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ABSTRACT

Monitoring trends in determinants of HIV can be important to explain changes in HIV prevalence. In Zimbabwe, men and women were tested for HIV in two consecutive rounds of the Zimbabwe Demographic and Health Survey (ZDHS), 2005-06 and 2010-11. This paper analyzes the changes in HIV prevalence among men and women between the two surveys by selected background characteristics and associated risk factors.

Methods: We analyzed the 2005-06 and 2010-11 ZDHS data sets and reported the proportional changes in HIV prevalence at the 95% confidence level. Using linear combinations of estimators (LINCOM) in linear and logistic regression, we explored the associations of change in HIV prevalence with 1) socio-demographic characteristics, 2) sexual risk-behaviour characteristics, and 3) biological characteristics, using STATA 12.1.

Results: Overall, women experienced a greater decline in HIV prevalence between 2005-06 and 2010-11 than men—16% ($p = 0.001$) compared with 15% ($p = 0.008$). In rural areas, the decline among women was even larger—19% ($p = 0.002$) compared with 13% ($p = 0.073$) among men, and the decline was statistically significant for women. In urban areas, the decline in HIV prevalence was greater among men than women—17% ($p = 0.089$) compared with 9% ($p = 0.144$), however the decline was not statistically significant for men. The decline in HIV prevalence by marital status was greater among those in marital union—men 23% ($p < 0.001$) and women 20% ($p < 0.001$)—than among those who were single—men 7% ($p = 0.628$) and women 10% ($p = 0.406$). There were notable declines in HIV prevalence among both men and women who reported age at first sex at 16 years and older—men 23% ($p < 0.001$) and women 21% ($p<0.001$). Among the largest declines in HIV prevalence were those seen among men and women who used a condom at last sexual intercourse in the past 12 months—men 33% ($p = 0.001$) and women 32% ($p < 0.001$). The decline in HIV prevalence was slightly greater among men who were circumcised than among those who were not—15% ($p = 0.313$) compared with 14% ($p = 0.017$).

Multivariate analysis confirmed the decline in HIV prevalence in both sexes between the two surveys, particularly in rural areas, among those with secondary or higher education, and those in the two wealthiest quintiles. Of the sexual risk behaviours, being currently in union, having their first sexual intercourse at age 16 or older, and having used a condom at last sexual intercourse were all associated with a decline in HIV prevalence.

Discussion and Conclusion: The larger declines in HIV prevalence among women than men in Zimbabwe suggest that gender-focused programming can lead to substantial reductions in HIV prevalence among target groups. Additionally, it is recognized that residence (urban-rural and province) is an important factor associated with the observed changes in HIV prevalence in Zimbabwe and needs to be taken into consideration when designing programme interventions. Finally, health programmes should continue to target individual sexual-risk behaviours and promote those that are associated with decline in HIV prevalence; these include increasing age at first sexual intercourse to at least 16 years and older, condom use during risky sexual intercourse, and voluntary medical circumcision for men.

Key words: Change in HIV prevalence, Zimbabwe

INTRODUCTION

Sub-Saharan Africa has experienced several HIV epidemics that show variation within and across countries. The Joint United Nations Programme on HIV/AIDS (UNAIDS) reported that three of the most severely affected countries—South Africa, Zambia, and Zimbabwe—reduced new HIV infections by more than 25% between 2001 and 2009[1]. Additionally, while national HIV prevalence declined in Kenya and stabilized in Uganda, Rwanda and Nigeria, it increased in Mozambique and remained high in Swaziland and Botswana. (Boerma et al. 2003)

As countries work to curb the impact of the HIV epidemic, understanding the socio-demographic, behavioural, and biological determinants of the HIV epidemic remains critical to developing evidence-based programming and policy response. Heterosexual transmission remains one of the main drivers of the HIV epidemic in sub-Saharan Africa. Women are disproportionately more affected by the epidemic than men as a result of the biological and cultural socio-economic disparities (Boerma et al. 2003; Glynn et al. 2001b). Data from both antenatal clinic surveillance and Demographic and Health Surveys (DHS) have shown that differentials in age, sex, education, and residence are associated with differentials in levels of HIV prevalence in sub-Saharan Africa. The differentials are most informative when comparisons are made within the same country. For example, 2001 data on women age 15-19 attending sentinel antenatal clinics in Zambia showed significant declines in HIV prevalence in this age group; at the same time, changes between the 2001-02 and 2007 DHS survey in Zambia provided more detailed information: HIV prevalence declined among women age 15-29 in urban areas and among women age 15-24 in rural areas. (Fylkesnes et al. 2001; Kayeyi et al. 2012)

Analysis of DHS data from eight national surveys conducted between 2003 and 2005 in sub-Saharan countries (Burkina Faso, Cameroon, Ghana, Kenya, Lesotho, Malawi, Tanzania, and Uganda) showed a positive association between household wealth status and HIV prevalence. The association was partially explained by other factors such as place of residence, education, and differences in sexual behaviour, e.g. multiple sex partners, condom use, and male circumcision (Mishra et al. 2007).

