Trends in HIV and AIDS Prevalence in Botswana: Results from Botswana AIDS Impact Survey 2013 (BAIS IV)

***Njoku Ola Ama*[1]**

Abstract

This paper used the results of the three Botswana AIDS Impact Studies (2004, 2008 and 2013) to illustrate the rural-urban and age patterns in HIV and AIDS prevalence in Botswana. The results show higher HIV prevalence in the rural (23.7%) than urban (18.5%) areas and very strong correlation (r = 0.99) in the rural-urban attitudes to HIV testing, circumcision and general attitude towards people living with HIV and AIDS. Furthermore, the results show that there has been a downward trend in HIV prevalence from the 2004 BAIS II, 2008 BAIS III and 2013 BAIS IV for Gaborone, Orapa, Jwaneng and Sowa districts and consistent upward trend in Borolong, Central Mahalapye, Kgalagadi North, Central Boteti, Kweneng East and Kgatleng districts. The effect of HIV and AIDS-related deaths and new infections was more prevalent between 2013 BAIS IV and 2004 BAIS II periods and least between 2008 BAIS III and 2004 BAIS II. The effect among locations is also highest (0.64) between 2013 and 2004, and lowest between 2013 and 2008 BAIS periods. Attitude of the population towards people living with HIV and AIDS is positive. The paper advocates for intensified interventions in the younger age groups as consistent reduction in HIV prevalence in these younger age groups would mean an overall reduction in prevalence over the years.

Keywords: Trend, HIV and AIDS, Prevalence, urban-rural attitudes, interventions

Introduction

Just like other countries in the sub-Saharan Africa region such as Kenya, Uganda, Zimbabwe and Nigeria (Boisson et al 1996; Gregson et al, 1995), Botswana relied on Sentinel surveillances to (i) obtain information on the prevalence of HIV and AIDS in order to monitor trends of HIV/AIDS infection, (ii) provide information for programme planning, monitoring and evaluation and (iii) assess the impact of intervention programmes on the prevalence of HIV and AIDS (UNAIDS/WHO, 2000; Ghys et al, 2006; Swai et al, 2006; Bello, 2006; Fylkesnes et al, 2001; Mahomva et al, 2006; Brown et al, 2008). The main concern in the use of such data in monitoring changes in HIV prevalence is that there could be selection biases which might change over time, and misleading conclusions may be drawn about these trends (Kumogola, 2010; Ghys et al., 2006). Botswana has so far gone beyond the use of sentinel surveillance data to monitor changes in HIV prevalence. The first *Botswana AIDS Impact Survey* (BAIS I), which was population based, was conducted in 2001. So far, four of such surveys have been conducted with each survey improving on the magnitude and methodology, including coverage of the population.

[1] Professor, Department of Statistics, University of Botswana. E-mail: amano@mopipi.ub.bw; njoku52@gmail.com

The BAIS IV, conducted between 21st January 2013 and 24th April 2013, was the fourth survey, and the first national survey to use smart phones for data collection. The information gathered were directly entered into smart phones during field enumeration period and sent to a storage centre through network systems, which enabled data capture directly to data savers. This procedure saved costs and data processing period, resulting in the availability of a preliminary result in seven months compared to the usual one and a half years in the previous surveys (Statistics Botswana, 2013). The survey provided current HIV incidence and prevalence estimates among the population aged six weeks to 64 years, and indicative trends in preventive behaviour among the population aged 10 to 64 years (Statistics Botswana, 2013)

Botswana and the HIV and AIDS situation

Botswana has one of the highest HIV prevalence rates in the world with latest reports from 2013 BAIS IV estimating it to be 18.5% of the general population aged18 months and above (Statistics Botswana, 2013) compared to 17.6% in the 2008 BAIS III. The adjusted incidence rate for the 2013 BAIS IV was 1.35% compared to 1.45% in 2008 BAIS III. This current HIV prevalence for Botswana translates to 378,464 HIV positive persons out of an estimated population of 2,045,752 (Statistics Botswana, 2013). The HIV prevalence rate shows gender disparity with more females (20.8%) compared to males (15.6%) being HIV positive. HIV prevalence also varies by location. About 19.2% of urban population (Cities, Towns and Urban villages) compared to 17.4% of the population in rural areas are HIV positive (Statistics Botswana, 2013; Schaan et al. 2012).

Sub-Saharan Africa's HIV and AIDS situation

Sub-Saharan Africa has the most serious HIV and AIDS epidemic in the world (UNAIDS, 2014a). In 2013, an estimated 24.7 million people were living with HIV, accounting for 71% of the global total. In the same year, there were an estimated 1.5 million new HIV infections and 1.1 million AIDS-related deaths (UNAIDS, 2014a; AVERT, 2015). HIV prevalence for the region is 4.7%, but varies greatly between regions within sub-Saharan Africa as well as individual countries. For example, Southern Africa is the worst affected region and is widely regarded as the 'epicentre' of the global HIV epidemic (Op cit). Swaziland has the highest HIV prevalence of any country worldwide (27.4%) while South Africa has the largest epidemic of any country with 5.9 million people living with HIV. By comparison, HIV prevalence in west and east Africa is low to moderate, ranging from 0.5% in Senegal to 6% in Kenya (Op cit).

There has been a decline by 43% in new HIV infections among children in sub-Saharan Africa since 2009, from 350,000 to 200,000 in 2013. The decline, however varies from one country to another (UNAIDS, 2014a; AVERT, 2015). In the period 2009 to 2013, new HIV infections among children in Malawi declined by 67% and by over 50% in Botswana, Ethiopia, Ghana, Mozambique, Namibia, South Africa and Zimbabwe. Nigeria, however, only achieved a 19% decline in new infections, and accounted for a quarter of new HIV infections among children in Global Plan priority countries in 2013 (51,000 cases) (UNAIDS, 2014a). In Mozambique, HIV prevalence is 7% among 15-19 year olds but rises to 15% for 25 years old. Likewise, in Lesotho, HIV prevalence rises from 4% among 15-19 year olds to 24% among 20-24 year olds (UNAIDS, 2014b). A review of 45 studies across sub-Saharan Africa found that relationships between young women and older men are common, and are associated with

unsafe sexual behaviour and low condom use, which heightens their risk of HIV infection (Leclerc-Madlala, 2008).

Of the 3.2 million children living with HIV around the world at the end of 2013, 91% of them reside in sub-Saharan Africa. In the same year only 24% of children who needed antiretroviral treatment (ART) received it, and 190,000 children died of AIDS-related illnesses (UNAIDS, 2014a). Regular HIV testing, treatment, monitoring and care for children living with HIV have been recommended as a factor that would enable them to live long and fulfilling lives. However, lack of necessary investment and resources for adequate testing, paediatric antiretroviral drugs (ARVs) and prevention programmes mean that children continue to suffer the consequences of the epidemic.

Conceptual framework

The conceptual framework for this paper is derived from HIV behavioural surveillance (Lansky et al 2007) which includes four major "sentinel events" in the life cycle of HIV infection, and four corresponding behavioural components. Behavioural surveillance has been defined by Lansky et al. (2007) as the systematic and ongoing collection of data about risk and health-related behaviours for correlating trends in behaviours with changes in disease over time. Behavioural data provide a tool to monitor short-term changes in epidemics without having to wait for changes in disease outcomes (Pisani et al. 1998). The sentinel events are: exposure to HIV, infection with HIV, development of clinical disease (morbidity), and death (mortality). The four corresponding behaviours are: risk behaviours, HIV testing, access to care, and acceptance of and adherence to therapy for HIV infection (Table 1).

