara (*Para 0*) or never given birth, primipara (*Para 1*) or given birth first time and multipara (*Para 2+*) given birth two or more times. Syphilis serological results was defined in two groups; *Positive* (RPR sero-positive test) and *Negative* (RPR sero-negative test).

#### 2.2.1.2 Database cleaning

All data cleaning was performed in STATA 7 and 9. Frequency checks were performed on all variables to determine the extent of missing values in the database and missing data was encoded using standard operating procedures. These procedures included replacing all missing data with specific numerical values of '99' and '999' which was subsequently excluded from the basic and multivariate analysis.

#### 2.2.1.3 Data coding

In order to facilitate the data analysis, most raw data variables required further manipulation and/or grouping resulting in the creation of new database variables. Data was exported from Microsoft Excel to STATA 9, via Stat-Transfer 7.0, to facilitate higher level coding and manipulation of data.

Several secondary variables were created to describe further associations between categorical variables and HIV status. Some certain continuous variables were recoded as categorical variables, to determine the level of risk exposure. Please refer to the analysis section for details on coding of the results.

### 2.3 Statistical analysis

For each province, the study sample was weighted using as reference the provincial distribution of women in the female population of reproductive age group (15-49 years) derived from the South African 2005 midyear population estimates [21, 22].

As in the 2005 antenatal HIV survey final report, the descriptive statistics were used to calculate the provincial age specific a*nd other potential risk factors specific* HIV prevalence using the Pearson's chi-square ($X^2$) test or the Yates' corrected chi-square test, when appropriate. The Pearson's chi-square ($X^2$)

test or the Yates' corrected chi-square test when appropriate, *was used to test for association between risk factors and HIV prevalence.*

Data from each province were analysed to evaluate the association between HIV infection and the socio-demographic factors considered in the study (i.e. age, education, gravidity and parity). For this analysis, a bivariate analysis was performed using simple logistic regression.

The factors associated with HIV infection in each province were then evaluated in a multivariate analysis using direct multiple logistic regression models. That is only variables with overall $p \leq 0.20$ in bivariate analysis were selected for multivariate analysis in each province. The odds ratios and their 95% confidence intervals (CI) were used to describe the strength of the associations.

All the statistical analyses were performed using Intercooled STATA version 9. The tests of significance were 2-sided and P-values of less than 0.05 were considered to be statistically significant. To facilitate the interpretation, percentage (%) and (adjusted) odds ratios, (OR & AOR) were presented and the data was summarised and displayed using tables and graphs.

## 2.4 Ethical considerations

The approval and permission was received from appropriate units in the NDOH (attached Data user agreement form). In addition, due care was also taken to ensure that the analysis is restricted to its purpose and no steps was taken against the regulations set by the NDOH on the HIV data user's agreement. The ethical clearance for the study was granted by the University of the Witwatersrand Ethical Committee (Ethics Clearance Certificate: M090966).

# 3. RESULTS

## 3.1 Characteristics of the Survey Population

Table 1 above presents the socio-demographic characteristics of pregnant women who participated in the 2005 HIV survey by each province. A total of 16510 pregnant women at 399 clinics participated in the survey in 2005. Based on the probability proportional to size (PPS) sampling method used, provinces with the biggest population sizes (of women in the reproductive age), such as KwaZulu-Natal and Gauteng, yielded the biggest sample sizes (n =3500 and 3110 respectively), whereas those with smaller population sizes had smaller sample sizes (e.g. Northern Cape (n= 567)).

The distribution of the pregnant women in relation to socio-demographic factors appeared to be following a similar pattern in all provinces. Close to half (50%) of women were between 20 and 29 years of age. Less than 12% of the women were older than 35 years. More than three-quarters (>75%) of the women had secondary and higher education. More than two-thirds (>66%) of women had been pregnant twice or less. About 40% of pregnant women had never delivered or given birth.

The only difference in the distribution was observed with information on the age of the partner as reported by the pregnant women. For example, in four provinces (Free State, KwaZulu Natal, North West and Western Cape), more than one-quarter (28%) of the women reported that their partners were between 25 and 29 years of age.

**Table 1: Socio-demographic characteristics of the antenatal clinic attendees anonymously tested for HIV infection in South Africa, 2005**

| | | EC | | FS | | GP | | KZN | | LP | | MP | | NC | | NW | | WC | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| **Sample** | **N** | *2189* | *13.3* | *935* | *5.7* | *3110* | *18.8* | *3500* | *21.2* | *1897* | *11.5* | *1027* | *6.2* | *567* | *3.4* | *1325* | *8.0* | *1960* | *11.9* | *16510* | *100* |
| **Age group Women** | **15-19** | *467* | *21.3* | *184* | *19.7* | *454* | *14.6* | *804* | *23.0* | *390* | *20.6* | *224* | *21.8* | *118* | *20.9* | *234* | *17.7* | *335* | *17.1* | *3210* | *19.5* |
| | **20-24** | *641* | *29.3* | *306* | *32.8* | *963* | *31.0* | *1207* | *34.5* | *569* | *30.0* | *311* | *30.3* | *155* | *27.5* | *422* | *32.0* | *618* | *31.6* | *5192* | *31.5* |
| | **25-29** | *489* | *22.3* | *234* | *25.1* | *833* | *26.8* | *718* | *20.5* | *451* | *23.8* | *241* | *23.5* | *131* | *23.2* | *296* | *22.4* | *513* | *26.2* | *3906* | *23.7* |
| | **30-34** | *339* | *15.5* | *132* | *14.1* | *530* | *17.0* | *492* | *14.1* | *259* | *13.7* | *143* | *13.9* | *105* | *18.6* | *218* | *16.5* | *316* | *16.1* | *2534* | *15.4* |
| | **35+** | *253* | *11.6* | *78* | *8.4* | *330* | *10.6* | *279* | *8.0* | *227* | *12.0* | *107* | *10.4* | *55* | *10.0* | *150* | *11.4* | *175* | *8.9* | *1654* | *10.0* |
| | **p-value**[!] | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | |
| **Age group male partner** | **15-19** | *125* | *5.8* | *61* | *6.7* | * | * | *177* | *5.1* | *96* | *5.1* | *71* | *7.0* | *26* | *4.7* | *50* | *3.9* | *105* | *5.4* | *711* | *5.4* |
| | **20-24** | *477* | *22.1* | *199* | *22.0* | * | * | *891* | *25.7* | *359* | *18.9* | *219* | *21.7* | *143* | *26.0* | *243* | *19.2* | *409* | *21.1* | *2940* | *22.3* |
| | **25-29** | *523* | *24.2* | *246* | *27.2* | * | * | *968* | *28.0* | *456* | *24.1* | *243* | *24.1* | *130* | *23.6* | *356* | *28.1* | *542* | *28.0* | *3464* | *26.3* |
| | **30-34** | *419* | *19.4* | *200* | *22.1* | * | * | *663* | *19.2* | *398* | *21.0* | *211* | *20.9* | *128* | *23.3* | *276* | *21.8* | *459* | *23.7* | *2754* | *20.9* |
| | **35+** | *618* | *28.6* | *198* | *21.9* | * | * | *762* | *22.0* | *587* | *31.1* | *266* | *26.3* | *123* | *22.4* | *341* | *26.9* | *422* | *22.0* | *3317* | *25.1* |
| | **p-value**[!] | *< 0.001* | | *< 0.001* | | * | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | |
| **Education Levels** | **0-7** | *360* | *16.7* | *143* | *15.3* | *356* | *11.7* | *646* | *18.6* | *314* | *16.7* | *178* | *18.3* | *152* | *27.7* | *216* | *17.2* | *241* | *12.4* | *2606* | *15.8* |
| | **8-10** | *867* | *40.2* | *366* | *39.1* | *939* | *30.8* | *1137* | *32.7* | *682* | *36.3* | *348* | *35.8* | *191* | *34.9* | *418* | *33.3* | *874* | *44.9* | *5822* | *35.9* |
| | **11+** | *928* | *43.1* | *426* | *45.6* | *1749* | *57.5* | *1698* | *48.8* | *884* | *47.0* | *447* | *45.9* | *205* | *37.4* | *623* | *49.6* | *831* | *42.7* | *7791* | *48.0* |
| | **p-value**[!] | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | |
| **Gravidity** | **1** | *980* | *45.0* | *414* | *44.3* | *1090* | *35.1* | *1403* | *40.3* | *764* | *40.3* | *397* | *38.9* | *218* | *38.6* | *484* | *36.9* | *729* | *37.3* | *6479* | *39.4* |
| | **2** | *611* | *28.0* | *287* | *30.7* | *1091* | *35.2* | *1113* | *32.0* | *521* | *27.5* | *317* | *31.1* | *152* | *26.9* | *450* | *34.3* | *621* | *31.7* | *5163* | *31.4* |
| | **3+** | *589* | *27.0* | *233* | *25.0* | *922* | *29.7* | *966* | *27.7* | *612* | *32.3* | *306* | *30.0* | *195* | *34.5* | *378* | *28.8* | *606* | *31.0* | *4807* | *29.1* |
| | **p-value**[!] | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | |
| **Parity** | **0** | *1037* | *47.5* | *462* | *49.5* | *1117* | *36.1* | *1439* | *41.4* | *778* | *41.1* | *411* | *40.3* | *228* | *40.3* | *521* | *39.7* | *798* | *40.8* | *6791* | *41.3* |
| | **1** | *586* | *26.8* | *273* | *29.2* | *1101* | *35.6* | *1121* | *32.2* | *534* | *28.2* | *311* | *30.5* | *173* | *30.6* | *442* | *33.7* | *642* | *32.8* | *5183* | *31.5* |
| | **2+** | *560* | *25.7* | *199* | *21.3* | *873* | *28.2* | *919* | *26.4* | *579* | *30.6* | *298* | *29.2* | *165* | *29.2* | *350* | *26.7* | *518* | *26.5* | *4461* | *27.1* |
| | **p-value**[!] | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | | *< 0.001* | |

N indicates number, % indicates percentage/proportion; * Data was not available;
! Differences in proportions within each socio-demographic factor were tested by $X^2$ tests across all provinces
EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West and WC = Western Cape.
.