An extended analysis of data from DHS surveys in Tanzania in 2003-04 and 2007-08 showed that early age at first marriage, multiple sexual partners, and treatment for sexually transmitted infections (STI) in the past 12 months were associated with higher levels of HIV

infection among both men and women. Further, the analysis showed that while HIV prevalence decreased by 14% overall in Tanzania during this period (from 7.9% to 6.8%), the decline was statistically significant only among men in urban areas. Other socio-demographic, behavioural and biological variables were similar across the two surveys. In urban areas, there was evidence of increased condom use, a decline in multiple sexual partners and, among younger women, delayed age at first sex. The Tanzania analysis highlights the need for disaggregated analysis of data (Mmbaga 2013).

While it is possible over time to show the associations between changes in HIV prevalence and programme interventions, or between changes in HIV prevalence and biological or behavioural risk factors, a mathematical deterministic model has shown that declines in HIV prevalence may be related to the natural course of the HIV epidemic (Walker et al. 2008). Walker et al. (2008) concluded that information about the factors associated with high-risk sexual behaviour and patterns of migration are key to the interpretation of declines in HIV prevalence (MOHCW 2012).

Zimbabwe has one of the highest HIV burdens in southern Africa, with a generalized epidemic in which an estimated 1.4 million adults and children are living with HIV (MOHCW 2012). The primary mode of HIV transmission in Zimbabwe is heterosexual contact (92%), followed by vertical transmission (7%) (NAC 2010). Zimbabwe has continued to scale up prevention programmes, care and treatment programmes, and monitoring and evaluation programmes, to track the burden of disease attributed to HIV. Antenatal clinic sentinel surveillance reports for Zimbabwe show a decline in HIV prevalence from 25.7% (2002) to 21.3% (2004) to 17.7% (2006) and to 16.1% (2009). (MOHCW 2002, 2004, 2006, and 2009) Because of the limitations of ANC data in representing HIV prevalence in the general population, Zimbabwe implemented HIV testing in the nationwide ZDHS survey in 2005-06, followed by the 2010-11 ZDHS, which also included HIV testing. The data from the two surveys showed a decline in HIV prevalence nationwide in Zimbabwe from 18.1% (2005-06) to 15.2% (2010-11). (CSO and Macro 2006; ZIMSTAT and ICFI 2011)

Several epidemiological studies in Zimbabwe have supported the conclusion that HIV prevalence has declined steadily since the late 1990s (Halperin et al. 2011; Muchini et al. 2011; Gregson et al. 2010). Halperin et al. (2011) suggested that the decline was due primarily to the

success of HIV prevention efforts and to reduction in personal risk-taking behaviour (Muchini et al. 2011). The paper concluded that the decline in HIV prevalence was largely due to reductions in casual sexual behaviour and partner concurrency, and increased condom use and awareness of AIDS deaths. The Halperin et al. synthesis used data from the 2005-06 ZDHS, antenatal clinic surveillance data, and data collected in focus group discussions and key informant interviews.

Monitoring trends in determinants of HIV can be important in exploring changes in HIV prevalence. Because there have been two consecutive rounds of the ZDHS (2005-06 and 2010-11) that included HIV testing, it is possible to carry out a comparative analysis of the temporal differences in HIV prevalence and associated risk factors. This study examines the changes in HIV prevalence among men and women in Zimbabwe by selected demographic, behavioural, and biological characteristics. We seek to describe the relationship between changes in HIV prevalence among men and women and the factors most closely associated with HIV transmission.

METHODOLOGY

Study Design, Population and Sampling

We conducted an extensive analysis of the 2005-06 and 2010-11 ZDHS datasets. Datasets for HIV prevalence data (AR), men (MR) and women (IR) were merged to provide a single analysis dataset. A total of 5,848 men and 6,947 women age 15-49 were tested for HIV in the 2005-06 survey, and 6,250 men and 7,313 women age 15-49 were tested in the 2010-11; all of these respondents were included in the analysis dataset.

Data Analysis

Change in HIV prevalence, calculated as the proportion HIV positive in 2005-06 minus the proportion HIV positive in 2010-11, was the main outcome variable in the analysis. Associations with changes in HIV prevalence were explored for socio-demographic characteristics, sexual risk-behaviour characteristics, and biological characteristics. Differences between change in HIV prevalence and the socio-demographic risk factors were explored using the mean command for survey data analysis (svy mean) in Stata SE version 12.1 followed by a Lincom command (Linear combinations of estimators), which is used to provide the equivalent of a t-test for differences between two proportions. Using this approach, we are directly testing the hypothesis that the difference between, for example, HIV prevalence in 2005-06 and 2010-11 among those age 15-19 is equal to zero. The study design was taken into consideration in the analysis by making use of the survey command (svy), specifying the strata and cluster uniquely within each survey. All continuous variables such as age and number of sexual partners were categorized for analysis. Because of differences between men and women in the profile of HIV infection, analyses were done separately for the two groups.