Table 1: Sentinel surveillance events, behaviours, and populations that comprise HIV behavioural surveillance

Sentinel event	Sentinel behaviour	Sentinel Population
Exposure	Risky behaviours	
	Acquisition	General, high risk, infected
	Transmission	Infected
Diagnosis of HIV Infection	HIV Testing	General, high risk, infected
Morbidity (AIDS)	Access to care; adherence	Infected
Mortality	Access to care; adherence	Infected

Source: Lansky A, Sullivan PS, Gallagher KM, Fleming PL. (2007)

Exposure to HIV

HIV testing is a key part of HIV prevention activities, as it is required to diagnose an HIV infection. Based on the results of HIV testing, serostatus-specific interventions can be delivered as appropriate to reduce acquisition and transmission of the virus.
To monitor the epidemic, it is important to know why, when and where people test or, conversely, why individuals do not seek an HIV test or refuse one if it is offered (Janssen et al. 2001).

Access to care and adherence to treatment

There are certain critical behaviours that relate to treatment of HIV infection and they include access to and seeking care, accepting recommended therapy, and adhering to prescribed therapy. With the advent of highly active antiretroviral therapy (HAART), early treatment of HIV-infected individuals and adherence to their medication regimens are very important. The benefits of treatment can occur at the individual level through reduced viral load, which slows down disease progression, and at the population level, where increasing the proportion of positive individuals with low viral load will reduce mortality and may reduce rates of transmission (Wawer et al., 2005; Gray et al., 2001). Understanding patterns of acceptance of and adherence to therapy provides a context in which to interpret trends in new AIDS diagnoses and AIDS-related deaths.

Populations at risk

The behavioural surveillance identifies the populations in which to monitor these behaviours; namely, general, high-risk, and infected populations. Data collected from the general population can be used to determine whether the epidemic is likely to become more generalized (similar to African countries) or remain concentrated in certain high-risk groups (as in the United States). These changes are best monitored through representative sampling of the general population to measure risk behaviours and HIV-testing behaviours (Holtzmann et al. 2001; CDC (US), 2004) Behavioural surveillance must also include the collection of data from infected populations and populations at increased risk for infection; namely, men that have sex with men (MSM), injecting drug users (IDUs), and high risk heterosexuals who engage in risky behaviours or have HIV-infected partners (HET). Behavioural surveillance data from these high-risk groups provide information from those likely to have the biggest impact on the epidemic's future course (Mils et al. 2004). In this group, it is necessary to monitor acquisition risk behaviours and HIV testing.

Behavioural data can be used for evaluating the representativeness of case surveillance systems. For example, data collected through behavioural surveillance can be compared to HIV case surveillance systems, which include only people who present for HIV testing. Behavioural surveillance data are also extremely useful for developing and delivering prevention programmes, identifying demographic characteristics of those at high risk, and what behaviours put them at risk so that prevention efforts can be targeted toward specific groups and their behaviours. Although the sex and drug-use behaviours that are associated with the risk of HIV infection are well known, that information alone is not enough to efficiently target prevention efforts. Understanding the reasons for lack of acceptance of therapy or non-adherence may help

identify strategies for improved secondary prevention services for those living with HIV infection (i.e., to prevent the progression of HIV to AIDS).

Trends in HIV prevalence in Botswana

The trends in HIV prevalence and incidence are indicators of the changes that have taken place with regards to interventions to curb or halt new infections of HIV and improve the life of those affected by the epidemic. In order to plan for the scale of future problems, and to evaluate the effectiveness of current national strategies that curb the spread of infection, it is important to understand the trend of existing data on HIV prevalence and incidence. A proper interpretation of the trend is also necessary. For instance, UNAIDS (1999; p.3) states that, "The dynamics of an epidemic mean that a reduction in the prevalence or incidence rates is not necessarily a consequence of reduced risk amongst a population. When reductions in the prevalence/incidence of HIV are observed at the population level, a number of questions arise: (i) Are the observed changes valid in a statistical sense? (ii) Are the observed changes a reflection of the natural progression of the epidemic? (iii) Are the observed changes a product of changes in behaviour? (iv) Are the observed changes a product of interventions?" The authors (UNAIDS, 1999) noted that the prevalence of HIV in a particular population will not grow indefinitely. It will saturate at some level. From the initial spread of HIV, there is a likelihood of a fall in the incidence of infection followed in turn by a resultant reduction in prevalence (UNAIDS, 1999).

In November 2004, the Joint United Nations Programme on AIDS (UNAIDS) Reference Group on Estimates, Modelling and Projections organised a meeting on ''Evidence and causes of declines in HIV prevalence and incidence in countries with generalised epidemics'' in Harare, Zimbabwe, where new data and analyses were presented. The issue of the decline of HIV prevalence raised questions about whether the HIV prevalence declines are really genuine or the result of measurement bias. If they are real, there are additional questions regarding whether the declines in the prevalence rate are a result of a decline in incidence rates or whether they are due to rising mortality rates overtaking the rate of new infections (Ghys et al, 2006; Boerma et al. 2003).

The analyses in this paper will be interrogated along the four UNAIDS (1999) questions raised in the 2004 UNAIDS meeting in Zimbabwe and the components of HIV behavioural surveillance.

Objectives of this paper

This paper provides further insights into the data collected from the study BAIS 2013 by examining the trend in rural-urban HIV prevalence. Using information from the 2004, 2008 and 2013 BAIS IV results, the paper further examines trends in HIV prevalence by age, and location (rural versus urban); and in attitudes towards people living with HIV and AIDS (PLWHA), HIV testing and circumcision.

Methodology

The fourth *Botswana AIDS Impact Survey* (BAIS IV) was a national two stage sample survey design. The first stage was the selection of EAs as Primary Sampling Units (PSUs) selected with probability proportional to measures of size (PPS), where measures of size (MOS) were the number of households in the EA as defined by the 2011 *Population and Housing Census*. In all 459 EAs were selected with probability proportional to size. At the second stage of sampling, the households were systematically selected from fresh list of occupied households prepared at the beginning of the survey's fieldwork (i.e. listing of households for the selected EAs). Overall 8,275 households were drawn systematically. Data collection started on the 21st January 2013 and was completed on 24th April 2013 using smart phone tablets instead of the conventional paper based method. Two sets of questionnaires (households and individual) were completed by sampled households (Statistics Botswana, 2013).

Dried Blood Spot specimens for ages over 18 months were screened for HIV antibodies in a parallel testing algorithm using commercial ELISA test kits – Vironostika-HIV Uni-Form II plus O (OrganonTeknika, Boxtel, The Netherlands) and Murex (Abbott, Wiesbaden, Germany) as per Botswana National Policy on HIV Testing. Any specimen that was reactive on parallel ELISA testing was considered HIV antibody positive, and was diagnostic for HIV infection, whereas any specimen that was not reactive on parallel ELISA testing was HIV antibody negative. Dry blood specimens less than 18 months were tested for HIV virus/antigen using DNA PCR Roche technology. Any sample that was reactive was repeated and if reactive twice then it was diagnosed as HIV positive. Samples that were non-reactive were diagnosed as HIV negative (Op cit).

The results of the 2013 BAIS IV are weighted and represent population values. Caution will, therefore, be taken to avoid statistical inference in the form of test of hypotheses. Descriptive statistics, namely, percentages, means, differences in proportions and graphical representations are used in the analyses.

Results

The characteristics of the population are shown in Table 2. The results show that 62.1 % of the population were from urban locations (Cities/Town, Urban Villages) while 37.9% were from rural areas. The greatest proportion of the population (14.2%) were of age 20-24 years while 13.4%, 13.2% and 13%, 22.6% were of ages 10-14, 25-29 15-19 and 30-49 years, respectively. The population aged 50 years and above make up 12.7%.