## 3.2 HIV prevalence

### 3.2.1 Province

Based on the results in Figure 1, about 30.1% of all the antenatal clients participated in the 2005 South Africa HIV survey were infected by HIV (95% CI: 29.4-30.8%).The prevalence ranged from 15.7% in the Western Cape to 39.1% in KwaZulu-Natal.

By and large, the highest prevalence of HIV infection (> 30.0%) was found in KwaZulu- Natal (39.1%), Mpumalanga (34.8%), Gauteng (32.4%), North West (31.9%) and Free State (30.3%). The lowest HIV prevalence was found in the Western Cape and Northern Cape (15.7% and 18.5% respectively). These differences in HIV prevalence were found to be significant (p <0.001).

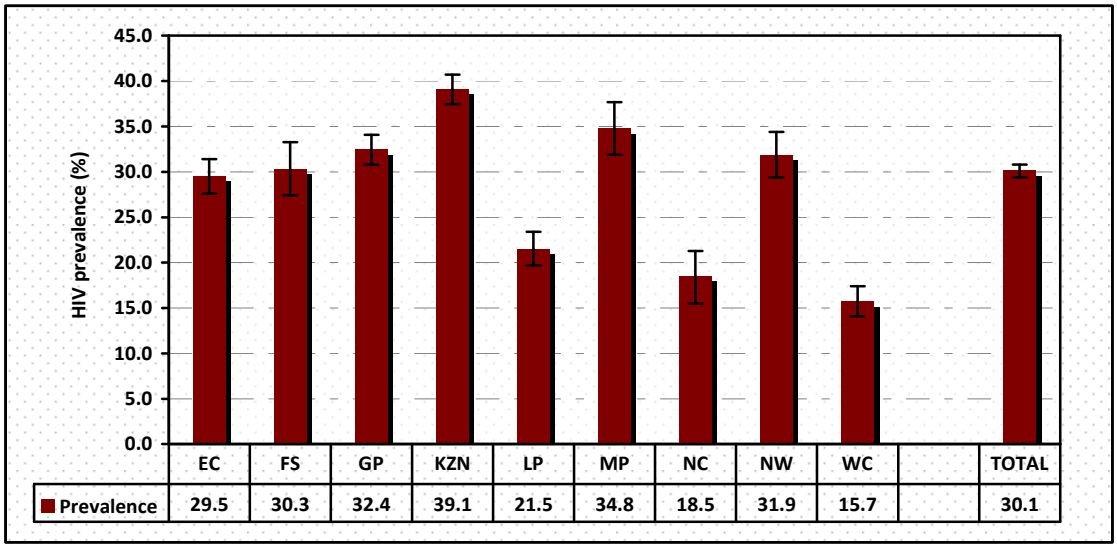


**Figure 1:** **HIV prevalence by province among antenatal clinic attendees in South Africa, 2005.**
*EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West & WC = Western Cape.
($X^2$ *test*) - P-value < 0.001; 95% Confident e Intervals indicated in error bars.

### 3.2.2 Age groups

Overall, the HIV prevalence peaked at 39.3% (CI=37.8-40.9) among women aged 25-29 years, 36.4% (CI=34.6-38.3) among women aged 30-34 years

and then 30.3% (CI=29.1-31.5) among women aged 20-24 years. This kind of pattern was similar in almost all the provinces except the Free State, Mpumalanga and Northern Cape provinces, where the HIV prevalence peaked among women aged 30-34 years (39.4%, 46.2% and 26.7% respectively) (Table 2).

Furthermore, in all provinces, the lower rates of HIV infection were observed in the below 20 year age group. In the 25–29-year age group, that is the age at which almost the highest prevalence of HIV infection was observed, five provinces (Eastern Cape, Gauteng, KwaZulu Natal, Limpopo & North West) were found to have an HIV prevalence of more than 30% (43.8, 40.6, 52.2, 31.0 and 46.3% respectively). The differences in HIV prevalence by age group was found to be statistically significant (p<0.001).

**Table 2: Provincial HIV prevalence by age group among the antenatal clinic attendees in South Africa, 2005.**

| Age group | | 15-19 | 20-24 | 25-29 | 30-34 | 35+ | P-value* ($X^2$ test) |
|---|---|---|---|---|---|---|---|
| EC | % | 13.5 | 31.2 | 43.8 | 34.3 | 20.6 | <0.001 |
| | CI | [10.7-16.9] | [27.7-34.9] | [39.4-48.2] | [29.5-39.6] | [16.0-26.0] | |
| FS | % | 16.3 | 29.1 | 37.6 | 39.4 | 30.8 | <0.001 |
| | CI | [11.6-22.4] | [24.3-34.4] | [31.6-44.0] | [31.4-48.0] | [21.5-41.8] | |
| GP | % | 18.5 | 29.0 | 40.6 | 39.6 | 29.4 | <0.001 |
| | CI | [15.2-22.4] | [26.2-31.9] | [37.3-44.0] | [35.5-43.9] | [24.7-34.5] | |
| KZ | % | 21.6 | 40.9 | 52.2 | 48.0 | 32.3 | <0.001 |
| | CI | [18.9-24.6] | [38.1-43.7] | [48.6-55.9] | [43.6-52.4] | [27.0-38.0] | |
| LP | % | 8.7 | 21.1 | 31.0 | 26.6 | 19.8 | <0.001 |
| | CI | [6.3-12.0] | [17.9-24.6] | [26.9-35.5] | [21.6-32.4] | [15.1-25.5] | |
| MP | % | 18.8 | 38.6 | 40.3 | 46.2 | 29.9 | <0.001 |
| | CI | [14.2-24.4] | [33.3-44.1] | [34.2-46.6] | [38.1-54.4] | [22.0-39.2] | |
| NC | % | 10.2 | 16.1 | 22.9 | 26.7 | 18.2 | <0.001 |
| | CI | [5.9-17.1] | [11.1-22.8] | [16.5-30.9] | [19.1-35.9] | [10.1-30.6] | |
| NW | % | 15.4 | 30.6 | 46.3 | 32.6 | 32.7 | <0.001 |
| | CI | [11.3-20.6] | [26.4-35.1] | [40.7-52.0] | [26.7-39.1] | [25.6-40.6] | |
| WC | % | 7.2 | 15.9 | 20.1 | 18.7 | 13.7 | <0.001 |
| | CI | [4.9-10.5] | [13.2-19.0] | [16.8-23.8] | [14.8-23.4] | [9.4-19.7] | |
| Total | % | 15.9 | 30.3 | 39.3 | 36.4 | 25.9 | <0.001 |
| | CI | [14.6-17.2] | [29.1-31.5] | [37.8-40.9] | [34.6-38.3] | [23.9-28.1] | |

% = Percentage, CI = 95% Confidence Interval.
EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West and WC = Western Cape.
* Difference in proportion between age groups were tested by $X^2$ *tests* in each province

### 3.2.3 Education

The levels of education attained in the total sample ranged from no formal education to post-Grade 11+ qualifications (Table 1). Differential patterns of HIV prevalence were observed by education levels and these were not significant ($p > 0.05$) in all provinces except in the Eastern Cape and Gauteng (Fig. 2 & Annexure 1).

In these provinces the HIV prevalence was higher (33%) among the most educated (Grade 11+) as compared to the least educated group - Grade 0-7 (23.9%) and Grade 8-10 (28.3%) in the Eastern Cape. However, in Gauteng, the highest HIV prevalence (39.6%) was observed among the least educated (Grade 0-7) compared to women with secondary and higher education - Grade 8-10 (34.3%) and Grade 11+ (30.4%).

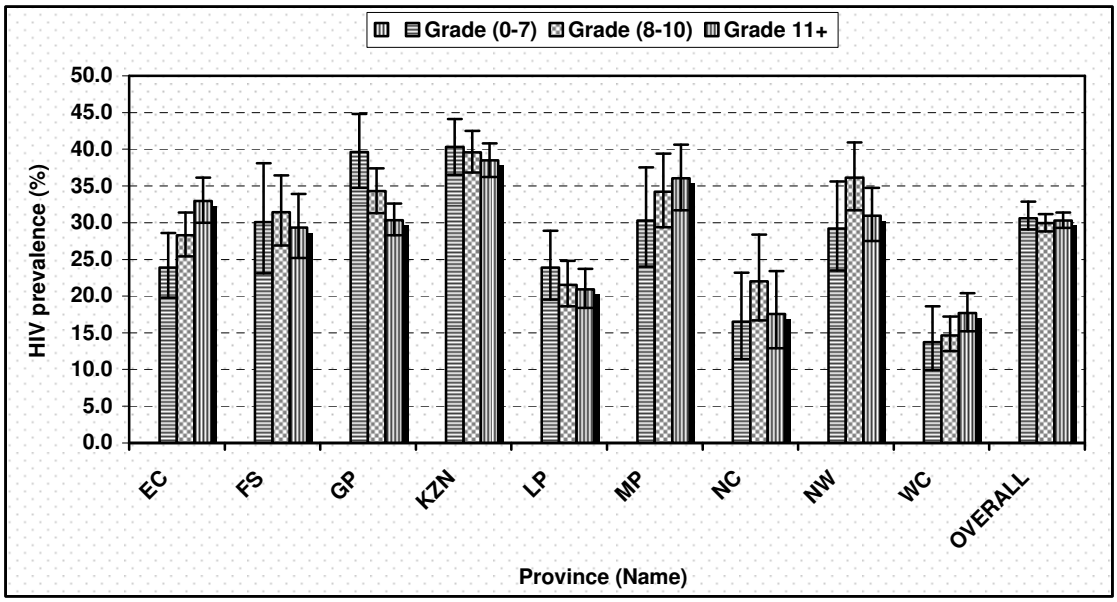


**Figure 2: HIV prevalence by education, among antenatal clinic attendees in South Africa, 2005**

* EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West, WC = Western Cape & SA = South Africa.

* Difference in proportion within educational ranks were tested by $X^2$ *tests* in each province

Of importance in Figure 3 below is the fact that generally in all the age groups, the HIV prevalence was lower among women with Grade (0-7) and this seemed to increase as the women got older.