Logistic regression was carried out for change in HIV prevalence by regressing HIV results (positive/negative) with the survey year variable indicator and including and controlling for the socio-demographic factors, sexual risk-behaviour factors, and biological factors. The procedure used survey command to take into account the ZDHS survey design. The coefficient of survey year (reference category: 2005-06) was used to obtain the adjusted odds ratio for change in HIV prevalence between the two surveys for the selected variable, while controlling for other factors. It is important to note that the survey year coefficient was the only one important for interpreting

the output of the logistic regression models fitted. For accurate comparison of men and women, the variable for male circumcision—which applies only to men—was not used in the logistic regression model. In Stata, the subpop command was used to fit the logistic regression models for each specific subgroup (e.g., age group 15-19 or Manicaland province). This resulted in a total of 51 logistic regression models being fitted. By fitting logistic regression, the potential problems of co-founding and collinearity were addressed.

RESULTS

The percentages of men and women who tested positive for HIV in the ZDHS 2005-06 and ZDHS 2010-11 are shown in Table 1 by socio-demographic, behavioural, and biological characteristics.

Table 1. Prevalence of HIV among men and women in Zimbabwe by socio-demographic characteristics, Zimbabwe DHS surveys 2005-06 and 2010-11

	Men (% HIV positive)		Women (% HIV positive)	
Characteristic	**2005-06**	**2010-11**	**2005-06**	**2010-11**
Number tested	5,848	6,250	6,947	7,313
National summary	14.5	12.3	21.1	17.7
SOCIO-DEMOGRAPHIC FACTORS				
Province				
Manicaland	16.6	9.8	22.3	17.9
Mashonaland Central	13.8	12.3	22.9	15.1
Mashonaland East	14.4	13.2	21.3	17.8
Mashonaland West	15.4	11.5	22.5	17.8
Matabeleland North	14.4	16.1	22.8	20.2
Matabeleland South	15.6	19.3	24.6	22.7
Midlands	11.5	13.0	20.1	17.4
Masvingo	12.1	11.8	17.3	16.3
Harare	17.3	9.3	21.1	16.7
Bulawayo	22.8	16.5	19.6	21.1
Residence				
Urban	15.7	13.1	21.6	19.6
Rural	13.8	12.0	20.8	16.8
Age group				
15-19	3.1	3.4	6.2	4.2
20-24	5.8	3.8	16.3	10.6
25-29	13.0	10.3	28.8	20.1
30-34	29.5	17.4	35.5	29.0
35-39	32.1	25.1	34.5	29.1
40-44	32.9	26.2	25.7	25.7
45-49	26.0	29.9	18.0	22.5
Education				
No education	23.4	15.8	20.0	15.2
Primary	15.0	13.6	22.4	20.1
Secondary and above	14.2	11.9	20.5	16.7

(Continued...)

Table 1. – *Continued*

Characteristic	Men (% HIV positive) 2005-06	Men (% HIV positive) 2010-11	Women (% HIV positive) 2005-06	Women (% HIV positive) 2010-11
Employment status in past 12 months				
Not employed	8.3	9.1	18.9	15.0
Employed	17.3	13.8	24.0	21.4
Wealth quintile				
Lowest & second	14.3	13.4	19.4	16.7
Middle	12.2	12.0	22.7	19.9
Fourth & highest	15.5	11.5	21.8	17.6
Currently in union				
No	4.3	4.0	8.4	7.6
Yes	23.1	17.7	20.2	16.1
SEXUAL RISK-BEHAVIOUR FACTORS				
Age at first sexual intercourse				
<16	16.3	14.5	27.0	23.6
>=16	19.5	15.0	25.8	20.3
Number of lifetime partners				
1	6.5	4.0	18.1	12.1
2	14.8	12.3	37.1	32.2
3-4	20.3	13.8	42.1	40.6
5-9	22.1	20.6	43.9	46.9
10+	31.2	27.2	76.2	40.6
Condom use at last sexual intercourse in past 12				
Yes	21.3	14.3	21.2	14.5
No	15.0	19.4	39.1	41.4
Biological factors				
Sexually transmitted infections in past 12 months				
Had STI or STI symptoms	14.0	12.0	19.9	17.0
No STI, no symptoms	35.7	26.3	51.2	41.3
Male circumcision				
No	14.2	12.2	-	-
Yes	16.6	14.1	-	-

Table 2 shows the changes in HIV prevalence among men and women between the ZDHS 2005-06 and the ZDHS 2010-11. The table presents HIV prevalence (% HIV positive), the proportion (%) of change in HIV prevalence between the two surveys, and p-values for the differences in HIV prevalence between the two surveys, by socio-demographic, behavioural, and biological characteristics.