The majority of the population (56.9%) were never married, while 19.2%, 18.5% were living together and married, respectively. The rest were separated (0.4%), divorced (1.2%) and widowed (3.8%). A slim majority of the population (51.9%) were females while the rest (48.1%) were males. Educationally, the majority (83.2%) had general education, while 5.9% and 5.1% had diploma, certificate and degree, respectively. Only 0.7% had a postgraduate qualification and PhD.

Table 2: Characteristics of the study population

Characteristic of the population		Count	%
Type of locality	Urban	1270362	62.1
	Rural	775390	37.9
Age in completed years	10-14	148581	13.4
	15-19	144140	13.0
	20-24	158063	14.2
	25-29	146581	13.2
	30-34	120865	10.9
	35-39	99826	9.0
	40-44	85452	7.7
	45-49	65573	5.9
	50-54	57567	5.2
	55-59	51813	4.7
	60-64	30792	2.8
Marital Status	Married	261213	18.5
	Never married	804198	56.9
	Living together	270807	19.2
	Separated	5605	0.4
	Divorced	16828	1.2
	Widowed	53868	3.8
Sex	Male	926356	48.1
	Female	1001084	51.9
What is the highest level that respondent is currently doing?	General	1265334	83.2
	Certificate	77037	5.1
	Diploma	89549	5.9
	Degree	77786	5.1
	Post Graduate	7607	0.5
	PhD	3156	0.2

Attitude of the people to HIV testing

The results in Table 3 reveal the attitude of the population to HIV testing. Sixty-nine percent of people from the rural and 70.8% of those from the urban areas who responded had tested for HIV while 31% from rural and 29.2% from urban had not tested for HIV. Among those who had been tested for HIV, the main reason was inquisitiveness (just to know their status) (67.5% from the rural and 66.1% from the urban). Others, (14.5% from rural, 10.2% urban), (12.4%, rural, 16.7%, urban), (1.9%, rural, 1.9%, urban) and (1.4%, rural, 1.8%, urban), had tested because of illness, pregnancy, encouragement by someone or had had unprotected sex, respectively.

Among those who had not been tested, half of them (50.3%) from the rural and 45% from the urban areas felt there was no need to be tested. Others, were afraid of the outcome (21.7%, rural and 23.2% from urban), feared the reaction of their partners (0.4%, rural and 0.4%, urban) or could not actually specify their reasons (27.6%, rural and 31.3%, urban). In the 12 months prior to the time of the survey, 34.9% of the rural population and 35.5%, 34.7% of the urban population had tested zero times and once, respectively, while (16.5%, rural, 16.65, urban), (10.2%, rural, 7.5%, urban), (2.5%, rural, 2.2%,urban) and (1%, rural and 0.8%, urban), respectively had tested 2, 3, 4, and 5 times.

The main testing facilities were the hospitals/clinics (73.8%, rural, 62.1%, urban), followed by Voluntary Counselling and Testing centres (16.8%, rural, 31.3%, urban), mobile clinics (7.6%, rural, 3.2%, urban), and field worker (1.8%, rural and 3.2%, urban). An overwhelming majority of the people (95.3%, rural and 96.8%, urban) were given or told their results. Of those who were tested in the last 12 months prior to the survey and were told or given their results, 23.7% from rural and 18.5% from urban areas were HIV positive. Only 72.1% (40,040 out of 55,530) from the rural and 79.9% (68406 out of 85, 608) from the urban are currently on ARVs. A high percentage of HIV positive people (85.6% from rural and 88.1% of the urban) said they informed other people of the result of the test while 14.4% reported that they kept the results to themselves.

Table 3: Attitudes of the people towards HIV testing

Questions asked		Type of locality			
		Urban		Rural	
		Count	%	Count	%
Have you ever been tested for HIV, the virus that causes AIDS?	Yes	493380	70.8	252661	69.0
	No	203854	29.2	113463	31.0
What was the main reason for testing?	Illness	29378	10.2	20963	14.5
	Pregnancy	48180	16.7	17840	12.4
	Wanted To Have A Child	4536	1.6	1265	0.9
	Had Unprotected Sex	5343	1.8	2083	1.4
	Rape	309	0.1	28	0.0
	Pre-Marital/ New Partner	83	0	1200	0.8
	Just Wanted To Know	190898	66.1	97294	67.5
	Needle Prick	261	0.1	35	0.0
	Encouraged By Someone	5396	1.9	2750	1.9
	Pre-Employment/ Scholarship Requirements	3206	1.1	220	0.2
	Don't Know	1302	0.5	508	0.4
Why haven't you tested?	Afraid/Scared	47370	23.2	24628	21.7
	Feared Reaction Of Partner	883	0.4	425	0.4
	No Need	91728	45.0	57065	50.3
	Other, Specify	63873	31.3	31344	27.6
In the past 12 months how many times have you been tested?	0	162179	35.5	84112	34.9
	1	171125	37.4	84204	34.9
	2	75993	16.6	39822	16.5
	3	34212	7.5	24558	10.2

	4	10034	2.2	6141	2.5
	5	3765	0.8	2375	1.0
Where did you go for your last test?	VCT Centre (Tebelopele/Bocaip)	154258	31.3	42440	16.8
	Hospital/Clinic	306523	62.1	186426	73.8
	Mobile Clinic	15545	3.2	19136	7.6
	Field Worker	15992	3.2	4427	1.8
	Other, Specify	1062	0.2	232	0.1
Were you told/given your results for your last HIV test?	Yes	477401	96.8	240782	95.3
	No	15979	3.2	11879	4.7
What was the result (answer if you don't mind)?	Positive	85608	18.5	55530	23.7
	Negative	376909	81.5	178944	76.3
Are you currently taking ARVs to treat your infection?	Yes	68406	79.9	40040	72.1
	No	17202	20.1	15489	27.9
Did you tell anyone the result of the test?	Yes	418912	88.1	204223	85.6
	No	56617	11.9	34234	14.4

Attitudes towards People Living with HIV and AIDS (PLWHA)

The people expressed their views on discrimination, stigmatisation against and support for PLWHA. The results are shown in Table 4. An overwhelming percentage of the urban (96.4%) and rural (94.4%) population were willing to care for HIV infected relatives in their homes. More of the urban population (81.1%) than the rural population (77.3%) can allow a housekeeper/nanny or anybody who is HIV positive but is not sick to keep looking after their child, or to continue working or assisting with baby sitting in their houses.

The population was also very positive in agreeing to allow a teacher who is HIV positive but is not sick to continue teaching in school (92.8% of urban, 88.1% of rural). On whether they can buy food or vegetables from a shopkeeper or food seller who had HIV or AIDS, 85.1% of the urban dwellers and 79.2% of the rural dwellers were in the affirmative.

On keeping the HIV status of their relatives secret, over half of the urban dwellers (52%) and (54.1%) of the rural dwellers indicated 'No'. There are still a high proportion of the people who would maintain the HIV status of their relative a secret (48%, urban and 45.9%, rural). There is a very strong correlation ($r = 0.9948$) between the rural-urban attitudes to PLHIV.

The 2008 BAIS III reported similar results with respect to attitudes of the population towards people living with HIV with 94.6% being willing to care for HIV infected relatives in their homes; 84.7% would allow a teacher who has HIV but is not sick, to continue teaching in school; 76.3% can buy food or vegetables from a shopkeeper or food seller who had HIV or AIDS; and 60% will keep the HIV status of their relatives secret (CSO, 2009).

