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W.T. Mapeta
N. Jonga
H. Musariri
E. Chikaka
S. Bradley
V. Mishra

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W.T. Mapeta[1]

N. Jonga[1]

H. Musariri[1]

E. Chikaka[2]

S. Bradley[3]

V. Mishra[3]

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Corresponding author: W.T. Mapeta, Central Statistical Office, Harare St., P.O. Box CY 342, Causeway, Harare, Zimbabwe; Phone: +263-11-221-809; Email: census@mweb.co.zw.

[1]Central Statistical Office, Harare, Zimbabwe
[2]Biomedical Research and Training Centre, Harare, Zimbabwe
[3]ICF Macro, Calverton, Maryland, USA

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ABSTRACT

Objectives: This study evaluates the extent of potential bias due to non-response in the 2005-06 Zimbabwe Demographic and Health Survey (ZDHS) and assesses the impact of such bias on the survey estimates of HIV prevalence. The study also examines the extent to which exclusion of non-household population groups from the ZDHS may have biased the HIV prevalence estimates.

Methods: Analysis in this study is based on 8,342 eligible men and 9,870 eligible women age 15-49. For the analysis of non-response bias, we divided the eligible survey population into three categories—interviewed and tested, interviewed but not tested, and neither interviewed nor tested. HIV prevalence for respondents in the two non-tested groups was predicted based on statistical models for those who were interviewed and tested, using a common set of predictor variables. For the analysis of non-household bias, we used the 2002 Population Census estimate of the size of the non-household population and simulated total HIV prevalence among all adults (household and non-household) under scenarios of whether HIV prevalence among the non-household population was double, triple, or quadruple that of the household population.

Results: Of eligible adults age 15-49 in the 2005-06 ZDHS, 36% of men and 24% of women did not have a valid HIV test result. Refusal was a more important reason for non-response than absence from the household. Non-tested men (but not women) had a slightly higher predicted prevalence of HIV than those tested. The overall effects of non-response bias on observed HIV prevalence estimates were small and not statistically significant, among both men and women. The estimated effects of exclusion of non-household population from the ZDHS were also

negligible. Even under the unlikely scenario that 72.4% of adults in the non-household population were HIV-positive, the survey-based estimate of HIV prevalence of 18.1% would only increase to 18.8%.

Conclusions: The findings that potential biases in the HIV prevalence estimates, whether due to non-response in the ZDHS or to exclusion of the non-household population, are negligible suggest that Zimbabwe can confidently continue using household-based national surveys to obtain reliable estimates of HIV prevalence. The anonymously linked socioeconomic and behavioural information with the HIV serostatus of individuals in such surveys is useful for identifying higher-risk and vulnerable populations and for informing prevention, care, and treatment programs. Nonetheless, it is recommended that similar evaluations of potential bias in survey-based estimates of HIV prevalence be conducted after each survey to ensure that the observed estimates of HIV prevalence from household surveys are reliable.

Key words: *Non-response; bias; HIV estimate; HIV prevalence; survey; Zimbabwe*

INTRODUCTION

This paper examines the effects of non-response in the 2005-06 Zimbabwe Demographic and Health Survey (ZDHS) on estimates of HIV prevalence. The ZDHS interviewed and tested for HIV a nationally representative sample of women age 15-49 and men age 15-54 living in households. We evaluate the extent of potential bias in the ZDHS estimates of HIV prevalence due to non-response, by predicting HIV prevalence among non-respondents based on the characteristics of the respondents. We also assess potential bias in the estimates of HIV prevalence due to exclusion of non-household population from the survey.

Since 1990, sentinel surveillance among pregnant women attending selected antenatal care (ANC) clinics has been the main source of national estimates of HIV prevalence in Zimbabwe (Ministry of Health and Child Welfare, 2006). However, ANC surveillance data have substantial limitations for use in estimating HIV prevalence—chiefly that they do not include men or non–pregnant women. In addition, coverage of rural areas by the sentinel surveillance system is often incomplete (Gouws et al., 2008; Garcia-Calleja et al., 2006; Boerma et al., 2003).

In recent years nationally representative population-based surveys in Zimbabwe and several other countries of sub-Saharan Africa have included HIV testing to obtain HIV prevalence estimates. These surveys also have limitations, particularly the potential for bias due to non-response in the survey and due to exclusion of non-household population groups (Mishra et al., 2008a). If the eligible respondents who are absent at the time of the survey or who refuse to be tested for HIV are more likely to be HIV-positive, then the observed HIV prevalence estimate based on those tested may be an underestimate. Similarly, if non-household population groups have higher HIV prevalence, the household survey-based estimate may be too low.