Table 2. Changes in HIV prevalence (weighted) among men and women between the ZDHS 2005-06 and the ZDHS 2010-11, by socio-demographic factors, sexual risk-behaviour factors and biological factors

	Men				Women			
Characteristic	**2005 -06**	**2010 -11**	**Percent-age change**	***p*-value (diff)**	**2005 -06**	**2010 -11**	**Percent-age change**	***p*-value (diff)**
Number tested	5,848	6,250			6,947	7,313		
Total HIV (%)	14.5	12.3	-15%	0.008	21.1	17.7	-16%	0.001
SOCIO-DEMOGRAPHIC FACTORS								
Province								
Manicaland	16.6	9.8	-41%	0.010	22.3	17.9	-20%	0.063
Mashonaland Central	13.8	12.3	-11%	0.620	22.9	15.1	-34%	0.055
Mashonaland East	14.4	13.2	-8%	0.654	21.3	17.8	-16%	0.161
Mashonaland West	15.4	11.5	-25%	0.073	22.5	17.8	-21%	0.094
Matabeleland North	14.4	16.1	12%	0.539	22.8	20.2	-11%	0.373
Matabeleland South	15.6	19.3	24%	0.387	24.6	22.7	-8%	0.455
Midlands	11.5	13.0	13%	0.526	20.1	17.4	-13%	0.289
Masvingo	12.1	11.8	-2%	0.889	17.3	16.3	-6%	0.753
Harare	17.3	9.3	-46%	<0.001	21.1	16.7	-21%	0.024
Bulawayo	12.8	16.5	29%	0.223	19.6	21.1	8%	0.530
Residence								
Urban	15.7	13.1	-17%	0.089	21.6	19.6	-9%	0.144
Rural	13.8	12.0	-13%	0.073	20.8	16.8	-19%	0.002
Age group								
15-19	3.1	3.4	10%	0.679	6.2	4.2	-32%	0.031
20-24	5.8	3.8	-34%	0.089	16.3	10.6	-35%	<0.001
25-29	13.0	10.3	-21%	0.123	28.8	20.1	-30%	<0.001
30-34	29.5	17.4	-41%	<0.001	35.5	29.0	-18%	0.012
35-39	32.1	25.1	-22%	0.026	34.5	29.1	-16%	0.040
40-44	32.9	26.2	-20%	0.078	25.7	25.7	0%	0.976
45-49	26.0	29.9	15%	0.307	18.0	22.5	25%	0.111
Education								
No education	23.4	15.8	-32%	0.351	20.0	15.2	-24%	0.277
Primary	15.0	13.6	-9%	0.402	22.4	20.1	-10%	0.175
Secondary and above	14.2	11.9	-16%	0.012	20.5	16.7	-19%	<0.001
Employment status in last 12 months								
Not employed	8.3	9.1	10%	0.477	18.9	15.0	-21%	<0.001
Employed	17.3	13.8	-20%	0.001	24.0	21.4	-11%	0.063
Wealth quintile								
Lowest & second	14.3	13.4	-6%	0.589	19.4	16.7	-14%	0.070
Middle	12.2	12.0	-2%	0.910	22.7	19.9	-12%	0.201
Fourth & highest	15.5	11.5	-26%	0.001	21.8	17.6	-19%	<0.001

(Continued...)

Table 2. – *Continued*

Characteristic	Men 2005-06	Men 2010-11	Men Percentage change	Men *p*-value (diff)	Women 2005-06	Women 2010-11	Women Percentage change	Women *p*-value (diff)
SEXUAL RISK-BEHAVIOUR FACTORS								
Currently in union								
No	4.3	4.0	-7%	0.628	8.4	7.6	-10%	0.406
Yes	23.1	17.7	-23%	<0.001	20.2	16.1	-20%	<0.001
Age at first sexual intercourse								
<16	16.3	14.5	-11%	0.502	27.0	23.6	-13%	0.109
>=16	19.5	15.0	-23%	<0.001	25.8	20.3	-21%	<0.001
Number of lifetime partners								
1	6.5	4.0	-38%	0.063	18.1	12.1	-33%	<0.001
2	14.8	12.3	-17%	0.298	37.1	32.2	-13%	0.024
3-4	20.3	13.8	-32%	<0.001	42.1	40.6	-4%	0.619
5-9	22.1	20.6	-7%	0.487	43.9	46.9	7%	0.656
10+	31.2	27.2	-13%	0.228	76.2	40.6	-47%	0.002
Condom use at last sexual intercourse in past 12 months								
Yes	21.3	14.3	-33%	<0.001	21.2	14.5	-32%	<0.001
No	15.0	19.4	29%	0.032	39.1	41.4	6%	0.508
Biological factors								
Sexually transmitted infections in past 12 months								
Had STI or STI symptoms	14.0	12.0	-14%	0.013	19.9	17.0	-15%	0.002
No STI, no symptoms	35.7	26.3	-26%	0.150	51.2	41.3	-19%	0.053
Male circumcision								
No	14.2	12.2	-14%	0.017	NA	NA	NA	NA
Yes	16.6	14.1	-15%	0.313	NA	NA	NA	NA