Table 4: Rural-urban attitudes towards PLHIV

		Type of locality			
		Urban		Rural	
		Number	%	Number	%
If a member of your family became sick with HIV/AIDS would you be willing to care for him or her in your household?	YES	672383	96.4	345732	94.4
	NO	24851	3.6	20392	5.6
If your housekeeper/ Nanny or anybody looking after your child has HIV but is not sick, would you allow him or her to continue working or assisting with baby sitting in your house?	YES	565323	81.1	283153	77.3
	NO	131910	18.9	82971	22.7
If a teacher has HIV but is not sick, should s/he be allowed to continue teaching in school?	YES	647197	92.8	322580	88.1
	NO	50037	7.2	43543	11.9
If you knew that a shopkeeper or food seller had HIV or AIDS, would you buy vegetables from them?	YES	593447	85.1	289926	79.2
	NO	103786	14.9	76197	20.8
If a member of your family got infected with HIV, would you want it to remain secret?	YES	334976	48.0	167994	45.9
	NO	362257	52.0	198130	54.1

General attitudes to circumcision

Circumcision has been pursued as a measure to curb or reduce HIV infection, yet not many of the concerned men are receiving the intervention. The results of the responses to questions posed to men on issues of circumcision are shown in Table 5. The table shows that only 26.6% of the urban and 20.4% of the rural men have been circumcised. The circumcision took place mainly at Government health facilities (71.9% of urban males, 61.4% of the rural males). Other places were Traditional centres (10.6% of the urban and 24.2% of the rural), private health facility (12.8% of urban males and 10% of rural males). Complications were rare, as only 7.2% of the urban males and 9.7% of the rural males reported some complications.

Table 5: Attitudes to circumcision

Circumcision		Type of locality			
		Urban		Rural	
		Number	%	Number	%
Are you circumcised?	Yes	83572	26.6	38043	20.4
	No	228563	72.7	146866	78.8
	Don't Know	2205	0.7	1489	0.8
Where were you circumcised?	Government Health Facility	60123	71.9	23342	61.4
	Private Health Facility	10695	12.8	3802	10.0
	Traditional	8848	10.6	9214	24.2
	Don't Know	3907	4.7	1684	4.4
Did you have complications during or after circumcision?	Yes	6018	7.2	3680	9.7
	No	67626	80.9	29580	77.8
	Don't Know	9928	11.9	4783	12.6

Do you intend to get circumcised in the next 12 months	Yes	118601	51.4	69689	47.0
	No	90569	39.2	64128	43.2
	Don't Know	21598	9.4	14538	9.8

On the question of intention to be circumcised in the next 12 months after the survey period, a little over half of the urban males (51.4%) and 47% of the rural males were in the affirmative. There is a very strong correlation (r = 0.9923) between the rural-urban attitude to circumcision. The 2008 BAIS III revealed that 11.8% of those aged 10-64 years were circumcised with 16% of those from urban and 8.8% from rural areas circumcised (CSO, 2009).

Trend in HIV prevalence among different ages in 2004, 2008 and 2013

Figure 1 shows a plot of the HIV prevalence rate by age groups from the 2004, 2008 and 2013 BAIS. The figure shows that in the 2004 BAIS, the age groups that had the highest prevalence rates were 25-29 (33%), 30-34 (40.2%) and 35-39 (35.9%). By the 2008 BAIS, these same age groups would have moved to the age groups (30-34), (35-39) and (40-44), which turned out to be age groups with the highest prevalence of 39.7%, 40.5% and 40.6%, respectively. This same cohort were the most affected by 2013 when their ages would be 35-39, 40-44 and 45-49 with prevalence rates of 43.8%, 41.6% and 42.2%, respectively. Thus, there is an upward trend in the HIV prevalence of these cohorts.

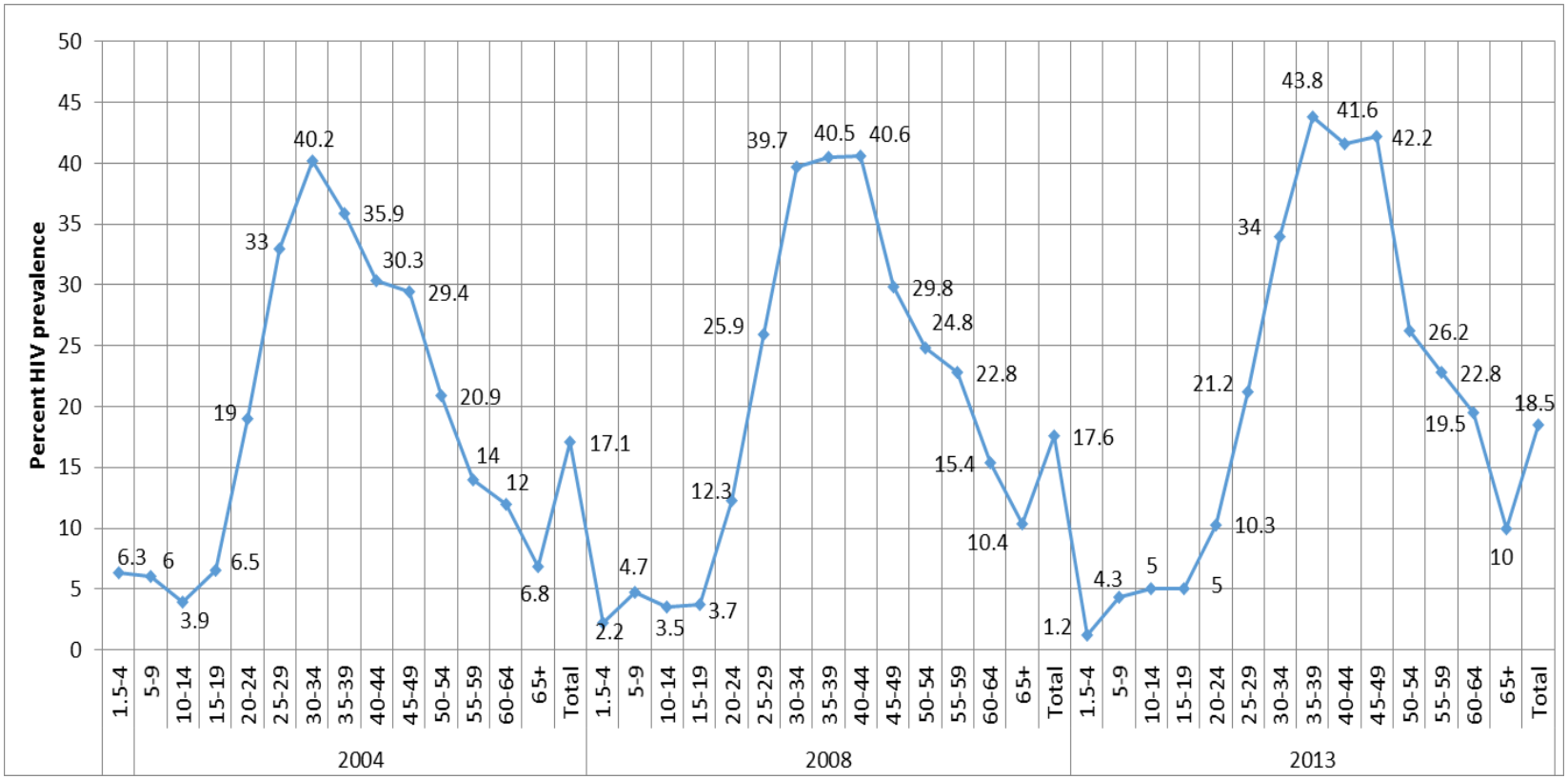

Figure 1: HIV prevalence for 2004, 2008 and 2013 by age

Rural-Urban age category trends in HIV prevalence in 2013 BAIS

Figure 2 shows significant differences in HIV prevalence rates between the urban and rural locations in the 2013 BAIS, with the rural locations showing higher prevalence rates than urban populations, across all ages except for the age groups (40-44) (-0.2%) and (50-54) (-0.6%). The highest differences of 12% and 10.3% in the rural-urban prevalence rates are within the youngest age cohorts (10-14) and oldest age cohorts (60-64) years. The higher rural HIV prevalence in is an indicator that interventions to curb HIV prevalence should focus more on the rural areas.