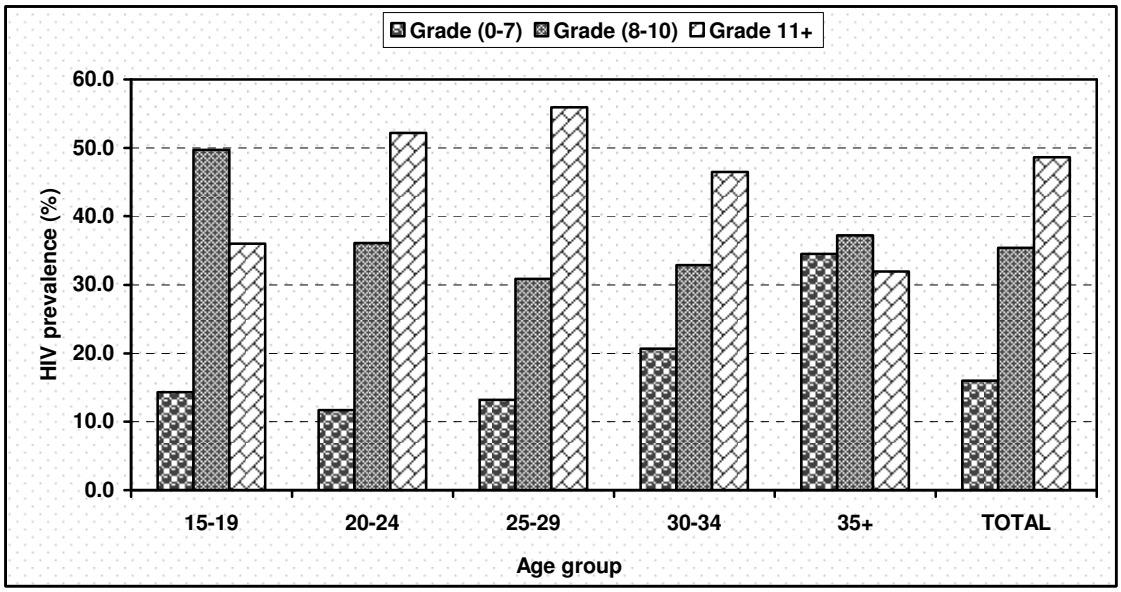


**Figure 3:** **National HIV prevalence by education and age group, among the antenatal clinic attendees in South Africa, 2005.**
*Difference in proportions within age groups were tested by $X^2$ *tests* among all HIV infected women

### 3.2.4 Gravidity and parity

The HIV prevalence by gravidity was higher (average: 38.1%) among women with second pregnancies (Gravidity = 2) as compared to women in their first and more than two pregnancies in all the provinces (average: 22.7% and 31.6% respectively). These differences in HIV prevalence in relation to the number of pregnancies were statistically significant in all provinces as supported by the P-value of less than 0.05 (Fig. 4 & Annexure 1).

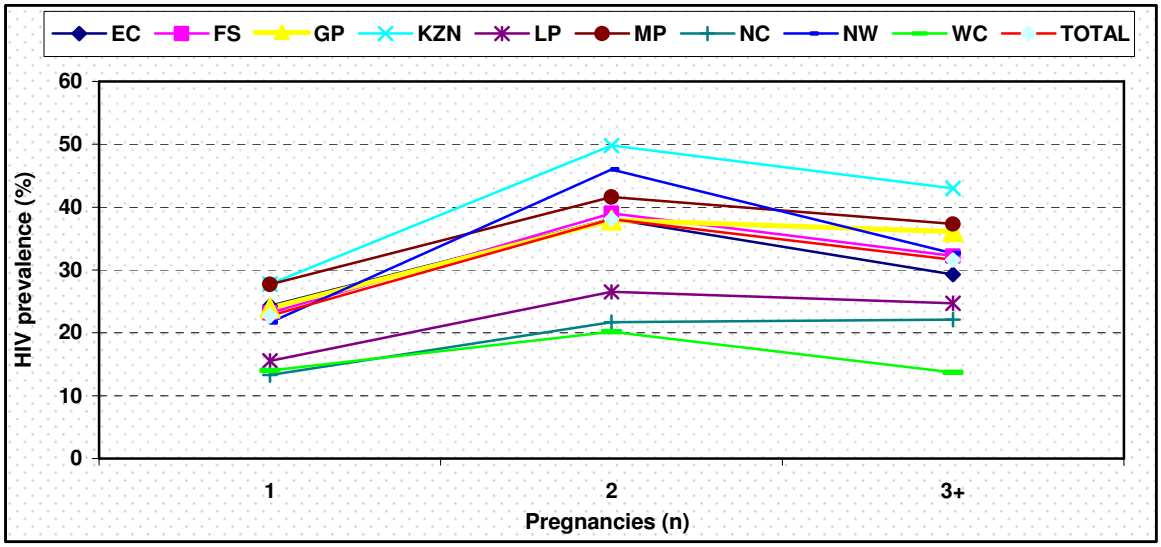


**Figure 4:** **HIV prevalence by gravidity, among antenatal clinic attendees in South Africa, 2005**

* EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West, WC = Western Cape & SA =South Africa. Difference in proportions within gravidity were tested by $X^2$ *tests* in each province

In terms of parity, the pattern was completely similar to the HIV prevalence by gravidity as described above. The HIV prevalence was higher (average: 37.5%) among women who gave birth once compared to women with more than one deliveries and those who never delivered (average: 23.7% and 31.4% respectively). The differences in HIV prevalence by parity were statistical significant in all provinces ($p< 0.05$) (Fig. 5 & Annexure 1).

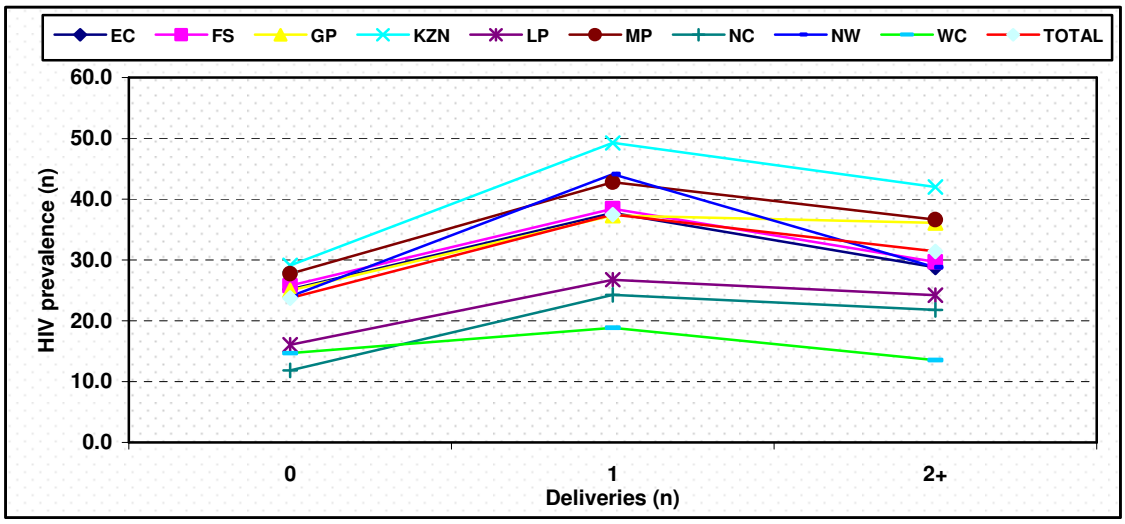


**Figure 5:** **HIV prevalence by parity, among the antenatal clinic attendees in South Africa, 2005**

* EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West, WC = Western Cape & SA = South Africa. Difference in proportions within parity were tested by $X^2$ *tests* in each province

### 3.2.5 Age differences

Figure 6 depicts the provincial HIV prevalence in relation to age differences between that of the woman and the respective male partner. According to the results, in four provinces (Eastern Cape, KwaZulu Natal, Mpumalanga and Western Cape), the highest prevalence of HIV (35.4%, 43.4%, 42.4% and 19.1% respectively) was observed among women who reported that their male partners were older by more than five years.

These differences in HIV prevalence in relation to the couple's age differences were also found to be significant in all provinces ($p < 0.05$) except in three provinces (Limpopo, Northern Cape and North West). It is important to note that the group size or sampling was relatively small (total = 93 in all province) among women who reported that their partners were younger by more than five years. This together with the unavailability of information about the age of the male partner from Gauteng province might have limited the interpretation (Fig. 6 & Annexure 2).

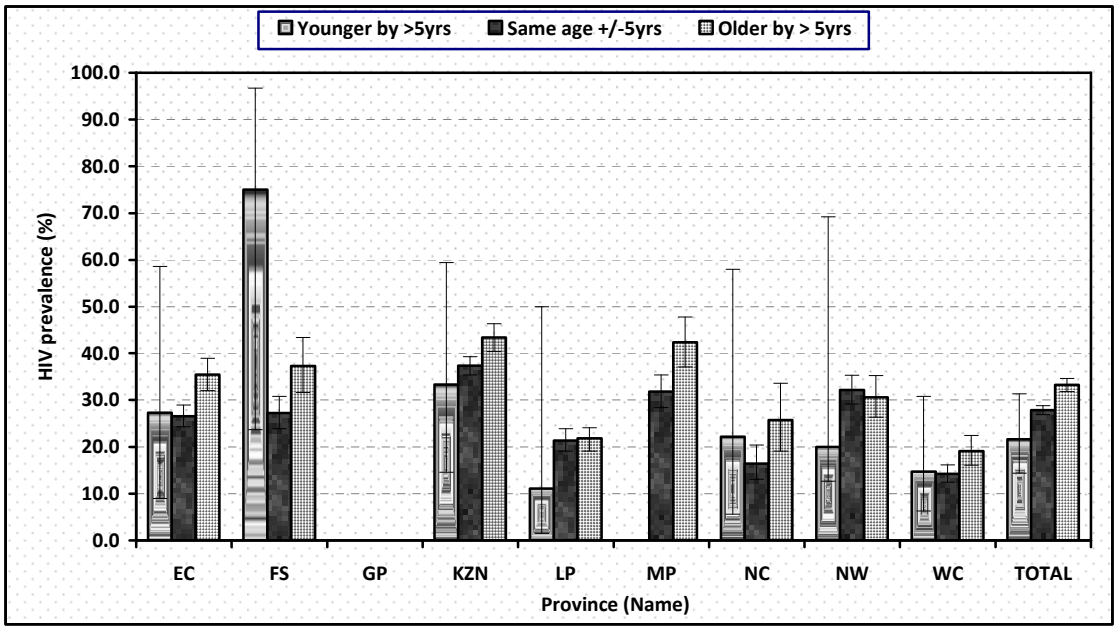


**Figure 6:** **Provincial HIV prevalence by age difference (woman & that of male partner) group in South Africa, 2005**

*EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West, WC = Western Cape.

