


# Sociodemographic Predictors of HIV Infection among Pregnant Women in Botswana: Cross-Sectional Study at 7 Health Facilities

Journal of the International Association of Providers of AIDS Care  
Volume 19: 1-8

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DOI: 10.1177/2325958220925659  
journals.sagepub.com/home/jia



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## Abstract

**Objectives:** To determine the prevalence and sociodemographic predictors of HIV among pregnant women in Botswana. **Methods:** This was a cross-sectional study of randomly enrolled women aged 18 to 49 years, attending 7 health facilities in Botswana. Data were gathered from November 2017 to March 2018 and analyzed using SPSS version 24. **Result:** Of the 429 women enrolled, 407 (96.4%) were included in the analysis. The HIV prevalence was 17%; 69 of 407 (95% CI: 13.4- 21.0). Women aged 35 to 49 years had higher HIV prevalence than those 18 to 24 years (adjusted odds ratio [AOR] = 6.2; 95% CI: 2.7-14.4). Illiterate and elementary school educated women had higher HIV prevalence than those with a tertiary education (AOR = 8.5; 95% CI: 1.8-39.1). Those with a history of alcohol intake had a higher HIV prevalence than those without (AOR = 2.6; 95% CI: 1.3-5.3). **Conclusion:** HIV prevalence was lower than it was in 2011. Age, level of education, and history of alcohol intake were strong predictors for HIV infection calling for targeted behavioral change interventions.

## Keywords

HIV in pregnancy, alcohol-related HIV risk, HIV prevalence, sociodemographic predictors of HIV, behavioral change strategies

Date received: 12 November 2019; revised: 19 April 2020; accepted: 20 April 2020.

## Introduction

In 2017, globally about 36.9 million people lived with HIV/AIDS and 940 000 died from it.<sup>1</sup> The same source indicated that about 53% of all people with HIV, and 66.0% of 1.8 million newly HIV-infected people reside in sub-Saharan Africa (SSA); women accounting for 59% of new HIV infections in SSA.<sup>1</sup>

Data obtained from 140 000 pregnant women in more than 300 clinics from 22 SSA countries showed an increase in HIV prevalence in Southern Africa from 21.3% (1997/8) to 23.8% (2002), while in Eastern Africa HIV prevalence declined from 12.9% to 8.5% during the same period. The trend in Western Africa was stable at 3.5% (1997/8) and 3.2% (2002).<sup>2</sup> Since 2010, a slow decline in the annual number of new infections

was noted globally, including Southern Africa. The decline of new infections in Eastern and Southern Africa was higher among young women aged 15 to 24 years old.<sup>1</sup>

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### What Do We Already Know about This Topic?

Botswana is one of high HIV burden countries, with HIV prevalence of 18.5%. Antenatal Care Sentinel Surveillance (ASS) was used to monitor HIV prevalence in Botswana since 1992. The 2011 HIV-ASS put the prevalence of HIV among pregnant women at 30.4%. A progressive decline of HIV prevalence was reported in Botswana, from 37.4% in 2003 to 30.4% in 2011.

### How Does Your Research Contribute to the Field?

There are no publicly accessible recent data on the prevalence and sociodemographic predictors of HIV infection among pregnant women in Botswana, since 2012; because the last ASS was conducted in 2011, a gap this study aimed to address.

### What Are Your Research's Implications toward Theory, Practice, or policy?

Having updated information on the prevalence of HIV among pregnant women and related sociodemographic risk factors would enable policy makers and program officers to redesign targeted interventions for program success.