*p-values below 0.05 are considered significant

Nationally, women experienced a slightly greater decline in HIV prevalence than men between the 2005-06 ZDHS and the 2010-11 ZDHS—16% (p = 0.001) compared with 15% (p = 0.008) (Table 2). However, in two provinces, Manicaland and Harare, the decline in HIV prevalence was greater among men than women; in Manicaland, the decline was 41% (p = 0.010) for men compared with 20% (p = 0.063) for women, and in Harare the decline was 46% (p < 0.001) for men and 21% (p = 0.024) for women. Among men, the decline in HIV prevalence was greater in urban areas than in rural areas—17% (p = 0.089) compared with 13% (p = 0.073). The reverse was seen for women—19% (p = 0.002) among women in rural areas compared with 9% (p = 0.144)

among women in urban areas. The decline among women in rural areas was statistically significant ( ).

By age, there was substantial decline in HIV prevalence among women in the three youngest age groups—15-19 (32% $p = 0.031$), 20-24 (35% $p < 0.001$), and 25-29 (30% $p < 0.001$) (Table 2). Among men, the decline was greatest among men age 30-34 (41% $p < 0.001$) and those age 35-39 year (22% $p = 0.026$). Men and women with secondary education and above had significant declines in HIV prevalence (16% $p = 0.012$) and 19% ($p < 0.001$), respectively. Being unemployed was significantly associated with greater decline in HIV prevalence among women (21% $p < 0.001$) while being employed was associated with greater decline in HIV prevalence among men (20% $p < 0.001$). Decline in HIV prevalence by wealth status was greatest for men and women living in households in the fourth and highest wealth quintiles—26% ($p = 0.001$) for men and 19 % ($p < 0.001$) for women.

Analysis of sexual risk-behaviour factors showed that the greatest declines in HIV prevalence by marital status were among men and women in union—23% ($p < 0.001$) for men and 20% ($p < 0.001$) for women—and those who reported age at first sexual intercourse as 16 or older—23% ($p < 0.001$) for men and 21% ($p < 0.001$) for women. Declines in HIV prevalence according to number of lifetime partners were greatest for men who reported 3-4 lifetime partners (32% $p < 0.001$) and women who reported 1 or 10+ lifetime partners—33% ($p < 0.001$) and 47% ($p = 0.002$), respectively. There were substantial declines in HIV prevalence among men and women who used a condom at last sexual intercourse in the past year—33% ($p < 0.001$) for men and 32% ($p < 0.001$) for women. At the same time, there was a statistically significant *increase in HIV prevalence* among men who did not use a condom at last sexual intercourse (29% $p = 0.032$). Men who were circumcised showed a slightly greater decline in HIV prevalence (15% $p = 0.313$) compared with uncircumcised men (14% $p < 0.017$) (Table 2).

Table 3 shows the adjusted odds ratios (AOR) of change in HIV prevalence among men and women age 15-49 who were tested for HIV during the ZDHS 2005-06 and ZDHS 2010-11. The table summarizes the results of running separate logistic regressions for each of the socio-demographic, behavioural, and biological characteristics, controlling for the other factors. The results shown for each characteristic subgroup are just the adjusted odds ratio (AOR), p-values,

and 95% confidence intervals (CI) for the change in HIV prevalence between the two surveys for each subgroup.