Studies have shown that non-responders, especially those who refuse to be tested for HIV, are more likely to be HIV-positive compared with those who participate and accept an HIV test (Garcia-Calleja et al., 2006). A scenario assuming that non-responders have twice the HIV prevalence of those who participated in surveys conducted in 19 sub-Saharan African countries since 2001 suggests that individual non-response could result in an adjusted HIV prevalence that is 1.03 to 1.34 times higher than the observed prevalence (Garcia-Calleja et al., 2006). Similarly, a health-facility based study in Ethiopia established that the patients who participated in the recent study were less likely to be HIV-positive than those who refused an HIV test (Reniers et al., 2007).

However, an evaluation of HIV prevalence estimates from recent Demographic and Health Surveys (DHS) and AIDS Indicator Surveys (AIS) in 17 countries shows that non-response in the surveys has small, insignificant effects on the observed HIV prevalence estimates from the surveys (Mishra et al., 2008b). Another recent study that evaluated potential bias in household survey-based estimates of HIV prevalence due to exclusion of non-household population in five countries concluded that for this bias to be significant both the relative size of the non-household population has to be large and HIV prevalence in the non-household population has to be much greater than in the household population (Mishra et al., 2008a).

DATA AND METHODS

Data

The sample for the 2005-06 ZDHS was designed to provide population and health indicator estimates at the national and provincial levels. The sampling frame used for the ZDHS was the 2002 Zimbabwe Master Sample (ZMS02) developed by Central Statistical Office (CSO) after the 2002 Population Census.

The ZDHS sample design was in two stages, with the first stage resulting in 400 Enumeration Areas (EAs) being selected with probability proportional to size (PPS), the size being the number of households enumerated in each EA during the 2002 Census. Households were selected in the second stage, after a complete house-listing in all selected EAs, using a systematic probability sampling technique. In the selected households all women age 15-49 and men age 15-54 who were either usual members or visitors of selected households were eligible to be interviewed and tested for HIV.

The protocol used for ZDHS allows for the merging of the HIV results with the demographic, socioeconomic, and behavioural data collected in the individual questionnaires, while at the same time maintaining the anonymity of the respondent.

Methods

In our analysis all respondents eligible for HIV testing were divided into three categories: i) interviewed and tested, ii) interviewed but not tested, and iii) neither interviewed nor tested. HIV prevalence for respondents in the two non-tested groups was predicted based on multivariate statistical models of HIV for those who were interviewed and tested using a common set of predictor variables. Logistic regression was used to calculate predicted prevalence separately for

the interviewed-but-not-tested and the neither-interviewed-nor-tested categories. Predictions for the latter category were based on a set of variables from the household questionnaire, while predictions for the former included additional variables derived from the individual questionnaires. Adjusted HIV prevalence was calculated as a weighted average of observed prevalence in the interviewed-and-tested group and predicted prevalence in the two non-tested groups.

The analysis was carried out separately for men and women age 15-49, as well as for all eligible adults (men and women combined). HIV prevalence for the neither-interviewed-nor-tested category was predicted using the following socioeconomic and demographic variables: age, residence (rural or urban), province of the country, educational attainment, and wealth status. Predictors for the interviewed-but-not-tested category additionally included the following variables: marital status, childbirth in last five years (women only), work status, mass media exposure, religion, circumcision (men only), sexually transmitted infections (STIs) or STI symptoms in the last 12 months, alcohol use at last sex in the last 12 months, number of sex partners in the last 12 months, cigarette smoking/tobacco use, age at first sex, number of lifetime sexual partners, number of sexual partners in the last 12 months, condom use at last sex in the last 12 months, higher-risk sex (sex with a non-marital, non-cohabiting partner) in the last 12 months, knowledge of HIV-prevention methods (abstinence, being faithful, and condom use), attitudes toward people living with HIV, woman's ability to negotiate safer sex with spouse, woman's participation in household decision-making (women only), number of medical injections in the last 12 months, duration of stay in current place of residence, number of times slept away in the last 12 months (men only), away (from usual place of residence) for more than 1 month in the last 12 months (men only), and previously tested for HIV.