Moreover, a review of data in SSA from 1989 to 2012 from 6 community-based studies in Eastern and Southern Africa showed the mean prevalence of HIV among pregnant women to be 17.2% (17.0-17.3). The same source showed that mortality ratio of HIV-positive to HIV-negative women who were pregnant or postpartum was 8.2 (5.7-11.8) indicating HIV-positive pregnant or postpartum women had around 8 times higher mortality than did their HIV-negative counterparts.<sup>3</sup> HIV prevalence among pregnant women has declined more rapidly than prevalence in women overall and increased among older and less fertile women.<sup>4</sup> However, adolescent girls and young women aged 15 to 24 years have up to 8-fold higher rates of HIV infection compared to their male counterparts.<sup>5</sup> A number of studies also indicated that the level of education, marital status, employment or income level, and alcohol consumption may be risk factors for HIV infection.<sup>1,6-10</sup>

In Botswana, population-based estimates of HIV prevalence among the general population was 18.5% in 2013, females being more affected (female = 20.8% versus male = 15.6%). The HIV prevalence was slightly higher than in 2008 (17.6%; (BAIS-II)) and 2004 (17.1%; BAIS-III).<sup>1,6</sup> Higher HIV-prevalence rate was reported among 35 to 49 years old women in Botswana compared to 15 to 24 years old (~44.0% versus 10.0%).<sup>1,6</sup> Females 35 to 49 years old had the highest (41.8%-43.7%) HIV prevalence, attaining peak of 50.6% earlier at 35 to

39 years of age, while men reached peak of 43.8% at 40 to 44 years.<sup>6</sup> The same source indicated that cities (19.5%) and towns (21.6%) had higher HIV prevalence than urban villages (18.7%) and rural villages (17.4%). The 2011 ASS<sup>11</sup> showed those never in school (35.3%) and primary educated (44.6%) had higher HIV prevalence than those with secondary (29.9%) and university (17.0%) education.

A total of 380 000 people still live with HIV in Botswana with 14 000 new infections and 4100 deaths in 2017; Of which about 55.3%, 51.4%, and 43.9% constitutes women > 15 years old, respectively.<sup>1</sup> The same source indicated that about 86% (94% women versus 74% men) of the people knew their HIV status, while only 47.0% of young people aged 15 to 24 years old had correct knowledge of HIV prevention. Moreover, about 25% of maternal mortality was attributed to indirect causes, of which 68% was due to HIV. HIV-infected pregnant women were 3 times more likely to die than those without HIV.<sup>12,13</sup>

Botswana began to reverse the spread of HIV/AIDS and also achieved universal access to antiretroviral therapy (ART-coverage of 96.1%) for HIV/AIDS<sup>14</sup>; and it is one of the few countries that initiated "treat ALL" strategy in 2016.<sup>1,15</sup>

Botswana started conducting Antenatal Care Sentinel Surveillance (ASS) for monitoring the HIV epidemic among pregnant women aged 15 to 49 years old from 1992, in 2 districts and rolled out nationally in 2005. The last ANC was conducted in 2011 in Botswana, and the adjusted HIV prevalence was 30.4%<sup>11</sup>, which showed a decline from 37.4% in 2003.<sup>11,14</sup> Since 2011, Prevention of Mother-to-Child Transmission (PMTCT) of HIV-based surveillance using both ANC and PMTCT program data replaced ASS to estimate HIV positivity among pregnant women. The previous ASS was costly and also challenged by issues of ethics. Ethical issues were related with the use of unlinked anonymous testing approach as the routine test was done without getting client consent, and the test results were not communicated back to clients. Challenges were addressed by using PMTCT program data. However, since 2011, there are no publicly available recent data on HIV prevalence among pregnant women which could be compared with the national figure; and the sociodemographic predictors of HIV infection among pregnant women were not well explored. This study aimed to address these.

## Materials and Methods

Botswana had an estimated total projected population of 2 254 021 (1 148 132 = 51.0% females) in 2017.<sup>16,17</sup> This study was conducted in 7 health facilities selected from 2 health districts (Greater Gaborone and Kweneng East). The projected population of Gaborone and Kweneng East districts in 2017 were 264 094 (11.7%) and 306 330 (13.5%), respectively. According to the 2011 ASS, the adjusted HIV-prevalence among pregnant women in Botswana was 30.4%, compared to 29.2% and 26.6% in Gaborone and Kweneng East districts, respectively.<sup>11</sup> The 7 health facilities purposefully selected for the study included 2 public hospitals (Princes Marina Hospital and Scottish

Livingstone Hospital), 1 private hospital (Gaborone Private Hospital), and 4 clinics (2 with and 2 without maternity wings).