(*Difference in proportions within age groups differences were tested by $X^2$ *tests across all provinces.* P-value < 0.001; 95% Confidence Intervals indicated in error bars.

### 3.3 Factors associated with HIV prevalence

#### 3.3.1 Bivariate analysis

Table 3 shows factors associated with HIV amongst pregnant women who participated in the 2005 HIV survey. The bivariate analysis of data showed that when comparing with 15-19 years , being aged 20-24, 25-29, 30-34 and 35+ years was significantly associated with HIV positive sero-status ($p < 0.05$) in all provinces except in the Northern Cape (Table 3A).

These associations were found to be stronger with increasing age up to the 25 to 29 year group (OR: 3.47 on average). However, in the Northern Cape, HIV infection was significantly associated with age, i.e. women aged 24 to 29 years had a OR of 2.62 (CI: 1.27-5.40) and those aged 30 to 34 years had a OR of 3.21 (CI: 1.54-6.71) compared to women aged 15 to 19 years old (Table 3A).

In the bivariate analysis, higher education in women (Grade 11+) compared to lower or no education (Grade 0-7) was found to be the sole sub-factor statistically associated with HIV infection in two provinces (Eastern Cape and Gauteng) - (OR: 1.56, $p = 0.002$ and OR: 0.66, $p = 0.001$ respectively). HIV-infected women were more likely to have a higher educational attainment (Grade 11+) compared to women with lower education attainment (Grade (0-7) in the Eastern Cape (OR: 1.56, CI 1.19-2.07). However in Gauteng, HIV infection was associated with lower educational attainment (Table 3A)".

The study revealed that a larger age difference (> 5 years) between women and their male partners was observed to be associated with HIV infection. This association was statistically significant in all provinces (OR >1.00 and 95% CI does not include OR = 1.00) except in Limpopo and North West (OR: 1.03, 0.92-1.28 and OR: 0.93, 0.72-1.20 respectively (Table 3B).

To observe whether there was any biomedical factor influencing the relationship between HIV prevalence, the syphilis prevalence rate (Figure. 7) was also explored in addition to the univariate logistic regression analysis in Table 5.

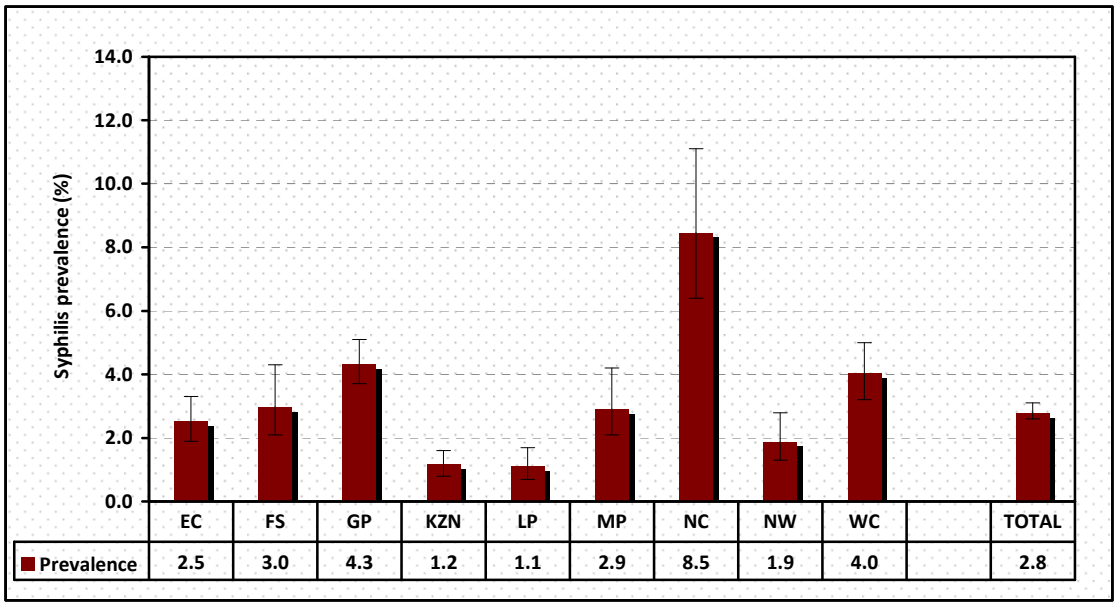


**Figure 7:** **Syphilis prevalence by province among antenatal clinic attendees in South Africa, 2005.**
*EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West and WC = Western Cape.
($X^2$ *test*) - P-value < 0.001; 95% Confident e Intervals indicated in Error bars.

As presented in Figure 7, this study found that overall 2.8% of pregnant women presenting at public antenatal care clinics in 2005 had syphilis infection. Unlike the provincial HIV prevalence patterns shown in Figure 1, the Northern Cape province reported the highest syphilis prevalence of 8.5% while Limpopo and KwaZulu-Natal showed the lowest syphilis prevalence rates approximating 1.0% (i.e. 1.1% & 1.2% respectively).

According to the results, there is a significant association (OR >1.00 and 95% CI does not include OR = 1.00) between HIV infection and being tested positive for syphilis only in four provinces (Gauteng, KwaZulu Natal, Limpopo and North West). That is the odds of HIV infection among women infected with syphilis was twice those of the non-syphilis infected group (OR = 3.38 in Limpopo, 2.46 in KwaZulu-Natal and OR = 2.36 in North West) (Table 3B).

Furthermore the results show that HIV was associated with increasing number of pregnancies. That is women who reported to have two or more pregnancies were found to be significantly associated with HIV infection as compared to those women in their first pregnancy (OR >1.00 and 95% CI does not include OR = 1.00). This was the case in all provinces except in the Western Cape. The odds of HIV infection among women who reported more than one pregnancy (Gravidity = 2 and Gravidity = 3+) was higher (overall 2.1 and 1.6 times respectively) than among women with one pregnancy (Table 3B).

**Table 3A: Bivariate analysis of factors associated with HIV infection among the antenatal clinic attendees in South Africa, 2005**

| | | Women's age group | | | | | Education levels | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 15-19 | 20-24 | 25-29 | 30-34 | 35+ | 0-7 | 8-10 | 11+ |
| EC | OR | 1.00 | 2.91 | 4.99 | 3.35 | 1.66 | 1.00 | 1.26 | 1.56 |
| | 95% CI | Reference | [2.13-3.98] | [3.63-6.87] | [2.37-4.74] | [1.11-2.49] | Reference | [0.95-1.67] | [1.19-2.07] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | 0.014 | | 0.114 | 0.002 |
| FS | OR | 1.00 | 2.11 | 3.09 | 3.34 | 2.28 | 1.00 | 1.07 | 0.97 |
| | 95% CI | Reference | [1.33-3.34] | [1.93-4.96] | [1.98-5.64] | [1.22-4.24] | Reference | [0.70-1.62] | [0.64-1.46] |
| | P-value | | 0.002 | < 0.001 | < 0.001 | 0.009 | | 0.767 | 0.869 |
| GP | OR | 1.00 | 1.80 | 3.01 | 2.98 | 1.83 | 1.00 | 0.80 | 0.66 |
| | 95% CI | Reference | [1.36-2.36] | [2.29-3.96] | [2.15-3.88] | [1.31-2.56] | Reference | [0.61-1.02] | [0.53-0.84] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | < 0.001 | | 0.075 | 0.001 |
| KZN | OR | 1.00 | 2.50 | 3.96 | 3.33 | 1.72 | 1.00 | 0.97 | 0.93 |
| | 95% CI | Reference | [2.04-3.06] | [3.17-4.95] | [2.62-4.26] | [1.27-2.33] | Reference | [0.80-1.18] | [0.77-1.12] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | < 0.001 | | 0.781 | 0.427 |
| LP | OR | 1.00 | 2.80 | 4.71 | 3.80 | 2.59 | 1.00 | 0.88 | 0.84 |
| | 95% CI | Reference | [1.87-4.20] | [3.15-7.06] | [2.43-5.94] | [1.60-4.18] | Reference | [0.64-1.20] | [0.62-1.15] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | < 0.001 | | 0.412 | 0.275 |
| MP | OR | 1.00 | 2.72 | 2.92 | 3.71 | 1.85 | 1.00 | 1.19 | 1.29 |
| | 95% CI | Reference | [1.81-4.09] | [1.91-4.46] | [2.32-5.94] | [1.08-3.15] | Reference | [0.81-1.76] | [0.89-1.88] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | 0.024 | | 0.373 | 0.178 |
| NC | OR | 1.00 | 1.70 | 2.62 | 3.21 | 1.96 | 1.00 | 1.43 | 1.08 |
| | 95% CI | Reference | [0.81-3.54] | [1.27-5.40] | [1.54-6.71] | [0.79-4.87] | Reference | [0.83-2.43] | [0.62-1.89] |
| | P-value | | 0.157 | 0.009 | 0.002 | 0.146 | | 0.200 | 0.618 |
| NW | OR | 1.00 | 2.42 | 4.74 | 2.66 | 2.67 | 1.00 | 1.37 | 1.09 |
| | 95% CI | Reference | [1.61-3.65] | [3.11-7.23] | [1.69-4.18] | [1.62-4.36] | Reference | [0.96-1.96] | [0.78-1.53] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | < 0.001 | | 0.080 | 0.618 |
| WC | OR | 1.00 | 2.44 | 3.26 | 2.97 | 2.06 | 1.00 | 1.08 | 1.35 |
| | 95% CI | Reference | [1.53-3.90] | [2.04-5.20] | [1.80-4.92] | [1.13-3.75] | Reference | [0.72-1.63] | [0.90-2.04] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | 0.018 | | 0.710 | 0.145 |
| SA | OR | 1.00 | 2.32 | 3.47 | 3.03 | 1.87 | 1.00 | 0.98 | 1.00 |
| | 95% CI | Reference | [2.07-2.59] | [3.62-6.87] | [2.37-4.74] | [1.11-2.49] | Reference | [0.89-1.09] | [0.91-1.11] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 1.00 | 0.710 | 0.950 |