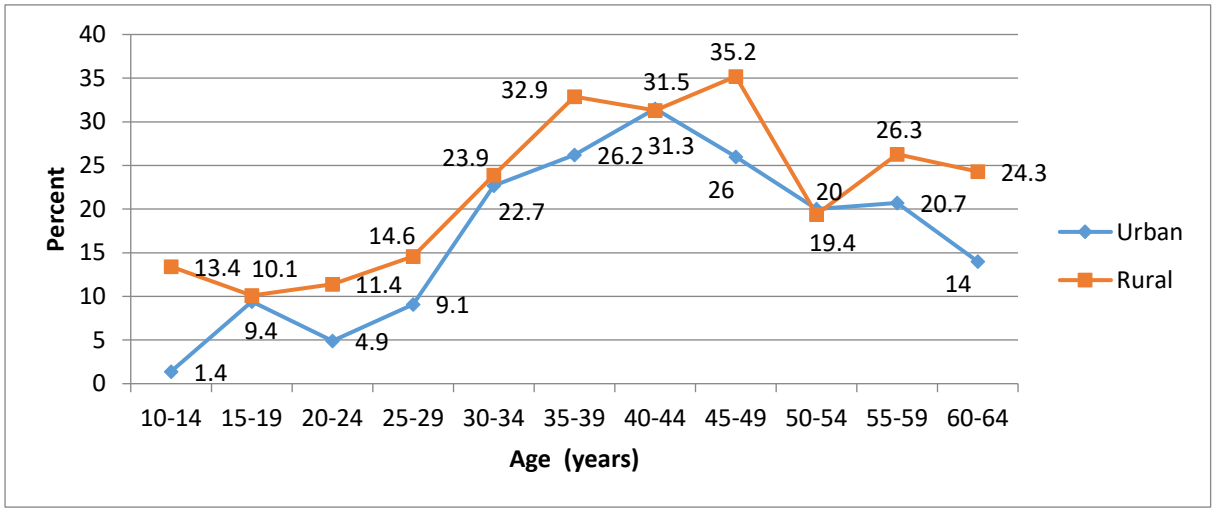

Figure 2: HIV Prevalence (2013 BAIS) by Age and locality

Age effect of HIV and AIDS-related deaths and new infections

Estimating HIV incidence by comparing prevalence data in two cross-sectional prevalence surveys, Hallet et al. (2008) have shown that the difference in prevalence rates between the two surveys is equal to effect of HIV and AIDS-related deaths and new infections occurring during the inter-survey interval (Rehle et al. 2010).

Table 6 shows the HIV prevalence rates in the 2004, 2008 and 2013 BAIS and the differences in D1: the prevalence rate in 2013 minus the prevalence rate in 2004; D2: the prevalence rate in 2013 minus the prevalence rate in 2008; and D3: the prevalence rate in 2008 minus prevalence rate in 2004. A negative value shows that the prevalence rate was higher in the earlier year than in the later year while a positive difference shows that HIV prevalence was higher in the later hear than in the earlier year.

The results indicate that while the HIV prevalence rates are decreasing within the age groups 1.5-4, and those aged 30-34 in all the BAIS periods, the prevalence rate has been increasing for the older age groups 35-39 and those aged 60-64. One expectation is that because of the numerous interventions that have been put in place, HIV prevalence rates between 2004 and 2013 should have been on the decrease, but this does not seem to be the case for the age groups 35 years and above. The table also shows a significant reduction in the HIV incidence cases during the study periods. The figures reported for the age group 1.5-4 in 2008 and 2013,

respectively, are actually incidence cases as this age group would have moved to 5-9 in 2008 and 10-14 in 2013, respectively.

The results of the analysis BAIS studies by age show that the effect of HIV and AIDS-related deaths and new infections is more prevalent between 2013 BAIS IV and 2004 BAIS II data (D1) and least between 2008 BAIS III and 2004 BAIS II data (D3) with greatest effect in the age range 40-59 years. The mean effects are 1.64 for 2013 and 2004, 0.77 for 2013 and 2008 and 0.86 for 2008 and 2004.

Table 6: HIV prevalence and differences in HIV prevalence rates (%) over the years 2004, 2008 and 2013 by age

Age	2004	2008	2013	D1	D2	D3
1.5-4	6.3	2.2	1.2	-5.1	-1.0	-4.1
5-9	6.0	4.7	4.3	-1.7	-0.4	-1.3
10-14	3.9	3.5	5.0	1.1	1.5	-0.4
15-19	6.5	3.7	5.0	-1.5	1.3	-2.8
20-24	19.0	12.3	10.3	-8.7	-2.0	-6.7
25-29	33.0	25.9	21.2	-11.8	-4.7	-7.1
30-34	40.2	39.7	34.0	-6.2	-5.7	-0.5
35-39	35.9	40.5	43.8	7.9	3.3	4.6
40-44	30.3	40.6	41.6	11.3	1.0	10.3
45-49	29.4	29.8	42.2	12.8	12.4	0.4
50-54	20.9	24.8	26.2	5.3	1.4	3.9
55-59	14.0	22.8	22.8	8.8	0.0	8.8
60-64	12.0	15.4	19.5	7.5	4.1	3.4
65+	6.8	10.4	10.0	3.2	-0.4	3.6
Total	17.1	17.6	18.5	1.4	0.9	0.5

D1: the prevalence rate in 2013 minus the prevalence rate in 2004; D2: the prevalence rate in 2013 minus the prevalence rate in 2008, and D3: the prevalence rate in 2008 minus prevalence rate in 2004; positive value shows an increase while–negative value shows a decrease in HIV prevalence rate.

Location effect of HIV and AIDS-related deaths and new infections

Table 7 shows the HIV prevalence rates during the BAIS 2004, 2008 and 2013 together with the differences in the prevalence rates classified by location of study. The first seven rows represent the cities/towns, followed by the urban villages and the rural areas (submerged in the urban villages). Between the study periods 2004 and 2008 (F1), HIV prevalence rates decreased in the cities/towns except for the Selibe Phikwe where there was an increase. HIV prevalence rates decreased between 2008 and 2013 in Gaborone (-0.1), Orapa (-1.1), Jwaneng (-2.9) and Sowa (-5.6) while the prevalence rate increased in Francistown, Lobatse and Selibe Phikwe. Remarkable increases in HIV prevalence rates between the same study periods were found in Barolong (6.4), Central Mahalapye (6.0), Kgalagadi North (6.3), Central Boteti (5.7), Kweneng East (4.8) and Kgatleng (4.1). When the 2013 BAIS HIV prevalence rates are compared with those of BAIS 2004, the results (F3) show that except for the Selibe Phikwe, all the cities/towns

showed a decrease in HIV prevalence rates while the highest increases were seen in Kweneng East (6.3), Barolong (6.1), Kgatleng (5.2), Central Mahalapye (5.2) and Central Boteti (4.2) (see Table 7).

When the trend in HIV prevalence is compared among locations, the effect of HIV and AIDS-related deaths and new infections are most prominent in villages/rural areas and least in the cities/towns. The mean effect among locations is also highest (0.64) between 2013 and 2004 (F3), followed by mean effect of 0.34 between 2008 and 2004 (F1) and 0.296 between 2013 and 2008 BAIS data (F2).