A cross-sectional study method was used to determine the prevalence of HIV among pregnant women and to assess the sociodemographic predictors of HIV infection.

Using the formula for single proportion,<sup>18</sup> the sample size was estimated at 429 (including 10% for nonresponse). Stratified random method proportional to the number of ANC clients per facility, and was used to select ANC clients to participate in the study. All pregnant women in the selected health facilities meeting the inclusion criteria were then consecutively enrolled until the required sample size was reached. Those candidates who did not meet the inclusion criteria were replaced by the next ANC client.

The inclusion criteria were ANC clients aged 18 to 49 years old in the selected health facilities, who were not an emergency case, and who did not have a mental condition and able to provide consent. Those not meeting these criteria were excluded from the study.

A paper-based structured data collection tool was used to collect quantitative data from November 2017 to March 2018. The tool was translated into Setswana and pretested in 2 clinics which were not part of the study. The study tool was adapted to accommodate the feedback from the pretesting exercise.

A written informed consent was obtained from all participants after an explanation was given about the objectives of the study and other pertinent information. Those who consented to participate in the study were requested to disclose their HIV status. Once consent was secured the data collection tool was administered.

Five nurses who were trained on the objectives of the study and the ethical issues administered the tool. A trained medical doctor supervised the field activities. HIV status was determined from client card as HIV testing is routinely done in Botswana at ANC clinics at their first visit. For those with HIV-negative result, repeating HIV test was a norm every 3 months until delivery, according to the national testing algorithm,<sup>15</sup> using 2 parallel rapid HIV test (ie, Unigold test [Trinity Biotek] and the KHB test [Shangai Keha Bioengineering]). If there is discordant result, the rapid test will be repeated. Enzyme-linked immunosorbent assay (ELISA) test was used as a tiebreaker in case of discordance after the repeated rapid test. If ELISA is also discordant, Western blot is used for verification.<sup>11,15</sup>

Data were checked, coded, and entered in an excel sheet that was then imported into SPSS version 24 for further processing and analyses. Discrepancies were identified through logic checks, and missing data were corrected through client's card review.

Descriptive statistics, bivariate and multivariate analysis were run. Descriptive statistics were performed using the following independent variables: sociodemographic (ie, age, gestational age, residence, level of education, occupation, history of alcohol intake, # of people in a household [HH]) and type of the health facility visited. The dependent variables that were used to determine any association with the independent variables of interest were knowledge of HIV status, consent to disclose HIV status, and HIV status. All variables with *P* value

≤.10 were eligible for reassessment in the multiple logistic regression analysis. Confidence interval and level of significance were set at 95% and 5%; and those variables having *P* value <.05 were statistically significant. Direct standardization method<sup>19</sup> using 2017 project population was used to estimate the total infected pregnant women and calculate age-adjusted HIV prevalence among pregnant women, so as to make it comparable with that of the general population and the results of 2011 ASS (Online Annex-1).

## Results

A total of 429 (93.5%) pregnant women consented and enrolled in the study but, 22 (5.1%) of those enrolled were excluded from the analysis because of incomplete information and/or mismatch, leaving 407 (94.5%) available for analysis (Figure 1).

The median age of the participants was 29 years (interquartile range [IQR]: 24-35) and their median gestational age was 30 weeks (IQR: 23-36). Additionally, 247 (61.1%; 95% CI: 56.4-65.9) women were in their third trimester of pregnancy, 138 (34.2%; 95% CI: 29.5-38.8) in their second trimester, and only 19 (4.7%; 95% CI: 2.6-6.8) were in their first trimester.

Most of the participants (97%) had either secondary 207 (51.1%; 95% CI: 46.2-56.0) or tertiary 188 (46.4%; 95% CI: 41.6-51.3) level education. Only 10 (2.5%; 95% CI: 1.0-4.0) had illiterate/elementary level education. A total of 148 (37.0%; 95% CI: 31.9-41.2) of the participants were unemployed; while 108 (26.5%; 95% CI: 22.2-30.8) and 65 (16%; 95% CI: 12.4-19.5) were private and government employees, respectively.