Table 3. Adjusted odds ratios (AOR) of change in HIV prevalence for factors associated with HIV prevalence among men and women age 15-49 who were tested for HIV, ZDHS 2005-06 and ZDHS 2010-11

	Men				Women			
Characteristic	**AOR**	***p*-value**	**95% CI**		**AOR**	***p*-value**	**95% CI**	
National	0.71**	<0.001	0.600	0.835	0.66**	<0.001	0.575	0.749
SOCIO-DEMOGRAPHIC FACTORS								
Provincial								
Manicaland	0.43**	**<0.001**	0.262	0.718	0.66*	0.024	0.449	0.944
Mashonaland Central	0.66	0.151	0.375	1.167	0.39**	0.005	0.208	0.747
Mashonaland East	0.58*	0.031	0.357	0.949	0.44**	**<0.001**	0.274	0.717
Mashonaland West	0.76	0.267	0.467	1.239	0.67	0.056	0.440	1.010
Matabeleland North	1.08	0.742	0.662	1.777	0.79	0.273	0.513	1.211
Matabeleland South	1.07	0.844	0.522	2.210	0.81	0.275	0.554	1.186
Midlands	1.03	0.904	0.627	1.694	0.75	0.157	0.502	1.120
Masvingo	0.68	0.110	0.430	1.092	0.73	0.095	0.502	1.058
Harare	0.45**	**<0.001**	0.300	0.678	0.57**	**<0.001**	0.408	0.797
Bulawayo*	-	-	-	-	0.82	0.327	0.553	1.222
Residence								
Urban	0.73*	0.023	0.554	0.957	0.75**	0.003	0.609	0.903
Rural	0.68**	**<0.001**	0.545	0.856	**0.61****	**<0.001**	0.514	0.717
Age								
15-19	0.74	0.585	0.256	2.160	0.49*	0.010	0.286	0.843
20-24	0.59	0.077	0.332	1.059	0.60**	**<0.001**	0.456	0.783
25-29	0.75	0.109	0.520	1.068	0.52**	**<0.001**	0.405	0.678
30-34	0.52**	**<0.001**	0.378	0.720	0.65**	0.002	0.493	0.859
35-39	0.66*	0.012	0.476	0.910	0.76	0.068	0.567	1.021
40-44	0.66*	0.037	0.447	0.975	0.86	0.536	0.548	1.367
45-49	1.08	0.748	0.664	1.769	1.57	0.136	0.868	2.826
Education								
No education	0.01*	0.021	0.000	0.493	1.08	0.853	0.472	2.479
Primary	0.78	0.170	0.554	1.110	0.74**	0.004	0.600	0.907
Secondary and above	0.66**	<0.001	0.547	0.793	0.60**	**<0.001**	0.513	0.704
Currently working								
Not employed	0.54**	0.003	0.365	0.807	0.64**	**<0.001**	0.544	0.757
Employed	0.72**	**<0.001**	0.601	0.867	0.68**	**<0.001**	0.549	0.831

(Continued...)

Table 3. – *Continued*

Characteristic	Men AOR	Men *p*-value	Men 95% CI		Women AOR	Women *p*-value	Women 95% CI	
Wealth quintile								
Lowest & second	0.78	0.137	0.560	1.083	0.66**	**<0.001**	0.536	0.819
Middle	0.60**	0.008	0.417	0.874	0.53**	**<0.001**	0.402	0.711
Fourth & highest	0.69**	**<0.001**	0.546	0.863	0.68**	**<0.001**	0.569	0.815
SEXUAL RISK-BEHAVIOUR FACTORS								
Currently in union								
No	0.67	0.149	0.389	1.155	0.56*	0.013	0.356	0.883
Yes	0.66**	<0.001	0.544	0.803	0.65**	**<0.001**	0.564	0.754
Age at first sexual intercourse								
<16	0.75	0.250	0.456	1.227	0.77	0.092	0.571	1.043
>=16	0.67**	<0.001	0.556	0.795	0.63**	**<0.001**	0.550	0.726
Number of lifetime partners								
1	0.56*	0.032	0.328	0.950	0.60**	**<0.001**	0.497	0.724
2	0.68	0.070	0.448	1.032	0.71**	0.003	0.563	0.890
3+	0.55**	<0.001	0.408	0.749	0.73*	0.039	0.540	0.986
Condom use at last sexual intercourse in past 12 months								
No	1.12	0.477	0.813	1.556	0.89	0.488	0.647	1.232
Yes	0.59**	<0.001	0.475	0.721	0.60**	<0.001	0.523	0.700
BIOLOGICAL FACTORS								
Sexually transmitted infections in past 12 months								
Had STI or STI symptoms	0.70**	<0.001	0.589	0.834	0.66**	<0.001	0.573	0.756
No STI, no symptoms	0.46*	0.041	0.214	0.967	0.66	0.113	0.392	1.109
Male circumcision								
No	0.71**	<0.001	0.589	0.848	NA	NA	NA	NA
Yes	0.59*	0.020	0.375	0.918	NA	NA	NA	NA

Significance level: ** p < .01; * p < .05

In the regression analysis, after controlling for other factors, there was a statistically significant decline in HIV prevalence among both men (AOR = 0.71, p < 0.001) and women (AOR = 0.66, p < 0.001) between the ZDHS 2005-06 and ZDHS 2010-11 (Table 3). Changes in HIV prevalence varied across provinces and declines for both men and women were significantly associated with three provinces—Manicaland (AOR = 0.43, p < 0.001 for men and AOR = 0.66, p = 0.024 for women), Mashonaland East (AOR = 0.58, p = 0.031 for men and AOR = 0.44,

$p < 0.001$ for women), and Harare (AOR = 0.45, $p < 0.001$ for men and AOR = 0.57, $p < 0.001$ for women). In Mashonaland Central, a significant decline was seen for women only (AOR = 0.39, $p = 0.005$).