To estimate the effects of excluding non-household population groups from the ZDHS sample, we made simulations under four scenarios. The first scenario (baseline) assumes that HIV prevalence is the same for both the household and non-household populations. The other three scenarios assume that HIV prevalence of the non-household population is, respectively, double, triple, and quadruple that of the surveyed population.

RESULTS

In the 2005-06 ZDHS a total of 10,752 households were selected, of which 9,778 were occupied. Of these, interviews were conducted in 9,285 households, yielding a household response rate of 95%. In the interviewed households complete interviews were conducted with 8,907 women age 15-49 and 7,175 men age 15-54, yielding individual interview response rates of 90% and 82%, respectively. The principal reason for non-response for individual interview was failure to find potential respondents at home, despite repeated visits to the household. Men had a lower response rate for individual interview than women, mainly due to more frequent and longer absences of men from the household. The refusal rate for individual interview was only 2% for women and 3% for men (CSO & Macro International, 2007).

All women and men eligible for individual interview were also eligible for HIV testing. HIV testing was completed for 70% of all eligible adults in the sampled households—64% of eligible men age 15-49 and 76% of eligible women age 15-49. Observed HIV prevalence among the tested adults age 15-49 was 18.1%. The prevalence was higher among women (21.1%) than among men (14.5%), and was higher in urban areas (18.9%) than in rural areas (17.6%).

Patterns of non-response for HIV testing

Table 1 shows non-response rates for HIV testing, by reasons for non-response and by selected background characteristics, for men and women age 15-49 who were eligible for HIV testing in the 2005-06 ZDHS. Non-response rates were substantially higher among urban men (50%) and urban women (35%) than among their rural counterparts (28% and 17%, respectively). For both sexes, non-response rates were highest among respondents in the highest household wealth quintile. Of the 10 provinces in Zimbabwe, Harare had the highest non-response rate for both

men (53%) and women (38%). Midlands had the lowest non-response rates for both men (18%) and women (9%).

The main reason for non-response was refusal to give blood for HIV testing. Overall, 21% of men and 15% of women refused testing, compared with 13% of men and 6% of women who were absent for testing. For about 3% of men and women, a blood sample was taken but a valid test result could not be obtained.

Table 1. HIV non-response rates by reasons for non-response and by selected background characteristics among all males and females age 15-49 who were eligible for HIV testing, ZDHS 2005-06

	Males					Females				
			Reasons for non-response					Reasons for non-response		
Characteristic	Number eligible for testing	Non-response rate	Refused	Absent	Other/ missing	Number eligible for testing	Non-response rate	Refused	Absent	Other/ missing
Age group										
15-19	2,266	28.6	16.5	9.7	2.4	2,350	23.5	14.8	6.5	2.2
20-24	1,751	37.2	20.8	13.8	2.6	2,157	25.2	16.5	6.6	2.1
25-29	1,300	40.5	23.2	14.4	2.9	1,605	23.8	13.7	7.8	2.3
30-34	1,118	41.3	23.4	15.3	2.7	1,331	23.7	15.3	6.5	1.9
35-39	829	42.2	22.9	15.3	4.0	948	24.6	15.3	6.1	3.2
40-44	550	36.6	21.8	11.6	3.1	785	23.8	16.4	4.6	2.8
45-49	528	37.5	21.4	10.4	5.7	694	23.6	13.8	5.2	4.6
Residence										
Urban	3,236	50.3	28.5	19.1	2.6	3,763	35.0	23.3	9.2	2.5
Rural	5,106	27.6	15.7	8.7	3.2	6,107	17.4	10.2	4.7	2.5
Province										
Manicaland	885	30.7	15.9	12.4	2.4	1,108	22.2	14.8	4.4	3.0
Mashonaland Central	773	40.5	28.1	8.5	3.9	807	27.8	21.1	4.7	2.0
Mashonaland East	661	29.2	12.4	12.9	3.9	778	19.3	7.5	8.9	3.0
Mashonaland West	790	32.3	13.9	15.8	2.5	880	25.6	15.5	8.0	2.2
Matabeleland North	583	32.3	21.8	5.5	5.0	708	19.5	13.4	2.7	3.4
Matabeleland South	535	44.3	29.7	12.3	2.2	698	23.9	14.5	6.5	3.0
Midlands	1,022	18.0	8.3	7.8	1.9	1,185	9.4	5.5	2.6	1.3
Masvingo	824	28.5	19.8	6.4	2.3	1,039	16.1	9.7	3.8	2.6
Harare	1,461	53.3	26.7	23.9	2.7	1,683	37.8	23.2	11.9	2.7
Bulawayo	808	47.2	30.8	12.3	4.1	984	31.7	22.1	7.7	1.9