All (100.0%) pregnant women knew their HIV status and 99.5% consented to disclose their status. A total of 69 (17.0%; 95% CI: 13.4-21.0) pregnant women were HIV positive. The age-adjusted HIV prevalence among pregnant women using direct standardization was 18.6% (116 893/629 255).

A total of 63 (15.6%) of 405 participants had history of alcohol drinking and 19 (30.2%) of 63 (95% CI: 19.2-43.0) were HIV positive. Those 63, with history of alcohol dinking, when asked about the frequency of drinking, 55 (87.3%) of 63 participants said they drink occasionally, 3 (4.8%) of 63 said weekly, and 2 (3.2%) of 63 said daily, while 3 (4.8%) did not respond to the question.

Age, education, history of alcohol intake, gestational age, and type of health facility were significantly (*P* < .001) associated with HIV infection in the bivariate analysis. The association between residence and HIV infection had borderline significance (*P* = .08), with more HIV infection among village residents (Table 1).

After running a logistic regression analysis on selected sociodemographic factors, age, educational level, and history of alcohol intake remained significantly associated with HIV infection (Table 2). There were higher odds of HIV infection among illiterate and elementary educated (adjusted odds ratio [AOR] = 8.45; 95% CI: 1.83-39.10) and older age-group, 35 to 49 years old (AOR = 6.23; 95% CI: 2.73-14.39) compared to tertiary educated and younger age-group (18-25 years old), respectively. Also, women with a history of alcohol intake had

**Table 1.** Characteristics of HIV-Infected ANC Clients in 7 Health Facilities in Botswana (2017-2018).<sup>a,b</sup>

HIV status	Total, N	HIV positive, N (%)	95% CI	P value
Variable				
Age groups (years) N = 403 <sup>c</sup>				<.01 <sup>d</sup>
HIV prevalence				
18-24	106	10 (9.4)	3.9-15	
25-34	193	24 (12.4)	7.8-17	
35-49	104	35 (33.7)	24.6-42.7	
18-49	403	69 (17.0)	13.4-20.8	
Education level, N = 403 <sup>c</sup>				<.01 <sup>d</sup>
Illiterate/elementary	10	4 (40.0)	12.2-73.8	
Secondary	205	49 (23.9)	18.1-29.7	
Tertiary	188	16 (8.5)	4.5-12.5	
History of alcohol intake, N = 405 <sup>c</sup>				<.01 <sup>d</sup>
Yes	63	19 (30.2)	19.2-43.0	
No	342	50 (14.6)	10.9-18.0	
Health facility, N = 405 <sup>c</sup>				.02 <sup>d</sup>
Private	69	5 (7.2)	2.4-16.1	
Public	336	64 (19.0)	14.8-23.2	
GA/trimester, N = 402 <sup>c</sup>				.11
First trimester	19	2 (10.5)	1.3-33.1	
Second trimester	138	31 (22.5)	15.5-29.4	
Third trimester	245	36 (14.7)	10.5-19.8	
Occupation, N = 405 <sup>c</sup>				.85
Housewife	19	3 (15.8)	3.4-39.6	
Self-employed	31	6 (19.4)	7.5-37.5	
Government employed	65	8 (12.3)	5.5-22.8	
Private Sector employed	108	22 (20.6)	12.9-28.2	
Health care worker	11	2 (16.7)	2.1-48.4	
Unemployed	148	23 (15.5)	9.7-21.4	
Others	23	5 (21.7)	7.5-43.7	
# People in a HH, N = 405 <sup>c</sup>				.33
1-3	202	29 (14.4)	9.5-19.2	
4-6	161	32 (19.9)	13.7-26.0	
7-9	28	4 (14.3)	4.7-37.4	
≥10	14	4 (28.6)	8.4-58.1	
ANC residence, N = 405 <sup>c</sup>				.08 <sup>e</sup>
Cities	247	35 (14.2%)	9.8-18.5	
Urban villages	124	29 (23.4)	15.9-30.8	
Villages	34	5 (14.7)	5.0-31.1	

Abbreviations: ANC, antenatal care; GA, gestational age; HH, household;

<sup>a</sup>N = 407.