- OR = Odds Ratio, CI = 95% Confidence Interval.
- EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West & WC = Western Cape

**Table 3B: Bivariate analysis of factors associated with HIV infection among the antenatal clinic attendees in South Africa, 2005**

| | | Age differences (woman & male partner) | | | Syphilis status | | *Gravidity ranks* | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ***Same age ±5yrs*** | ***Younger by >5yrs*** | ***Older by >5yrs*** | **Negative** | **Positive** | **1** | **2** | ***3+*** |
| **EC** | *OR* | *1.00* | *1.04* | *1.52* | *1.00* | *1.49* | *1.00* | *1.92* | *1.28* |
| | *95% CI* | *Reference* | *[0.27-3.94]* | *1.25-1.84* | *Reference* | *[0.86-2.59]* | *Reference* | *[1.54-2.39]* | *[1.02-1.62]* |
| | *P-value* | | *0.954* | *< 0.001* | | *0.154* | *]* | *< 0.001* | *0.030* |
| **FS** | *OR* | *1.00* | *8.03* | *1.59* | *1.00* | *2.04* | *1.00* | *2.12* | *1.57* |
| | *95% CI* | *Reference* | *[0.83-77.8]* | *[1.17-2.16]* | *Reference* | *[0.96-4.36]* | *Reference* | *[1.52-2.95]* | *[1.10-2.25]* |
| | *P-value* | | *0.072* | *0.003* | | *0.064* | | *< 0.001* | *0.013* |
| **GP** | *OR* | *1.00* | | | *1.00* | *1.91* | *1.00* | *1.94* | *1.79* |
| | *95% CI* | *Reference* | | | *Reference* | *[1.34-2.70]* | *Reference* | *[1.61-2.34]* | *1.47-2.17]* |
| | *P-value* | | | | | *< 0.001* | | *< 0.001* | *< 0.001* |
| **KZN** | *OR* | *1.00* | *0.83* | *1.28* | *1.00* | *2.46* | *1.00* | *2.57* | *1.96* |
| | *95% CI* | *Reference* | *[0.29-2.46]* | *[1.11-1.49* | *Reference* | *[1.31-4.63]* | *Reference* | *[2.18-3.04]* | *[1.65-2.33]* |
| | *P-value* | | *0.748* | *0.001* | | *0.005* | | *< 0.001* | *< 0.001* |
| **LP** | *OR* | *1.00* | *0.46* | *1.03* | *1.00* | *3.38* | *1.00* | *1.95* | *1.77* |
| | *95% CI* | *Reference* | *[0.06-3.69]* | *[0.92-1.28* | *Reference* | *[1.42-8.00]* | *Reference* | *[1.48-2.57]* | *[1.36-2.32]* |
| | *P-value* | | *0.465* | *0.808* | | *0.006* | | *< 0.001* | *< 0.001* |
| **MP** | *OR* | *1.00* | * | *1.58* | *1.00* | *1.67* | *1.00* | *1.86* | *1.55* |
| | *95% CI* | *Reference* | * | *[1.20-2.07]* | *Reference* | *[0.80-3.46]* | *Reference* | *[1.36-2.55]* | *[1.13-2.13]* |
| | *P-value* | | * | *0.001* | | *0.169* | | *< 0.001* | *0.007* |
| **NC** | *OR* | *1.00* | *1.45* | *1.76* | *1.00* | *1.02* | *1.00* | *1.81* | *1.84* |
| | *95% CI* | *Reference* | *[0.29-7.14]* | *[1.10-2.79]* | *Reference* | *[0.48-2.17]* | *Reference* | *[1.04-3.13]* | *[1.10-3.09]* |
| | *P-value* | | *0.648* | *0.017* | | *0.966* | | *0.035* | *0.020* |
| **NW** | *OR* | *1.00* | *0.53* | *0.93* | *1.00* | *2.36* | *1.00* | *3.07* | *1.41* |
| | *95% CI* | *Reference* | *[0.06-4.75]* | *[0.72-1.20]* | *Reference* | *[1.07-5.22]* | *Reference* | *[2.31-4.09]* | *[1.03-1.92]* |
| | *P-value* | | *0.569* | *0.580* | | *0.034* | | *< 0.001* | *0.032* |
| **WC** | *OR* | *1.00* | *1.04* | *1.42* | *1.00* | *1.27* | *1.00* | *1.55* | *0.95* |
| | *95% CI* | *Reference* | *[0.40-2.71]* | *[1.09-1.84]* | *Reference* | *[0.71-2.26]* | *Reference* | *[1.16-2.06]* | *[0.69-1.29]* |
| | *P-value* | | *0.939* | *0.008* | | *0.416* | | *0.003* | *0.741* |
| **SA** | *OR* | *1.00* | *0.72* | *1.28* | *1.00* | *1.58* | *1.00* | *2.10* | *1.56* |
| | *95% CI* | *Reference* | *[0.44-1.19]* | *[1.18-1.39]* | *Reference* | *[1.31-1.91]* | *Reference* | *[1.94-2.28]* | *[1.43-1.69]* |
| | *P-value* | | *0.201* | *< 0.001* | | *< 0.001* | | *< 0.001* | *< 0.001* |

* Dropped and 6 observations were not used from the STATA.

- OR = Odds Ratio, CI = 95% Confidence Interval.
- EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West & WC = Western Cape

### 3.3.2 Multivariate analysis

The results of multivariate analyses are shown in Table 4A. As in the bivariate analysis, age 20-24, 25-29 and 30-34 years remain statistically associated with HIV infection compared to age 15-19 years. This was the case in all provinces except in the Northern Cape (especially among 20-24 years old) (AOR >1.00 and 95% CI does not include AOR = 1.00).

However, among the older age group (35+ years), the significant association with HIV was also observed only in four provinces (KwaZulu Natal, Limpopo, North West and Western Cape) (AOR: 1.46, $p = 0.044$; AOR: 2.48, $p = 0.002$; AOR: 4.05, $p < 0.001$ and AOR: 3.75, $p < 0.001$ respectively) compared to women aged 15-19 years.

This multivariate analysis also revealed that HIV infection remained significantly associated with educational attainment in Gauteng (women who had attained Grade 11+ compared to Grade 0-7 in Gauteng (AOR: 0.64, $p < 0.001$); having male partners older by more than 5 years compared to partners of the same age ( ± 5 years) in six provinces (Eastern Cape, Free State, KwaZulu Natal, Mpumalanga, Northern Cape & Western Cape); being tested positive for syphilis compared to a negative test for syphilis in three provinces (Gauteng, KwaZulu Natal and Limpopo); being pregnant twice compare to a single pregnancy in five provinces (Eastern Cape, Free State, Gauteng, KwaZulu Natal and North West) and lastly being pregnant more than three times compared to single pregnancy in two provinces (KwaZulu Natal and Western Cape) (Table 4B).

In contrast to the bivariate analysis, women who had attained Grade 8-10 compared to Grade 0-7 in North West (AOR: 1.47, $p = 0.044$) and being tested positive for syphilis compared to negative test in Free State (AOR: 2.47, $p = 0.033$) gained a statistical significance in the multivariate analysis Furthermore the significant associations between HIV infection and being tested positive for syphilis in North West was not confirmed in the multivariate analysis (AOR = 1.81, $p = 0.179$) as it was in the bivariate analysis.

**Table 4A: Multivariate analysis of factors associated with HIV infection among the antenatal clinic attendees in South Africa, 2005**

| | | Women's age group | | | | | Education levels | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 15-19 | 20-24 | 25-29 | 30-34 | 35+ | 0-7 | 8-10 | 11+ |
| EC | AOR | 1.00 | 2.60 | 4.23 | 3.00 | 1.62 | 1.00 | 1.30 | 1.36 |
| | 95% CI | Reference | [1.86-3.63] | [2.93-6.11] | 196-4.59] | [0.98-2.67] | Reference | [0.96-1.76] | 1.00-1.84] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | 0.059 | ] | 0.092 | 0.051 |
| FS | AOR | 1.00 | 1.87 | 2.66 | 3.06 | 1.94 | 1.00 | | |
| | 95% CI | Reference | [1.13-3.08] | [1.55-4.54] | [1.63-5.73] | [0.91-4.12] | Reference | | |
| | P-value | | 0.014 | < 0.001 | < 0.001 | 0.086 | | | |
| GP | AOR | 1.00 | 1.75 | 2.71 | 2.51 | 1.44 | 1.00 | 0.82 | 0.64 |
| | 95% CI | Reference | [1.30-2.35] | [1.98-3.70] | [1.78-3.57] | [0.96-2.16] | Reference | [0.63-1.06] | [0.50-0.82] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | 0.074 | | 0.122 | < 0.001 |
| KZN | AOR | 1.00 | 2.09 | 3.07 | 2.69 | 1.46 | 1.00 | | |
| | 95% CI | Reference | [1.68-2.61] | [2.36-4.00] | [1.98-3.66] | [1.01-2.11] | Reference | | |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | 0.044 | | | |
| LP | AOR | 1.00 | 2.64 | 4.31 | 3.47 | 2.46 | 1.00 | | |
| | 95% CI | Reference | [1.73-4.04] | [2.72-6.84] | [2.05-5.88] | [1.38-4.38] | Reference | | |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | 0.002 | | | |
| MP | AOR | 1.00 | 2.47 | 2.74 | 3.64 | 1.91 | 1.00 | | |
| | 95% CI | Reference | [1.60-3.83] | [1.62-4.62] | [2.01-6.57] | [0.97-3.76] | Reference | | |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | 0.061 | | | |
| NC | AOR | 1.00 | 1.62 | 2.52 | 2.96 | 1.85 | 1.00 | | |
| | 95% CI | Reference | [0.72-3.63] | [1.06-6.04] | [1.15-7.62] | [0.61-6.59] | Reference | | |
| | P-value | | 0.240 | 0.037 | 0.024 | 0.280 | | | |
| NW | AOR | 1.00 | 2.35 | 4.71 | 3.12 | 4.05 | 1.00 | 1.47 | 0.99 |
| | 95% CI | Reference | [1.50-3.68] | [2.86-7.76] | [1.75-5.57] | [2.13-7.68] | Reference | [1.01-2.14] | [0.69-1.44] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | < 0.001 | | 0.044 | 0.978 |
| WC | AOR | 1.00 | 2.60 | 4.15 | 4.42 | 3.75 | 1.00 | 1.03 | 1.08 |
| | 95% CI | Reference | [1.59-4.27] | [2.43-7.08] | [2.43-8.02] | [1.85-7.61] | Reference | [0.67-1.58] | [0.70-1.68] |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | < 0.001 | | 0.907 | 0.727 |
| SA | AOR | 1.00 | 2.18 | 3.12 | 2.83 | 1.88 | 1.00 | | |
| | 95% CI | Reference | [191-2.49] | 2.69-3.61] | [2.39-3.35] | [1.54-2.29] | Reference | | |
| | P-value | | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 1.00 | | |