Table 7: HIV prevalence and differences in HIV prevalence rates (%) over the years 2004, 2008 and 2013 by districts

	HIV Prevalence rates by districts					
District	**2004**	**2008**	**2013**	F1	F2	F3
1.Gaborone	18.3	17.1	17.0	-1.2	-0.1	-1.3
2. Francistown	24.6	23.1	24.3	-1.5	1.2	-0.3
3. Lobatse	17.8	16.3	17.2	-1.5	0.9	-0.6
4. Selibe-Phikwe	23.3	26.5	27.5	3.2	1.0	4.2
5. Orapa	18.2	16.7	15.6	-1.5	-1.1	-2.6
6.Jwaneng	19.0	15.7	12.8	-3.3	-2.9	-6.2
7. Sowa	18.8	25.4	19.8	6.6	-5.6	1.0
8. Southern	12.4	13.3	11.8	0.9	-1.5	-0.6
9. Barolong	14.2	13.9	20.3	-0.3	6.4	6.1
10. Ngwaketse West	16.0	16.1	18.8	0.1	2.7	2.8
11. South East	14.2	12.6	16.6	-1.6	4.0	2.4
12. Kweneng East	15.2	16.7	21.5	1.5	4.8	6.3
13. Kweneng West	10.8	10.3	11.8	-0.5	1.5	1.0
14. Kgatleng	14.7	15.8	19.9	1.1	4.1	5.2
15. Central Serowe	18.2	20.0	17.1	1.8	-2.9	-1.1
16. Central Mahalapye	17.9	17.1	23.1	-0.8	6.0	5.2
17. Central Bobonong	18.2	18.9	19.3	0.7	0.4	1.1
18. Central Boteti	16.0	14.6	20.3	-1.4	5.7	4.3
19. Central Tutume	18.9	20.0	18.2	1.1	-1.8	-0.7
20. North East	18.1	21.8	17.7	3.7	-4.1	-0.4
21. Ngamiland South	16.6	19.8	15.2	3.2	-4.6	-1.4
22. Ngamiland North	13.3	16.5	13.5	3.2	-3.0	0.2
23. Chobe	29.4	23.0	17.7	-6.4	-5.3	-11.7
24. Ghanzi	15.6	13.5	17.1	-2.1	3.6	1.5
25. Kgalagadi South	11.8	19.1	11.1	7.3	-8.0	-0.7
26. Kgalagadi North	15.2	11.8	18.1	-3.4	6.3	2.9
27. Total	17.1	17.6	18.5	0.5	0.9	1.4

F1: Prevalence Rate in 2008-Prevalence Rate in 2004; F2: Prevalence Rate in 2013-Prevalence Rate in 2008; F3: Prevalence Rate in 20013-Prevalence Rate in 2004; positive value shows an increase while –negative value shows a decrease in HIV prevalence.

Figure 3 shows that in 2004, Chobe (29.4%) had the highest HIV prevalence rate followed by Francistown (24.6%) and Selibe Phikwe (23.3%). In the 2008 BAIS, the highest prevalence was from Selibe Phikwe (26.5%) followed by Sowa (25.5%), Francistown (23.1%) and Chobe (23%). In 2013 BAIS, the highest prevalence was Selibe Phikwe (27.5%) followed by Francistown (24.3%) and Central Mahalapye (23.1%).

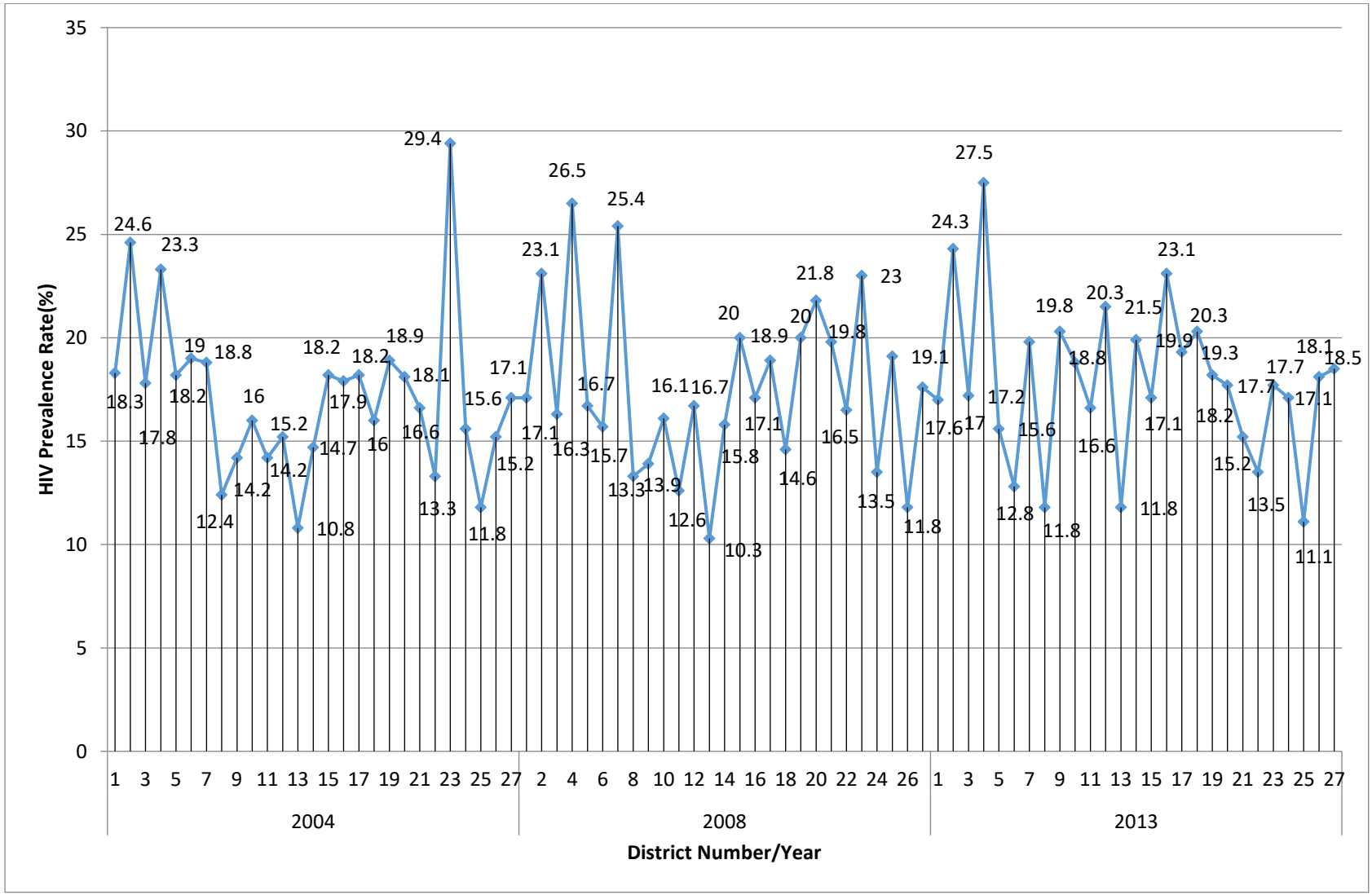

Figure 3: HIV prevalence by districts over the 2004, 2008 and 2013 BAIS (the numbers reflect the district locations in Table 2)

Discussion of results

The objectives of this paper were to use information from the 2004, 2008 and 2013 BAIS IV results to examine trends in HIV prevalence rates by age, and location, as well as to gauge of the rural and urban people's attitudes towards HIV, towards people living with HIV and AIDS (PLWHA), HIV testing and circumcision.