<sup>b</sup>The analyses showed that Hosmer and Lemeshow Test was insignificant ( $\chi^2 = 4.95$ ;  $df = 8$ ;  $P = .70$ ); and 24.1% of the variance from the model described HIV infection (Nagelkerke  $R^2 = 0.241$ ;  $P < .001$ ).

<sup>c</sup>There are missing values (ie, 2 to 5).

<sup>d</sup>Significant at  $P < .05$ .

<sup>e</sup>Border line significance.

higher odds of HIV infection compared to those without a history of alcohol intake (AOR = 2.59; 95% CI: 1.27-5.28). Gestational age maintained borderline significance ( $P = .052$ ), while residence was not significantly associated with HIV infection ( $P = .68$ ). Women in the second trimester are at higher risk than those at first trimester, but the difference was not statistically significant (AOR = 2.23; 95% CI: 0.41-12.19).

## Discussion

All our study participants knew their HIV status and the age-adjusted HIV prevalence among pregnant women was 18.6%.

The youngest age groups of 15 to 24 years old women had the lowest HIV prevalence, while the highest HIV prevalence was among 35 to 49 years old. Age, educational level, and history of alcohol intake were the major predictors of HIV infection among pregnant women.

After age adjustment using direct method,<sup>19</sup> the adjusted HIV prevalence in our study was significantly lower ( $P < .001$ ) than that reported in 2011 for both the national average (18.6% versus 30.4%) and the HIV prevalence of the 2 districts included in our study (ie, 18.6% versus 28.7% [Gaborone] and 18.6% versus 26.3% [KE-district]).<sup>11</sup> Our result was supported by the marked decline in HIV prevalence observed over the

**Table 2.** Logistic Regression Analysis of HIV Status on Selected Sociodemographic Factors at 10 Health Facilities in Botswana (2017-18).<sup>a</sup>

Covariates	N (%), HIV infected	UOR (95% CI)	P values, AOR (95% CI)
Age group <sup>b</sup>	N = 403		<.001
18-24	10 (9.4)	1 <sup>®</sup>	1 <sup>®</sup>
25-34	24 (12.4)	1.36 (0.63-2.97)	1.63 (0.72-3.69)
35-49	35 (33.7)	4.87 (2.26-10.49) <sup>c</sup>	6.23 (2.73-14.39) <sup>c</sup>
Educational level <sup>b</sup>	N = 403		<.001
Illiterate/elementary	4 (40.0)	7.17 (1.83-28.06) <sup>c</sup>	8.45 (1.83-39.10) <sup>c</sup>
Secondary	49 (23.9)	3.38 (1.85-6.18) <sup>c</sup>	4.09 (2.13-7.88) <sup>c</sup>
Tertiary	16 (8.5)	1 <sup>®</sup>	1 <sup>®</sup>
History of alcohol <sup>b</sup>	N = 405		.009
Yes	19 (30.2)	2.52 (1.36-4.67) <sup>c</sup>	2.59 (1.27-5.28) <sup>c</sup>
No	50 (14.6)	1 <sup>®</sup>	1 <sup>®</sup>
Residence <sup>b</sup>	N = 405		.68
Cities	35 (14.2)	1 <sup>®</sup>	1 <sup>®</sup>
Urban villages	29 (23.4)	0.54 (0.31-0.94) <sup>c</sup>	1.30 (0.69-2.45)
Villages	5 (14.7)	0.96 (0.35-2.64)	0.93 (0.30-2.82)
Gestational age <sup>d</sup>	N = 402		.052
First trimester	2 (10.5)	1 <sup>®</sup>	1 <sup>®</sup>
Second trimester	31 (22.5)	2.46 (0.54-11.25)	2.23 (0.41-12.19)
Third trimester	36 (14.7)	1.46 (0.32-6.61)	1.08 (0.19-5.86)