- AOR = Adjusted Odds Ratio, CI = 95% Confidence Interval.
- EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West & WC = Western Cape

**Table 4B: Multivariate analysis of factors associated with HIV infection among the antenatal clinic attendees in South Africa, 2005**

| | | Age differences (woman & male partner) | | | Syphilis status | | *Gravidity ranks* | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ***Same age ±5yrs*** | ***Younger by >5yrs*** | ***Older by >5yrs*** | **Negative** | **Positive** | **1** | **2** | ***3+*** |
| **EC** | *AOR* | *1.00* | *0.98* | *1.46* | *1.00* | *1.56* | *1.00* | *1.31* | *0.98* |
| | *95% CI* | *Reference* | *[0.25-3.84]* | *[1.19-1.80]* | *Reference* | *[0.87-2.80]* | *Reference* | *[1.02-1.69]* | *[0.70-1.36]* |
| | *P-value* | | *0.974* | *< 0.001* | | *0.135* | | *0.034* | *0.889* |
| **FS** | *AOR* | *1.00* | *5.49* | *1.50* | *1.00* | *2.44* | *1.00* | *1.58* | *0.95* |
| | *95% CI* | *Reference* | *[0.51-58.86]* | *[1.10-2.06]* | *Reference* | *[1.07-5.55]* | *Reference* | *[1.09-2.29]* | *[0.60-1.52]* |
| | *P-value* | | *0.160* | *0.011* | | *0.033* | | *0.016* | *0.838* |
| **GP** | *AOR* | *1.00* | | | *1.00* | *1.70* | *1.00* | *1.45* | *1.25* |
| | *95% CI* | *Reference* | | | *Reference* | *[1.24-2.55]* | *Reference* | *[1.18-1.78]* | *[0.96-1.60]* |
| | *P-value* | | | | | *0.002* | | *< 0.001* | *0.103* |
| **KZN** | *AOR* | *1.00* | *0.73* | *1.26* | *1.00* | *2.50* | *1.00* | *1.78* | *1.29* |
| | *95% CI* | *Reference* | *[0.24-2.19]* | *[1.08-1.47]* | *Reference* | *[1.30-4.82]* | *Reference* | *[1.47-2.14]* | *[1.01-1.64]* |
| | *P-value* | | *0.578* | *0.003* | | *0.006* | | *< 0.001* | *0.041* |
| **LP** | *AOR* | *1.00* | | | *1.00* | *3.15* | *1.00* | *1.18* | *1.07* |
| | *95% CI* | *Reference* | | | *Reference* | *[1.30-7.65]* | *Reference* | *[0.87-1.62]* | *[0.75-1.54]* |
| | *P-value* | | | | | *0.011* | | *0.291* | *0.704* |
| **MP** | *AOR* | *1.00* | | *1.43* | *1.00* | *1.57* | *1.00* | *1.15* | *0.92* |
| | *95% CI* | *Reference* | | *[1.08-1.91]* | *Reference* | *[0.74-3.33]* | *Reference* | *[0.79-1.69]* | *[0.58-1.47]* |
| | *P-value* | | | *0.013* | | *0.239* | | *0.459* | *0.742* |
| **NC** | *AOR* | *1.00* | *1.08* | *1.83* | *1.00* | | *1.00* | *1.29* | *1.13* |
| | *95% CI* | *Reference* | *[0.21-5,45* | *[1.14-2.94]* | *Reference* | | *Reference* | *[0.69-2.44]* | *[0.56-2.30]* |
| | *P-value* | | *0.924* | *0.012* | | | | *0.425* | *0.726* |
| **NW** | *AOR* | *1.00* | | | *1.00* | *1.81* | *1.00* | *1.88* | *0.75* |
| | *95% CI* | *Reference* | | | *Reference* | *[0.76-4.32]* | *Reference* | *[1.35-2.62]* | *[0.47-1.18]* |
| | *P-value* | | | | | *0.179* | | *< 0.001* | *0.218* |
| **WC** | *AOR* | *1.00* | *0.93* | *1.50* | *1.00* | | *1.00* | *0.97* | *0.50* |
| | *95% CI* | *Reference* | *0.35-2.51]* | *[1.15-1.95]* | *Reference* | | *Reference* | *[0.70-1.35]* | *[0.33-0.76]* |
| | *P-value* | | *0.888* | *0.003* | | | | *0.856* | *0.001* |
| **SA** | *AOR* | *1.00* | *0.65* | *1.25* | *1.00* | *1.44* | *1.00* | *1.46* | *0.98* |
| | *95% CI* | *Reference* | *[0.39-1.07]* | *[1.15-1.35]* | *Reference* | *[1.14-1.82]* | *Reference* | *[1.32-1.62]* | *[0.86-1.11]* |
| | *P-value* | | *0.090* | *< 0.001* | | *0.002* | | *< 0.001* | *0.728* |

- AOR = Adjusted Odds Ratio, CI = 95% Confidence Interval.
- EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West & WC = Western Cape

**Annexure 1: Summary Provincial HIV prevalence by education, gravidity and parity among the antenatal clinic attendees in South Africa, 2005**

| | | Education level | | | | Gravidity | | | | *Parity* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Grade 0-7 | Grade 8-10 | Grade 11+ | P–value* ($X^2$ test) | 1 | 2 | 3+ | P–value* ($X^2$ test) | 0 | 1 | 2+ | P–value* ($X^2$ test) |
| **EC** | % | *23.9* | *28.3* | *33.0* | *0.0033* | *24.3* | *38.1* | *29.3* | *<0.001* | *25.2* | *37.7* | *28.8* | *<0.001* |
| | CI | *[19.8-28.6]* | *[25.4-31.4]* | *[30.0-36.1]* | | *[21.7-27.1]* | *[34.4-42.1]* | *[25.7-33.1]* | | *[22.6-27.9]* | *[33.9-41.7]* | *[25.2-32.7]* | |
| **FS** | % | *30.1* | *31.4* | *29.3* | *0.8165* | *23.2* | *39.0* | *32.2* | *<0.001* | *25.8* | *38.5* | *29.7* | *0.0014* |
| | CI | *[23.1-38.1]* | *[26.9-36.4]* | *[25.2-33.9]* | | *[19.4-27.5]* | *[33.5-44.8]* | *[26.5-38.5]* | | [219-29.9] | *[32.9-44.4]* | *[23.7-36.4]* | |
| **GP** | % | *39.6* | *34.3* | *30.4* | *0.0014* | *23.9* | *38.0* | *36.0* | *<0.001* | 25.0 | *37.3* | *36.1* | *<0.001* |
| | CI | *[34.7-44.8]* | *[31.3-37.4]* | *[28.3-32.6]* | | *[21.5-26.6]* | *[35.1-40.9]* | *[33.0-39.2]* | | [22.5-27.6] | *[34.5-40.3]* | *[33.0-39.3]* | |
| **KZN** | % | *40.3* | *39.6* | *38.5* | *0.6852* | *27.8* | *49.8* | *43.0* | *<0.001* | 29.1 | *49.2* | *42.0* | *<0.001* |
| | CI | *[36.5-44.1]* | *[36.8-42.5]* | *[36.2-40.8]* | | *[25.5-30.2]* | *[46.8-52.7]* | *[40.0-46.1]* | | *[26.8-31.5]* | *[46.3-52.2]* | *[20.9-45.2]* | |
| **LP** | % | *23.9* | *21.6* | *20.9* | *0.5489* | *15.6* | *26.5* | *24.7* | *<0.001* | *16.1* | *26.8* | *24.2* | *<0.001* |
| | CI | *[19.5-28.9]* | *[18.6-24.8]* | *[18.4-23.7]* | | *[13.2-18.3]* | *[22.9-30.5]* | *[21.4-28.3]* | | *[13.7-18.8]* | *[23.2-30.7]* | *[20.9-27.8]* | |
| **MP** | % | *30.3* | *34.2* | *36.0* | *0.4018* | *27.7* | *41.6* | *37.3* | *<0.001* | *27.7* | *42.8* | *36.6* | *0.0001* |
| | CI | *[24.0-37.5]* | *[29.4-39.4]* | *[31.7-40.6]* | | *[23.5-32.3]* | *[36.3-47.2]* | *[32.0-42.8]* | | *[23.6-.32.3]* | *[37.4-48.3]* | *[31.3-42.2]* | |
| **NC** | % | *16.5* | *22.0* | *17.6* | *0.3633* | *13.3* | *21.7* | *22.0* | *0.0384* | *11.8* | *24.3* | *21.8* | *0.0030* |
| | CI | *[11.4-23.2]* | *[16.7-28.4]* | *[12.9-23.4]* | | *[9.4-18.5]* | *[15.9-28.9]* | *[16.8-28.4]* | | *[8.2-16.7]* | *[18.5-31.2]* | *[16.2-28.8]* | |
| **NW** | % | *29.2* | *36.1* | *31.0* | *0.1196* | *21.7* | *46.0* | *28.0* | *<0.001* | *24.0* | *44.1* | *28.0* | *<0.001* |
| | CI | *[23.5-35.6]* | *[31.7-40.9]* | *[27.5-34.7]* | | *[18.2-25.6]* | *[41.4-50.6]* | *[29.4-34.4]* | | *[20.5-27.9]* | *[39.6-48.8]* | *[23.5-32.9]* | |
| **WC** | % | *13.7* | *14.7* | *17.7* | *0.1423* | *14.0* | *20.1* | *13.4* | *0.0013* | *14.7* | *18.9* | *13.5* | *0.0260* |
| | CI | *[9.9-18.6]* | *[12.5-17.2]* | *[15.2-20.4]* | | *[11.7-16.7]* | *[17.2-23.5]* | *[10.9-16.3]* | | *[12.4-17.3]* | *[16.0-22.1]* | *[10.8-16.7]* | |
| **SA** | % | *30.6* | *30.0* | *30.3* | *0.8155* | *22.7* | *38.1* | *31.6* | *<0.001* | *23.7* | *37.5* | *31.4* | *<0.001* |
| | CI | *[28.9-32.4* | *[28.8-31.1]* | *[29.3-31.4]* | | *[21.7-23.8]* | *[36.7-39.4]* | *[30.3-32.9* | | *[22.7-24.8]* | *[36.1-38.8]* | *[30.0-32.8]* | |