The results show that the age groups (25-29), (30-34) and (35-39) were the most affected age groups in 2004 with HIV prevalence rates of 33%, 40.2% and 35.9%, respectively; in 2008, the age groups with highest HIV prevalence rates were (30-34), (35-39) and (40-44) with prevalence rates of 39.7%, 40.5% and 40.6%, respectively, while in 2013, those in age groups 35-39, 40-44 and 45-49 were the most affected with HIV prevalence rates of 43.8%, 41.6% and 42.2%, respectively. There is, therefore, an upward trend in the HIV prevalence rates among these cohorts. The increasing trends in HIV prevalence is indicative of more new infections within the cohorts, showing that prevention messages may not have been effective in helping people to change their attitude and behaviour towards sexual activities and sexual orientations. The ARV, on the other hand, may have been effective in preventing many people from dying. Although AVERT (2013) reports that new HIV infections in Botswana have decreased significantly from 15,000 in 2005 to 9,100 in 2013 and AIDS-related deaths have dramatically reduced from 14,000 in 2005 to 5,800 in 2013. The incidence rates within these cohorts are likely to have increased. Thirumurthy et al., (2008, 2012) and McLaren (2010) indicated that ARV clearly benefits HIV-positive recipients and their caretakers but the availability of treatment reduces health risk for HIV-negative people by lowering the probabilities of both infection and mortality conditional on infection. Lakdawalla et al. (2014) call this benefit, which is not well-documented empirically, the insurance value of medical innovation. Furthermore, results show that while the HIV prevalence are decreasing within the age groups 1.5-4 to those of 30-34 in all the BAIS periods, the prevalence has been increasing for the older age groups 35-39 to those aged 60-64. These results are in line with Abah (2014), who showed that a decline in national HIV prevalence in Nigeria in the age group 15-24 years. Thus, the indicated decline in prevalence and deaths due to AIDS (AVERT, 2013) are likely to be more among the younger age groups.

People living with HIV (PLHIV) face discrimination and moral judgment because HIV infection is associated with behaviours that are portrayed in the media as social taboos (Li et al, 2009). The plight of PLHIV is exacerbated by negative attitudes that stem from this social construct of HIV and AIDS, and lead PLHIV to isolate themselves, hide their HIV status, and deprive themselves of available services, including HIV testing and medical care (Fortenberry et al 2002; Lichtenstein, 2003; Mensah et al., 2008). Negative attitudes can also affect PLHIV if they are present in health care professionals (Smith and Mathews, 2007). The study shows, however, that the attitude of the population to PLHIV in all the study periods were positive with over 90% accepting to care for their sick relatives in their homes. Positive attitude towards people living with HIV (PLHIV) is a good indicator of successful interventions as the HIV infected would be ready to go for treatments and freely associate with other people.

The Joint United Nations Programme on AIDS (UNAIDS) Reference Group on "Estimates, Modelling and Projections" (UNAIDS, 1999) raised the issue on whether declines in HIV prevention are the result of a decline in incidence or due to rising mortality rates overtaking

the rate of new infections, and whether the results are statistically valid and meaningful. The decrease in the prevalence within certain age groups, 1.5-4, 5-9, 20-24, 25-29, and 30-35 and an increase in the other age groups using the results of the 2004 BAIS II, 2008 BAIS III and 2013 BAIS IV results are statistically valid and meaningful. The designs of the Botswana AIDS Impact studies are statistically adequate and appropriate and samples are representative of the population. Well trained and qualified enumerators and supervisors are used to collect the data and experts in handling large data analyse the data.

Results of decline in the youngest age group are clearly due to decline in incidence of HIV resulting from several interventions such as the PMTCT and ARV, which have been extensively embraced by pregnant and nursing mothers in Botswana. The 2013 estimates report shows that Botswana has more than 95% antiretroviral treatment coverage (AVERT, 2015). Ghys et al. (2006) and Mahy et al. (2012) have shown that in a generalized epidemics, trends in HIV prevalence among young people aged 15–24 years can been used as an indicator of trends in new infections among the adult population aged 15–49 years especially where the HIV infections among young people occur only through sexual transmission. The age group 1.5-4 in 2008 would represent completely new births since those in that age group in 2004 would have moved to age 5-9 in 2008 and age 10-19 in 2013. The decline in the other age groups will be a combination of decline in incidence as well as mortality. The 2013 BAIS IV results, for example, show that of all the most recent deaths that occurred in the households (N=45, 362), 40.6% (N=18,428) were due to AIDS. Table 8 shows the percentage of deaths due to AIDS within the various age groups with highest percentage deaths occurring within the age groups 35-54. These age groups also represent the most HIV affected (Statistics Botswana, 2013).

Table 8: Number of most recent deaths due to AIDS within the households

Age	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+
No. of deaths due AIDS	232	535	0	2082	0	0	1007	4348	2592	3152	3957	523	0	0
%	1.3	2.9	0	11.3	0	0	5.5	23.6	14.1	17.1	21.5	2.8	0	0

Conclusions

1. The positive attitude of the population to PLHIV is an indicator that PLHIV are likely to be responsive to interventions and programmes to curb the incidence of HIV. Public health planners should capitalize on this attribute in putting in place interventions on behavioural changes.
2. The decline in the prevalence in younger age groups is also an indication that PMTCT and ARV prevention interventions have been extensively embraced and need to be intensified as consistent reduction in these younger age groups would mean an overall reduction in prevalence in the long term.

Acknowledgement

The author wishes to appreciate NACA for releasing the data and report of the 2013 BAIS IV to facilitate the preparation of this paper.

References

Abah, R. C. (2014). The demographic implications of the HIV prevalence trend in Nigeria. *Journal of Public Health in Africa* 5, 19-22AVERT. (2013). HIV and AIDS in Botswana. Retrieved on 20 December 2015 from http://www.avert.org/node/397/pdf

AVERT(2016). Global information and advice on HIV and AIDS. Retrieved on 12 January 2016 from http://www.avert.org/professionals/hiv-around-world/sub-saharan-africa

Bello, GA, Chipeta, J. & Aberle-Grasse, J. (2006). Assessment of trends in biological and behavioural surveillance data: Is there any evidence of declining HIV prevalence or incidence in Malawi? *Sexually Transmitted Infections*, 82(Suppl. 1), 9-13.

Boerma ,J.T., Ghys, P.D.,& Walker, N. (2003). Estimates of HIV-1 prevalence from national population-based surveys as a new gold standard. *The Lancet*, 362, 1929–1931.

Boisson, E., Nicoll, A., Zaba B. & Rodrigues, L.C.(1996). Interpreting HIV seroprevalence data from pregnant women. *Journal of Acquired Immune Deficiencies and Human Retrovirology*,13, 434–439.

Brown, T, Salomon, J.A., Alkema, L., Raftery, A.E. & Gouws E (2008). Progress and challenges in modelling country-level HIV/AIDS epidemics: The UNAIDS Estimation and Projection Package 2007. *Sexually Transmitted Infections* 84,5-10

CDC (US) (2004). Number of persons tested for HIV—United States 2002. MMWR Morb Mort Weekly Rep 53(47):1110-1113.

CSO (2009).(The 008 *Botswana AIDS Impact Survey* III. Statistical Report. Gaborone: Government Printers.

Fortenberry, J. D., McFarlane, M., Bleakley, A., Bull, S., Fishbein, M., Grimley, D. M. & Stoner B. P. Relationships of stigma and shame to gonorrhoea and HIV screening. *American Journal of Public Health*, 92,378-381.

Fylkesnes, K., Musonda, R.M., Sichone, M., Ndhlovu, Z., Tembo, F. & Monze, M. (2001).Declining HIV prevalence and risk behaviours in Zambia: Evidence from surveillance and population-based surveys. *AIDS* 15, 907-916.