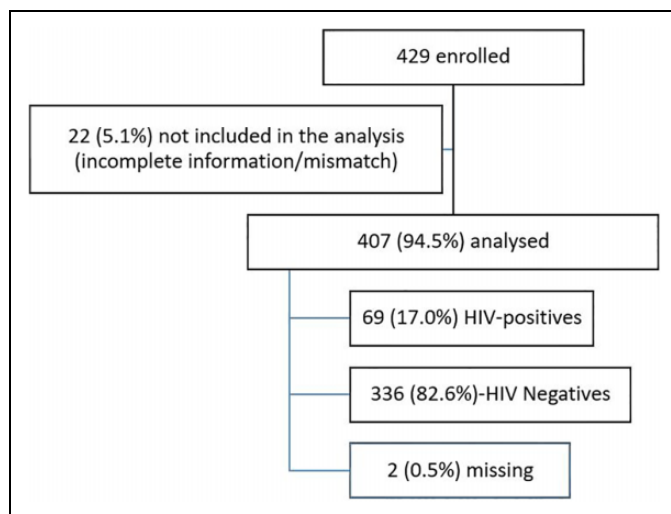
Abbreviations: AOR, adjusted odds ratio; HH, household; <sup>®</sup>, reference group.

<sup>a</sup>N = 407.

<sup>b</sup>Significant in univariate analysis.

<sup>c</sup>Significant at  $\alpha < .05$ .

<sup>d</sup>Borderline significance.

**Figure 1.** The flow diagram showing enrollment and HIV status.

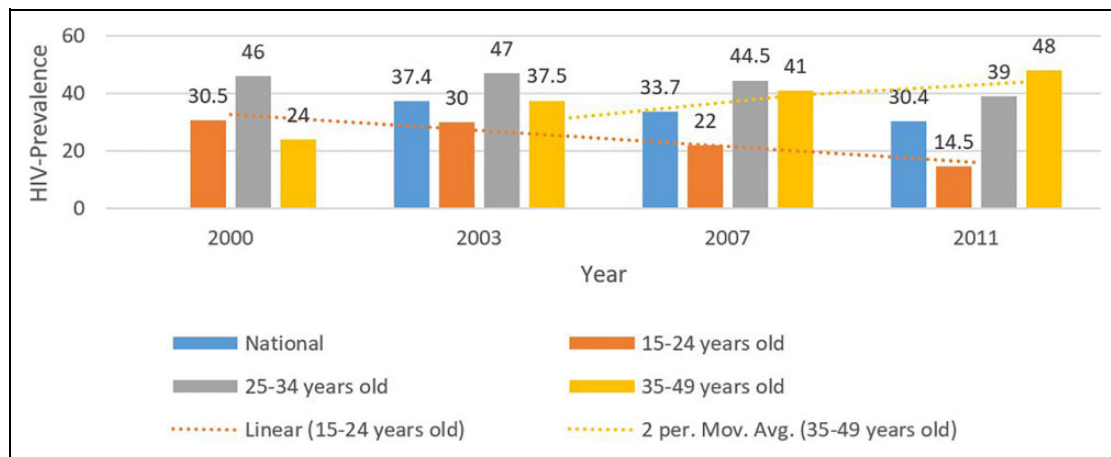
years, particularly among the younger age groups.<sup>11,14</sup> The Millennium Development Goals status report<sup>14</sup> revealed that HIV prevalence in Botswana declined from 37.4% in 2003 to 30.4% in 2011 (Figure 2). However, the adjusted HIV prevalence among pregnant women is higher than that of the general population,<sup>6</sup> implying that they are still at higher risk (Annex-1).

The higher HIV prevalence among older pregnant women was largely attributed to the prolonged survival as a result of ART. Our finding is supported by HIV ASS result in Gambia

that showed higher age was significantly associated with HIV infection,<sup>8</sup> Additionally, it is supported by the national and international HIV progress reports.<sup>1,11,14,20,21</sup> The last Botswana AIDS impact survey (BAIS-IV)<sup>6</sup> revealed a higher HIV prevalence among 35 to 49 years old women compared to 15 to 24 years (44.0% versus 10.0%). Likewise, the findings from 2011 HIV ASS showed a declining HIV prevalence among the younger age groups<sup>11</sup> (Figure 2). The comprehensive multi-faceted HIV prevention and control endeavors by Botswana's Government seem to have contributed to the declining trend of HIV incidence among the younger age groups, particularly the successful and robust PMTCT program may have contributed to this, as more HIV-free younger cohorts are entering into ANC services.