- % = Percentage, CI = 95% Confidence Interval.
- EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West & WC = Western Cape

**Annexure 2: Summary Provincial HIV prevalence by age group differences (between the male partners and that of ANC attendees in South Africa, 2005**

| | | *Age differences (woman & male partner)* | | | |
|---|---|---|---|---|---|
| | | **Same age ±5yrs** | **Younger by >5yrs** | **Older by >5yrs** | ***P–value* ($X^2$ test)*** |
| **EC** | *N* | *1411* | *11* | *740* | *0.0001* |
| | *%* | *26.5* | *27.3* | *35.4* | |
| | *CI* | *[24.3-28.9]* | *[9.0-58.6]* | *[32.0-38.9]* | |
| **FS** | *N* | *640* | *4* | *260* | *0.0017* |
| | *%* | *27.2* | *75.0* | *37.3* | |
| | *CI* | *[23.9-30.8]* | *[23.7-96.7]* | *[31.6-43.4]* | |
| **GP** | *N* | * | * | * | * |
| | *%* | * | * | * | |
| | *CI* | * | * | * | |
| **KZN** | *N* | *2369* | *15* | *1077* | *0.0033* |
| | *%* | *37.4* | *33.3* | *43.4* | |
| | *CI* | *[35.4-39.3]* | *[14.6-59.4]* | *[40.4-46.3]* | |
| **LP** | *N* | *1118* | *9* | *769* | *0.7265* |
| | *%* | *21.4* | *11.1* | *21.9* | |
| | *CI* | *[19.1-23.9]* | *[1.5-50.0]* | *[19.1-24.9]* | |
| **MP** | *N* | *676* | *6* | *328* | *0.0009* |
| | *%* | *31.8* | *0* | *42.4* | |
| | *CI* | *[28.4-35.4]* | | *[37.1-47.8]* | |
| **NC** | *N* | *401* | *9* | *140* | *0.0540* |
| | *%* | *16.5* | *22.2* | *27.5* | |
| | *CI* | *[13.1-20.4]* | *[5.6-58.0]* | *[19.1-33.6]* | |
| **NW** | *N* | *862* | *5* | *399* | *0.7341* |
| | *%* | *32.1* | *20.0* | *30.6* | |
| | *CI* | *[29.1-35.3]* | *[27.1-69.2]* | *[26.3-35.3]* | |
| **WC** | *N* | *1327* | *34* | *576* | *0.0277* |
| | *%* | *14.2* | *14.7* | *19.1* | |
| | *CI* | *[12.5-16.2]* | *[6.3-30.8]* | *[16.1-22.5]* | |
| **SA** | *N* | *8804* | *93* | *4289* | *<0.001* |
| | *%* | *27.8* | *21.7* | *33.2* | |
| | *CI* | *[26.9-28.8]* | *[14.4-31.3]* | *[28.8-30.3]* | |

* N/A indicates that data was not available or recorded;

N indicates the sample size; Percentage, CI = 95% Confidence Interval.

EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP =Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West, WC = Western Cape & SA = South Africa.

# 4. DISCUSSION

HIV infection in pregnant women has become a serious problem in South Africa and for many countries around the world [2]. The 2005 antenatal survey was conducted to estimate the prevalence of HIV infection in all nine provinces using the standard unlinked anonymous methodology [2].

Data collected from these kinds of surveys inform the country on HIV trends, interventions and improvements in the HIV prevention and care programme, in addition to contributing to the understanding of the HIV epidemic in the general population [2, 6, 23]. However, there are some limitations to the National Department of Health's technique particularly in the survey report and this prompted the study.

Statistical evidence revealed that most antenatal clinics routinely collect data on the demographic profile of women's participation to the survey and often such data are rarely analysed [5, 6]. For example, pregnancies can be ranked by a woman's parity or gravidity, so that it should be possible to obtain HIV prevalence categorised by parity or gravidity [6]. These are viewed as important factors towards understanding the epidemiology surrounding HIV and AIDS. The analyses undertaken for this study tried to assess the basic socio-demographic factors associated with HIV sero-status in pregnant women participating in the 2005 antenatal HIV survey.

The current study showed that in 2005, 30.1% of pregnant women attending public antenatal clinics in South Africa were infected with HIV. This indicates that HIV is a major public health problem among women of reproductive age in the country. The provincial data surveys revealed substantial differences in HIV prevalence between the provinces, ranging from 15.7% to 39.1%. The five provinces that recorded the highest HIV rates (> 30%) were KwaZulu Natal, Mpumalanga, Gauteng, North West and Free State. The Western Cape and Northern Cape recorded the lowest prevalence (less than 20%).

The figures were almost similar to what was reported in the 2005 National HIV antenatal survey report, as well subsequent antenatal HIV surveys conducted by the National Department [1, 2]. In addition, a recent household study by the HSRC in 2008 showed reasonably consistent 'evidence' that HIV prevalence is lowest in the Western Cape followed by Northern Cape, Limpopo and Eastern Cape. The highest HIV prevalence remains in KwaZulu Natal and Mpumalanga [4, 23].

However, it must be noted that figures from the household survey [4, 23] were lower compared to results of this analysis, probably because not all the young women who participated in the household survey were sexually active, and those represented in the antenatal data were by definition engaged in unprotected sex, which put them at higher risk of HIV infection [6, 8]. These inter-provincial differences can be explained partly by differences in demographic mix, ethnic group as well as other cultural factors [12, 4.]

For example, male circumcision is believed to be a major factor explaining inter-regional differences in HIV prevalence within Africa[18, 19, 24]. Male circumcision is widely practised among the Pedi (largest cultural group in Limpopo) and the Xhosa (who inhabit mostly the Eastern Cape), but is uncommon among the Zulu, (the largest cultural group in KwaZulu- Natal) [12, 25]. The observed difference in HIV prevalence between Limpopo, Eastern Cape, and KwaZulu-Natal is consistent with the protective effect of male circumcision at the individual level, although this alone cannot explain the provincial differences [4, 12, 25].

In addition, a number of studies conducted in South Africa showed that HIV prevalence is highest among Africans compared with other race groups [4]. The proportion of the population that is African is relatively low in the Western Cape and the Northern Cape (predominantly coloured), and this partially explains why prevalence levels are so low in these provinces [4].

Other factors such as differences in urbanisation, migration, socio-economic status and access to HIV prevention and treatment services could also explain some of the differences in HIV prevalence between South Africa's provinces, as proposed by numerous studies [13, 26]. However, further studies are required to elucidate the reasons in details. To some extent these differences may reflect the fact that the various provincial epidemics are at different levels of maturity as reported by Dorington *et al.*, 2002 [12].

Secondly, the study found that the age-specific HIV prevalence presented a fairly significant pattern of the highest prevalence (ranging between 20.1% - 52.2%) among the 25-29 year age group in all provinces except Free State, Mpumalanga and the Northern Cape where the highest age-specific prevalence was observed among women aged 30-34 years (39.4%, 46.2% and 26.7% respectively). In all provinces, the lower rates of HIV infection were observed in those below the age of 20 years.

The less sampling of older women aged 35+ years (n = < 110) in three provinces (Free State, Mpumalanga and Northern Cape) together with other HIV risk factors outlined previously might have contributed to these inter-provincial differences in the age pattern [12, 13]. Despite this, the inability to moderate cultural circumstances is believed to be a factor in the high HIV prevalence among these older women in some provinces as suggested by other studies [27].

The observed age pattern of HIV prevalence in this study is comparable with findings of previous studies conducted elsewhere in South Africa[4, 27-29]. A report from other studies showed that the difference in HIV prevalence between women aged 15-19 and 20-24 years is much larger in the population-based surveys than in the antenatal care group [4, 27]. This is because at the age of 15-19 pregnant women are less representative of their age group than at the age of 20-24 years. Since the 15-19 year age group contains a large proportion of women who have not yet become sexually active or not take precautions against falling pregnant [4, 27-29].

Furthermore, the substantial age difference between female and male sexual partners has been noted elsewhere and was also confirmed in this study [18, 29, 33]. The study revealed that women whose partners were older by more than five (> 5) years had high HIV prevalence than women whose partners were of the same age group (same age ± five years). This was the case in all provinces except in Limpopo and North West. These behaviour patterns may be due to cultural factors including the expectation that women should marry earlier than men, as well as social and economic inequalities as suggested by other studies [4, 12, 34, 35].

Furthermore the results of this study demonstrate that the HIV prevalence in South Africa was highest among women with primary education (Gauteng, 40%) as well those with higher education (Eastern Cape, 30%). Moreover, in other provinces, the differences in HIV prevalence in relation to educational attainment did not differ significantly between women who completed higher education, secondary education, and primary education.