For both men and women, there was a statistically significant decline in HIV prevalence associated with living in rural areas—AOR = 0.68, $p < 0.001$ for men and AOR = 0.61, $p < 0.001$ for women—versus urban areas—AOR=0.73, $p = 0.023$ for men and AOR=0.75, $p = 0.003$ for women. By age, the decline in HIV prevalence was associated with men 30-39 and women 15-34 (Table 3).

Having secondary or more education (AOR = 0.66, $p < 0.001$) among men, and women who had both primary (AOR = 0.74, $p = 0.004$) and secondary or more education (AOR = 0.60, $p < 0.001$) were significantly associated with decline in HIV prevalence.

Other significant socio-demographic factors associated with decline in HIV prevalence were employment status and wealth status, for both men and women; however, men in the lowest and second wealth quintiles did not show a significant change in HIV prevalence. Among women, there were significant reductions in HIV prevalence regardless of wealth quintile (Table 3).

Among the sexual behaviour risk factors for women declines in HIV prevalence were significant both for women in union (AOR = 0.65, $p = < 0.001$) or not in union (AOR = 0.56, $p = 0.013$), women with 1, 2, or 3 or more lifetime partners, women using a condom at last sexual intercourse (AOR = 0.60, $p < 0.001$). Among men, there were slight variations, with statistically significant declines in HIV prevalence associated with being in union (AOR=0.66, $p < 0.001$), having 3 or more lifetime partners, using a condom at the last sexual intercourse, and having an STI. Statistically significant declines in HIV prevalence are seen among both men and women who first had sexual intercourse at age 16 or older.

Biological factors such as having an STI or its symptoms in the past 12 months were associated with decline in HIV prevalence among both men (AOR = 0.70, $p < 0.001$) and women (AOR = 0.66, $p < 0.001$). A significant association of decline in HIV prevalence was observed among men regardless of circumcision status although the decline is greater in circumcised men.

DISCUSSION

Overall, women experienced greater decline in HIV prevalence than men between the ZDHS 2005-06 and ZDHS 2010-11—16% ($p = 0.001$) compared with 15% ($p = 0.008$). Decline in HIV prevalence in rural areas was greater among women than men and the decline was statistically significant—19% ($p = 0.002$) compared with 13% ($p = 0.073$). In urban areas, although not statistically significant, men had a greater decline in HIV prevalence than women—17% ($p = 0.089$) compared with 9% ($p = 0.144$). The fact that the declines in HIV prevalence among women are both greater and are statistically significant suggests that gender-focused programming can lead to significant reductions in HIV prevalence among target groups.

Across provinces, decline in HIV prevalence among women was significantly associated with 4 of the 10 provinces/cities, while declines among men were associated with 3 provinces/cities. This finding may reflect a policy emphasis on interventions such as PMTCT, which target women specifically. However, the decline in HIV prevalence was not significant among men and women in the provinces of Mashonaland West, Matabeleland North, Matabeleland South, Midlands, and Masvingo. While most interventions have national coverage, typically local Provincial Medical Directorates have oversight in each province. A study of the differential spread of HIV in four African cities concluded that changes in sexual risk behaviours alone were not sufficient to explain changes in HIV prevalence and suggested that change in HIV prevalence also reflects differences in the commitment to fight HIV and AIDS. (Glynn et al. 2001a; Buvé et al. 2001)

This analysis shows that decline in HIV prevalence in Zimbabwe was associated with women age 15-34 and women with primary and secondary education (regardless of wealth quintile). The findings may reflect the national focus on women and girls in HIV interventions. The association of decline in HIV prevalence with men age 30-39 may reflect increased attention to this age group in HIV programming. The lack of statistically significant change in HIV prevalence among men and women age 40 and older may indicate stabilization of HIV infection in this age group, as the result of a combination of factors such as reduction in the number of new infections and, perhaps, deaths among people living with HIV/AIDS.

Our study indicates that higher education (secondary and above) in both men and women is associated with significant decline in HIV prevalence. We note that women with no education

appear to remain vulnerable to HIV infection—because of non-significant decline in HIV prevalence between the two surveys ($p = 0.853$)—while women with primary education showed a significant decline in HIV prevalence ($p = 0.004$). These findings suggest that continued focus on education in Zimbabwe has the potential of bringing about further reductions in HIV prevalence. At the same time, the fact that men with no education showed significant decline in HIV prevalence ($p = 0.021$) while those with primary education did not, is of interest in understanding the underlying factors associated with transmission of HIV.