The observed low prevalence among 15 to 24 years old age-group in our study is also supported by 2018 USAID report,<sup>1</sup> which revealed a declining trend of HIV infection in SSA countries since 2010, and the highest decline in new HIV infections was in Eastern and Southern Africa, where there were 30% fewer new infections in 2017 (19.6 million [17.5-22.0]) than was in 2010. The same source indicated that the highest decline was among those aged 15 to 24 years old, and this age-group gives a proxy measure of HIV incidence.

The success noted in Botswana could be related to the fact that Botswana is one of the few countries that progressed well in achieving the 90-90-90-global USAID targets, particularly among pregnant women, and initiation of the treat ALL strategy in 2016.<sup>1,15,22</sup> By 2017, Botswana reached above 80% in diagnosing HIV-positive persons, providing ART and achieving viral suppression in all age groups; while it fulfilled the



**Figure 2.** Trends of HIV prevalence, antenatal care (ANC) sentinel surveillance, Botswana (2000-2011). Source: Botswana Antenatal HIV surveillance report, 2011.

90.0% targets in all the 3 indicators among women above 15 years old. As a result, the proportion of pregnant women who knew their HIV status and accessing ART in Botswana was higher than that reported for Kenya and Mozambique but similar to Lesotho and South Africa.<sup>1,23</sup> Additionally, in our study, all participants knew their HIV status. Nevertheless, BAIS-IV report showed a low level (47.0%) of correct and comprehensive knowledge about HIV among young people aged 15 to 24 years in Botswana, as well as 15.8% and 65.2% having multiple concurrent sexual partners and low level of consistent use of condom with nonregular partner in the general population.<sup>6</sup> This highlights the need to enhance behavioral change interventions to maximize gains documented, particularly among the “windows of hope” that represent those who have not yet been infected with HIV.

Our results also showed that pregnant women who were less educated were disproportionately infected with HIV. Those illiterate and elementary school educated pregnant women had more than 8 times odds of being at risk of HIV infection (AOR = 8.45; 95% CI: 1.8-39.1) compared to those who were tertiary school educated, while secondary school educated pregnant women had more than 4 times odds of being at risk of HIV infection (AOR = 4.01; 95% CI: 2.1-7.8) compared to tertiary school educated. This was supported by the findings of 2011 ASS, which showed that those who have never been to school (35.3%) and primary educated (44.6%) had higher HIV prevalence than those secondary (29.9%) and university (17.0%) educated.<sup>11</sup> Similar findings were reported by Gregson et al<sup>24</sup> who showed HIV prevalence fell steeply from 15.9% (2000) to 8.0% (2003) among young women aged 15 to 24 years old in Eastern Zimbabwe, and the decline was among educated groups. Our study showed that village residents having higher HIV prevalence than those living in cities, though not significant association. This finding was in contrast to the population survey result, which showed cities (19.5%) and towns (21.6%) have higher HIV prevalence than urban villages (18.7%) and rural villages (17.4%).<sup>25</sup> Similar finding was reported by

Sambisa and Stokes<sup>26</sup> that showed that rural residents were more likely to have risky sexual behavior, mainly as a result of inadequate knowledge and access to available services.

We found that alcohol consumption was strongly associated with HIV infection. Pregnant women with a history of alcohol intake had more than 2 times odds of acquiring HIV infection compared with the nondrinkers (AOR = 2.59; 95% CI: 1.27-5.28). This finding is similar to findings of a systematic review of 20 studies in Africa,<sup>7</sup> which indicated that alcohol drinkers are prone to HIV infection than nondrinkers. Another study by Morris<sup>27</sup> in Kenya, Zambia, and Rwanda, as well as the study by Balachova et al<sup>28</sup> from Russia demonstrated similar findings that revealed a strong association of alcohol use and HIV infection. All these studies pointed out the need for proven behavioral change strategies to be in place, in order to maintain the declining trend of new infection among the youngest age groups.