There have been mixed conclusions on the risk of HIV in relation to educational attainment, but most studies from sub- Saharan Africa have previously shown increased schooling to be associated with increased risk of HIV [13, 16, 17]. This is still the case in the Eastern Cape based on these study findings. Studies that are more recent [16, 17] however, have indicated that this association changed direction in the 1990s. In young people, the likelihood of infection was higher in those with little education compared to those with more education [16, 17].

The HIV prevalence tended to decline with educational attainment in this study suggesting that HIV prevention strategies may have been more effective in more educated women. The results add to the body of mixed evidence on the association between education and HIV infection [16, 17]. Together with other evidence on multivariate analysis, this study suggests that higher educational attainment does protect against HIV only in Gauteng province.

The relationship between HIV prevalence and level of education in the Eastern Cape is slightly unclear at higher education levels, and this could probably be confounded by other factors. Schooling is one of the most consistent predictors of behaviour and knowledge: education level predicts protective behaviours such as the use of counselling and testing, discussion of AIDS between spouses, and knowledge about HIV, but it also predicts a higher level of infidelity and a lower level of abstinence [16].

Further findings from this study demonstrate that the national syphilis prevalence for 2005 was 2.8%. In contrast to the HIV prevalence pattern, syphilis shows a higher prevalence (8.4%) in the Northern Cape and lower prevalence (1.1%) in Limpopo. For example, in three provinces (KwaZulu Natal, Northern Cape & Western Cape), there is a pattern of high HIV prevalence in provinces with a low syphilis prevalence. The lower syphilis prevalence relative to HIV prevalence can be explained in terms of better access to treatment for sexual transmission infection (STI) in the country. However more information on number of the women treated for STI may be needed to support the explanation.

In addition, the provincial pattern is similar to what was observed in the 2005 National HIV survey report and other studies [2, 11]. As in the case of HIV infection, the inter-provincial differences found in this study can be explained partly by differences in socio-economic factors, demographic mix, as well as other cultural factors which are likely to influence the sexual risk behaviours [4, 12, 18].

This analysis demonstrated further women's parity and gravidity in relation to HIV prevalence. Most antenatal clinics routinely collect data on the rank order of the pregnancy and often such data are also reported in HIV sentinel surveillance, but are rarely analysed [4, 6]. A chi-square analysis showed that HIV infection peaked at the second pregnancy. However it should be noted that pregnancy history is often underreported. Ideally, a pregnancy history

should include previous abortions, stillbirths and live births and these are frequently underreported or completely missed.

This is similar to other settings where such data have been analysed [4, 6]. However it should also be noted that age may have confounded the findings as the majority (> 55%) of women participated in the survey were in the 24-29 age group (i.e. an age group with highest HIV prevalence (> 36%), and very likely to be in their second pregnancies. Further investigations are warranted with more detailed assessment of age as a confounder.

Women who have large numbers of children are likely to be in more stable, long-term relationships, than women with relatively low fertility [6]. Studies by *Zaba and Gregson*, also show that HIV infection tends to cause lower fertility rates [6], and this may also partially explain the high HIV prevalence observed among women with low levels of gravidity.

However, results on the multivariate analysis indicate that the relationship between HIV prevalence and gravidity in all provinces is somewhat weaker and not significant. Reports from UNAIDS found reporting problems inherent in classifying women by gravidity, because abortions and stillbirth are underreported [6]. Secondly it is not clear whether the reporting about gravidity have included the current pregnancy which led her to participate in this survey.

In summarising factors associated with HIV sero-positivity, the results from the multivariate analyses suggest that several factors are significantly associated with HIV sero-status in different provinces. The study reveals that the risk of HIV infection increases (1) among women aged 20-24 years, 25-29 years and 30-34 years compared to women who were 15-19 years in all provinces except in the Northern Cape; (2) having male partners older by more than 5 years compared to partners of the same age ( ± 5 years) in six provinces (Eastern Cape, Free State, KwaZulu Natal, Mpumalanga, Northern Cape & Western Cape); (3) attaining higher levels of education compared to the lowest levels of education in Gauteng; (4) being tested positive for syphilis

compared to a negative test for syphilis in five provinces (Free State, Gauteng, KwaZulu Natal and Limpopo); and (5) being pregnant twice compare to a single pregnancy in five provinces (Eastern Cape, Free State, Gauteng, KwaZulu Natal and North West) (Table 4B).

In addition, this study also found that, apart from higher educational attainment (Grade 11+) being a risk factor for HIV infection in the Eastern Cape, this seems to be protective against HIV in Gauteng. In recent years, the risk of HIV infection in young South African women with completed secondary education has reduced significantly relative to that in young women with primary education, suggesting that HIV prevention strategies may have been more effective in more educated women [16, 17]. This could be the case in Gauteng.

Although the risk profile derived from the multivariate analyses did not differ significantly from that of the bivariate analysis (overlapping confidence intervals), the differences were noted with women attained Grade 8-10 compared to Grade 0-7 in North West (AOR: 1.47, p = 0.044) and being tested positive for syphilis compared to a negative test for syphilis in the Free State (AOR: 2.47, p = 0.033). Among the women aged 35+ years, the significant association was observed only in four provinces (KwaZulu Natal, Limpopo, North West and Western Cape) compared to women aged 15-19 years. This difference between the bivariate and multivariate analysis pattern is probably due to confounding issues as well possible interactions with other variables (not examined) which are likely to affect the sexual risk behaviours [28, 34] However more studies may still be needed to clarify this in details.

The strength and direction of the associations found in the multivariate analysis are consistent with findings from other studies conducted in elsewhere in sub-Saharan Africa, where significant associations have been found for socio-demographic factors such as increased age, education attainment, being impregnated by male partners in the older age group, and being infected with syphilis [4, 11-13, 27-30].

## 4.1 Strength and limitation of the study

South Africa's antenatal clinic data are among the best in Africa. The surveys follow a stratified cluster sampling methodology, with clinics being sampled on a probability proportional to size (PPS) basis. The overall sample sizes are very large, making this HIV-prevalence dataset one of the largest in the world. To the best of a researcher's knowledge, this is the first study to assess the socio-demographic factors associated with HIV infection among pregnant women attending public antenatal clinic in South Africa using data collected in 2005.

Nevertheless, there are several unexpected challenges introducing limitations and possible bias to this research project. Databases are only as good as the quality of data they provide. The study is a secondary data analysis, which makes it difficult to exert control over the quality as well as misclassification of the data. Although data are reported to various levels for verification before being reported to the national office for its management, there is a room for misinterpretation during the process.

Another limitation is that the analysis has been designed to understand factors associated with HIV prevalence across the entire provinces, although there may be other confounding factors like poverty, income, sexual behaviours and other risk factors for HIV that may still remain unanswered as the data were not available. In addition, the intention of this study was to use the most recent HIV surveillance data. However, due to some logistics, the 2005 data was officially approved by the NDOH and available to use for this study. The 2005 data might not reflect or address the present situation.

Another weakness is in the age cut-off point for sexually active women. That is the age was restricted to 15-49 years. Pregnant women below the age of 15 years were grouped with the 15-19 years. It is possible that this may lead to over/underestimation in this age group. The same thing applies to those above 49 years old. The statistical analyses conducted also excluded data from Gauteng (n =3110) on the age of the partner. There was also a lack of

representativeness (i.e. small proportion of women in some group of exposure variables e.g. age, education) and these factors may have limited the analyses.

The analysis is primarily based on cross-sectional data, so the odds ratios observed may overestimate risk estimates and the associations may not be causal. For instance, although multivariate analysis showed syphilis to be positively associated with HIV infection, it remains unclear whether the participants were infected with syphilis before or after becoming infected with HIV.

Lastly, the key limitations of unlinked surveys of pregnant women in South Africa are that they do not examine women attending private sector clinics, women who are not fertile, older women or women who choose not to have children. When interpreting the results of this study, it should be considered that estimates of HIV prevalence based on data from the ANC surveys likely represent an underestimate of the prevalence among the general female population and this may be the case in this study.

### 4.2 Programme implication

- Finally, the study's findings contribute to the comprehension of HIV infectivity in South Africa and support the need for extra specific prevention intervention strategies in each province.

- The Young people at their marriage age (age 20-29 years) still constitute a large proportion of those infected particularly in almost all provinces and the high HIV prevalence amongst women 25-29 years may suggest a high incidence of infection still occurring among the young couples. There is the need to focus intervention programmes which include family planning towards this sub-population.

- In Gauteng and the Eastern Cape, the higher HIV prevalence amongst women with Grade 0-7 and Grade 11+ respectively suggests additional

risk of exposure for the female learners and students. There is a need to focus activities on girls within primary and secondary or high schools to empower them to protect themselves from HIV infection. HIV and AIDS education in schools should be adopted in all provinces as a strategy to address this issue even though the analysis showed no association between HIV infection and education in other provinces.

- Provision and strengthening of services to treat sexually transmitted diseases and educational empowerment programmes that will promote safer sex among pregnant women are urgently needed, particularly in Gauteng, KwaZulu Natal, Limpopo and Free State and to some extent in the North West.

- Behavioural surveys should be conducted so as to generate data that can explain the various factors driving the epidemic in the various provinces of the country and inform intervention. This should clear some understanding regarding sexual networking especially in young women engaging sexual relationship with older partners as it was more prevalent in six provinces (Eastern Cape, Free State, KwaZulu Natal, Mpumalanga, Northern Cape and Western Cape).

**IN CONCLUSION**, identifying and knowing the importance of any factors associated with HIV infection among pregnant women is vital for understanding the epidemiology and the provincial differences in HIV prevalence in South Africa [7, 36, 37.] When targeting public health messages and intervention, it is equally important to recognise that geographical areas cannot be regarded as a homogeneous group with respect to factors associated with HIV infection. This mean that targeting provinces collectively may not be the single best way to utilise resources for HIV prevention and control among pregnant women due to demographic mix and different culturally related factors. Hence, it is important to identify these differences so that provinces receive prevention and control messages that are appropriate to their HIV infection risk.

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