Ghys, P. D., Kufa, E. & George, M. V.(2006): Measuring trends in prevalence and incidence of HIV infection in countries with generalised epidemics. *Sexually Transmitted Infections*, 82(Suppl 1), i52-56.

Gray, R. H., Wawer, M. J., Brookmeyer, R., Sewankambo, N. K., Serwadda, D., Wabwire-Mangen, F., et al.(2001). Probability of HIV-1 transmission per coital act in monogamous, heterosexual, HIV-1 discordant couples in Rakai, Uganda. *The Lancet* 357,1149-1153.

Gregson, S., Zhuwau, T., Anderson, R. M. et al. 1995).Age and religion selection biases in HIV-1 prevalence data from antenatal clinics in Manicaland Zimbabwe. *Central African Journal of Medicine*, 41,339–345.

Hallett, T. B., Zaba ,B., Todd, J., Lopman, B., Mwita W. et al. (2008). Estimating incidence from prevalence in generalised HIV epidemics: methods and validation. *PLoS Med* 5: e80.

Holtzman, D., Bland, S., Lansky, A. & Mack, K. A. (2001). HIV-related behaviors and perceptions among adults in 25 states. *Am Journal of Public Health* 91,1882-1888.

Janssen, R. S., Holtgrave, D.R., Valdiserri, R.O., Shepherd, M., Gayle, H. D. & DeCock, K.M. (2001). The serostatus approach to fighting the HIV epidemic: Prevention strategies for infected individuals. *Am Journal of Public Health* 91,1019-24.

Kumogola, Y., Slaymaker, E., Zaba, B., Mngara, J., Isingo, R., Changalucha, J., Mwidunda, P., Imaro Daniel, & Urassa M (2010). Trends in HIVand syphilis prevalence and correlates of HIV infection: Results from cross-sectional surveys among women attending ante-natal clinics in Northern Tanzania BMC. *Public Health*,10,553; Retrieved on 12 January 2016 from http://www.biomedcentral.com/1471-2458/10/553

Lakdawalla,D., Malani,A., Reif, J., 2014. The Insurance Value of Medical Innovation. Retrieved on 12 January 2016 from at https://economics.uchicago.edu/workshops/Malani%20-%20The%20Insurance%20Value%20of%20Medical%20Innovation.CURRENT.pdf

Lansky, A., Sullivan, P. S., Gallagher, K.M. & Fleming, P.L. (2007). HIV behavioral surveillance in the U.S.: A conceptual framework. *Public Health Reports/* 122(S1), pages?

Leclerc-Madlala, S. (2008). Age-disparate and intergenerational sex in southern Africa: The dynamics of hyper-vulnerability. *AIDS*,22 (S 4) :S17-25. doi: 10.1097/01.aids.0000341774.86500.53.

Li L., Wu, Z., Lin, C., Guan, J., Rotheram-Borus, M. J. & Lu,Y. (2009). NIMH Collaborative HIV/STD prevention trial group: Mass media and HIV/AIDS in China. *Journal of Health Communication*, 14, 424-438.

Lichtenstein, B. (2003). Stigma as a barrier to treatment of sexually transmitted infections in the American deep south: Issues of race, gender and poverty. *Social Science & Medicine*, 57, 2435_2445.

McLaren, Z. (2010). The effect of access to AIDS treatment on employment out- comes in South Africa. Retrieved on date 15 January 2016 from http://liberalarts.iupui.edu/economics/uploads/docs /mclaren.pdf

Mahomva, A., Greby, S., Dube, S., Mugurungi, O., Hargrove, J., Rosen, D., Dehne, K. L., Gregson, S., St Louis, M. & Hader, S (2006). HIV prevalence and trends from data in Zimbabwe, 1997-2004.*Sexually Transmitted Infections*, 82(S 1), i42-47.

Mahy, M., Garcia-Calleja, J.M. & Marsh, K.A. (2012). Trends in HIV prevalence among young people in generalised epidemics: Implications for monitoring the HIV epidemic. *Sexually Transmitted Infections* 88 (S2), i65–i75

Mensah, M. N., Waugh, T., Lavoie, R., Dumas, J., Bernier, M. & Garneau, M. J. & Otis, J. (2008). The VIHsibilite Project: HIV-positive people in the Quebec press and community responses. *AIDS Care*, 20, 596-600.

Mills, S., Saidel, T., Magnani, R. & Brown, T. (2004). Surveillance and modelling of HIV, STI, and risk behaviours in concentrated HIV epidemics. Sexually Transmitted Infections , Vol. 80,ii57-62.

National AIDS Coordinating Agency (NACA) (2012). Botswana 2012 Global AIDS Response Report -Progress Report of the National Response to the 2011 Declaration of Commitments on HIV and AIDS-Reporting Period: 2010-2011.

Pisani, E., Brown, T., Saidel, T., Rehle, T. & Carael M.(1998). Meeting the behavioural data collection needs of national HIV/AIDS and STD programmes. Place: UNAIDS.

Rehle, T. M., Hallett, T. B., Shisana, O., Pillay-van Wyk, V., Zuma, K., Carrara, H,et al (2010). A decline in new HIV infections in South Africa: Estimating HIV incidence from three national HI surveys in 2002, 2005 and 2008. PLoS One, Vol.5(6):e11094. doi: 10.1371/journal.pone.0011094

Schaan, M. M., Taylo,r M., Puvimanasinghe, J., Busang, L., Keapoletswe, K. & Marlink R (2012).Sexual and reproductive health needs of HIV-positive women in Botswana : Astudy of health care worker's views. *AIDS Care*, 24(9), 1120-5. DOI: 10.1080/09540121. 672814.

Smith, D. M. & Mathews, W. C. (2007). Physicians' attitudes toward homosexuality and HIV: Survey of a California Medical Society- revisited (PATHH-II). *Journal of Homosexuality*, 52(3/4):1-9

Statistics Botswana (2013). *Botswana AIDS Impact Survey (BAIS IV*. Gaborone: Government Printers.

Swai, R., Somi, G. R., Matee, M. I. N., Killewo, J. Z., Lyamuya, E. F., Kwesigabo, G., Tulli T., Kabalimu, T. K., Ng'anga, L., Isingo, R. & Ndayongeje, . J. (2006). Surveillance of HIV and syphilis infections among antenatal clinic attendees in Tanzania-2003-2004. *BioMed Central(BMC) Public Health* 6: 91: doi:10.1186/1471-2458-6-91

Thirumurthy, H., Graff Zivin, J. &Goldstein, M. (2008).The economic impact of AIDS treatment: Labour supply in Western Kenya. *Journal of Human Resources* 43, 511–552.

Thirumurthy, H.,Graff Zivin, J., Goldstein, M., Goldstein, M., Graff Zivin, J., Hab-yarimana, J.,Pop-Eleches, C., (2012). Behavioural responses of patients in AIDS treatment programs: Sexual behaviour in Kenya. *Forum for Health Economics and Policy* 15(2), 1–29.

UNAIDS (2014a) 'The Gap Report 2014'

UNAIDS (2014b) Global AIDS Response progress reporting 2014

UNAIDS (1999) Trends in HIV incidence and prevalence: natural course of the epidemic or results of behavioural change? UNAIDS Geneva, Switzerland 1999

UNAIDS/WHO Working Group of Global HIV/AIDs and STI Surveillance: Guidelines for Second Generation HIV Surveillance. Geneva: UNAIDS/WHO 2000.

Wawer, M.J., Gray, R.H., Sweankambo, N. K., Serwadda, D., Li, X., Laeyendecker, O., et al. Rates of HIV-1 transmission per coital act, by stage of HIV-1 infection, in Rakai, Uganda. *Journal of Infectious Diseases* ,191, 1403-1409.