Another interesting finding in our study is that both level of education (>99.0%) and rate of unemployment (36.9%) were higher than that reported for the general population, which were 85.0% and 19.8%, respectively (2013, BAIS-IV report).<sup>6</sup> This paradox necessitates further interrogation, so as to devise a mechanism to improve the employment rate among educated people. A similar finding was reported by Wojcicki,<sup>10</sup> from a systematic review that looked at 36 studies in SSA, of which 30 were cross sectional. The studies used variables measuring educational level, occupation or employment status, and HH income at individual and neighborhood level to ascertain socioeconomic status (SES). Fifteen of these studies found no association, 8 found negative association while 12 found a positive association between women’s SES and HIV infection, and finally concluded that in low-income SSA countries where poverty is widespread, increasing access to resources for women may initially increase risk of HIV or have no effect on risk-taking behavior. These studies suggest that in some parts of Southern Africa where per-capita income is higher and within country inequalities in wealth are greater, increasing



SES may decrease risk of HIV infection. Another case–control study in the HIV clinic of rural tertiary health center in Nigeria indicated that the attainment of secondary-level education and participants monthly income had statistically significant relationship with HIV infection ( $P = .018$  and  $.05$ , respectively).<sup>29</sup> Translating this into Botswana situation, SES seems to have a negative correlation with risk of HIV infection, as our result showed that those government employed (12.3%) were the least infected. Therefore, targeted interventions are critical with emphasis on villages with least educated pregnant women but higher rate of unemployment.

## Study Limitations

We measured the number people in a HH sharing the same roof, but we did not measure the number of people per-room to get the crowding and socioeconomic measures in this study. However, the number of people in a HH still gives an overall view and that was not main objective of the study, so the conclusions we have made will not be affected by this.

In our study, we included all pregnant women irrespective of their gestational age and did not differentiate between those newly diagnosed during the current pregnancy from those previously diagnosed. We recognize that there is a risk of seroconversion for those previously tested HIV negative. However, all pregnant women enrolled for ANC/PMTCT program have to be tested every 3 months, and the chance of seroconversion within 3 months was documented to be less than 1.0% (2017 ANC/MoHW report), ensuring that this level of seroconversion does not have a significant implication on our results and does not affect our conclusions.

Thus, these limitations are minor compared to the significance of the findings, which can be used as evidence to guide policy and programmatic decision.

## Conclusion

The prevalence of HIV among pregnant women is significantly lower than it had been in 2011, but it is still higher than that of the general population.

Age, level of education, and alcohol intake are strong predictors for HIV infection. Therefore, targeted behavioral change interventions are highly recommended with a focus on the young and less educated pregnant women. Particularly, innovative alcohol-related HIV risk reduction programs are highly encouraged among younger age groups, while strengthening existing initiatives among the older age groups.

## Acknowledgements

The authors would like to thank all our clients who participated in this study. Our gratitude also goes to our data collectors, the management of Kweneng East and Gaborone DHMT and participating health facilities staff for their support. The authors would like also to thank Mr Relemogeng Mothata for his proper data management, Mrs Talita Eyman, the procurement officer of Medical Faculty for her unreserved support, Mr Khutsafalo Kadimo and Stella Kube for their technical and administrative assistance.

## Authors' Note

This study was designed by S.G.H. and J.G.T. who participated in all stages of this study from proposal preparation to manuscript writing and reviewing. D.J. participated in proposal preparation and manuscript writing; G.M. participated in data collection and manuscript writing; T.M. participated in manuscript writing and reviewing. While V.S. participated in project management, manuscript writing, and manuscript reviewing. The data underlying this findings is not publicly available in order to maintain confidentiality, but the corresponding authors can share the data once permission from the research team and University of Botswana ORD is secured. A written ethical approval was obtained from University of Botswana office of research and development (REF # UBR/RES/IRB/BIO/006) as well as the Institutional Review Boards of MoH and Wellness/Botswana (REF # HDME 13/18/1 X1 (68)). To protect confidentiality, data were gathered using anonymous coding and kept securely.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The study was financially supported by the UB-office of research and development (ORD) under the 32nd round internal grant. However, the information, content, and conclusion of this study are those of the authors and should not be constructed as the official position or policy of our sponsor.

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