Both men and women showed significant decline in HIV prevalence regardless of employment status. The same was noted for men and women in all wealth quintiles, except for men in the lowest and second wealth quintiles. Recent developments in Zimbabwe have resulted in most people participating in the non-formal employment sector; hence employment status ceases to play a major role in levels of HIV prevalence.

This analysis highlights the contributions to decline in HIV prevalence of adopting safe sexual behaviour such as increased age at first sexual intercourse and being in union (married). The latter finding suggests that marital union may be regarded by some as providing some amount of protection against transmission of HIV. At the same time, women who were not in union ($p = 0.013$) also had a statistically significant decline in HIV prevalence, suggesting that a reduction in high-risk sexual behaviour may be taking place in this group. The finding that there was no significant decline in HIV prevalence among single men may be related to an increase in discordant couples (one partner HIV positive and one HIV negative), which has been observed in other countries[17].

There was a statistically significant decline in HIV prevalence among both men who were circumcised and those who were not. Because the medical male circumcision programme had not yet been implemented in Zimbabwe at the time of the two surveys, the decline in HIV prevalence cannot be associated with this biological factor.

LIMITATIONS

A limitation of our study is that it focused solely on change in HIV prevalence between two DHS surveys, the ZDHS 2005-06 and ZDHS 2010-11. This constraint is intrinsic to the design of Demographic and Health Surveys, which are cross-sectional in structure, thus limiting opportunities to assess change in HIV incidence. Information on HIV incidence is critical for the development of broad strategies to combat the spread of HIV in Zimbabwe. Future research efforts should be directed toward determining the feasibility of calculating HIV incidence for the general population, based on ZDHS data and other reliable population-based studies.

At the same time, our analysis of change in HIV prevalence in Zimbabwe provides results that are useful for a range of HIV programming activities such as PMTCT, ANC, youth HIV programmes, and blood safety programmes; changes of note can inform programme design and be incorporated into programming activities. The limited scope of this analysis did not permit examination of the contribution of mortality and migration to the observed declines in HIV prevalence in Zimbabwe; hence, the results should be interpreted with caution.

PUBLIC HEALTH IMPLICATIONS

Our analysis identifies the main factors associated with change in HIV prevalence among men and women in Zimbabwe. These socio-demographic, behavioural, and biological factors are directly related to the public health context in Zimbabwe. As such, policy-makers aiming to combat the transmission of HIV need to give them full consideration.

Second, given the geo-spatial variations in change in HIV prevalence and the differential associations of socio-demographic, behavioural, and biological factors with change in HIV prevalence, effective policies to combat the transmission of HIV will need to be 1) context-specific, 2) multidisciplinary, and 3) designed for/and implemented at national, regional or sub-national levels.

Third, the authors emphasize that further research is needed to provide a better understanding of the statistical relations identified in this paper. The variables used in our analysis were measured at a high level of aggregation and are likely to represent a variety of processes at regional and local levels. In other words, our analysis provides evidence of the effect of aggregate processes *only* at the national and provincial levels; more in-depth analysis of these factors will likely indicate a substantial amount of regional heterogeneity. Therefore, more detailed research is needed to 1) obtain a better understanding of the effects of the factors identified in our analysis at the regional/local level, 2) detect actual levels of regional heterogeneity and, 3) provide a more informed basis for future successful policy design and implementation.

Finally, the HIV epidemic shows a pattern of decline in many parts of Zimbabwe. This has been attributed to 1) dying out of the infected population, 2) decrease in high-risk sexual behaviours, and 3) increased access to treatment (Gregson et al. 2006, and 2010). We recommend implementation of a study to assess the role of mortality in declines in HIV prevalence in population subgroups.

CONCLUSION

HIV prevalence declined among both men and women in Zimbabwe between the ZDHS 2005-06 and ZDHS 2010-11; the patterns of decline varied according to socio-demographic, behavioural, and biological factors. Overall, decline in HIV prevalence was greater among women than men; this was seen particularly in rural areas. In contrast, decline in HIV prevalence in urban areas was greater among men than women. There were marked declines in HIV prevalence in some but not all provinces. Decline in HIV prevalence is associated with the adoption of safe sexual behaviours, although significant differences are seen between men and women. The public health implications of these findings are that HIV programmes should continue targeting subgroups according to gender, place of residence, and individual risk behaviours, in order to sustain the declines in HIV prevalence in Zimbabwe. The results presented in this paper support the conclusion that the HIV epidemic in sub-Saharan Africa is complex and requires rigorous, ongoing studies to accommodate the data needs of evidence-based HIV/AIDS programmes.

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