(Cont'd)

Table 1 – cont'd

Characteristic	Males					Females				
	Number eligible for testing	Non-response rate	Reasons for non-response			Number eligible for testing	Non-response rate	Reasons for non-response		
			Refused	Absent	Other/ missing			Refused	Absent	Other/ missing
Education										
No education	159	56.6	17.0	12.6	27.0	443	26.6	11.7	4.5	10.4
Primary	2,231	30.5	17.3	9.6	3.6	3,212	20.8	13.5	4.7	2.7
Secondary or higher	5,952	38.1	22.0	13.9	2.1	6,215	25.6	16.3	7.5	1.8
Household wealth quintile										
Lowest	1,352	27.4	14.9	9.0	3.6	1,741	17.8	10.2	4.6	3.0
Second	1,448	26.5	14.2	8.6	3.8	1,710	16.2	9.8	3.8	2.6
Middle	1,452	28.2	16.1	9.0	3.2	1,747	17.6	9.9	5.5	2.2
Fourth	2,135	40.3	24.2	13.7	2.4	2,129	26.3	17.1	6.8	2.3
Highest	1,955	51.7	29.0	20.3	2.5	2,543	36.3	24.1	9.8	2.3
Total		**36.4**	**20.6**	**12.8**	**3.0**		**24.1**	**15.2**	**6.4**	**2.5**
Number	**8,342**	**3,036**	**1,723**	**1,065**	**248**	**9,870**	**2,376**	**1,497**	**636**	**243**

Table 2 provides patterns of non-response by selected risk behaviours and other characteristics among men and women who were eligible for HIV testing and were interviewed in the ZDHS.

Men and women in polygynous unions had higher HIV non-response rates than those in monogamous unions, never married, or formerly married. Non-response rates were also higher among men and women who had regular weekly exposure to the three sources of media (radio, TV, and newspapers). Among men, the Apostolic Sect and the Pentecostals exhibited a higher non-response rate (24%) than other religions; among women, Pentecostals had a higher non-response rate (18%) than other religions.

The non-response rate among respondents tested in the past 12 months was higher than among the non-tested. Among those tested in the last 12 months, men (26%) were more likely than women (17%) to refuse an HIV test. Men who were uncircumcised exhibited a slightly higher non-response rate (23%) than circumcised men (21%). However, the numbers of circumcised men in Zimbabwe are negligible.

Men who engaged in the following risk behaviours were more likely to refuse an HIV test as part of the survey: no condom use in the last 12 months; commercial sex in the last 12 months; sleeping away from home more than four times in the last 12 months; lack of knowledge of the three "ABC" HIV-prevention methods (abstaining, being faithful, and using condoms); having more than two sexual partners in the last 12 months; and having small perceived risk of acquiring HIV.

Women who engaged in the following risk behaviours exhibited higher non-response rates for HIV testing: smoke/chew tobacco; do not participate in two or more major household decisions; and lack of knowledge of the "ABC" HIV-prevention methods.

Table 2. HIV non-response rates by reasons for non-response and selected risk behaviours and other characteristics among all males and females age 15-49 who were eligible for HIV testing and were interviewed, ZDHS 2005-06

	Males				Females			
			Reasons for non-response				Reasons for non-response	
Characteristic	Number interviewed	Non-response rate	Refused	Other/ missing	Number interviewed	Non-response rate	Refused	Other/ missing
Religion								
Roman Catholic	693	21.5	20.5	1.0	920	13.8	12.3	1.5
Protestant	1,158	20.6	19.3	1.2	2,257	15.7	14.7	1.0
Pentecostal	883	23.6	22.4	1.1	1,535	18.3	16.6	1.8
Apostolic Sect	1,560	24.0	22.4	1.5	2,672	15.3	14.4	0.9
Other/none	2,555	22.5	21.3	1.2	1,523	15.8	14.6	1.2
Work status								
Not working	2,629	20.9	19.9	1.1	5,643	15.5	14.3	1.3
Working	4,220	23.5	22.2	1.4	3,264	16.5	15.4	1.1
Marital status								
Never in union	3,453	20.7	19.5	1.2	2,452	17.3	16.1	1.3
In monogamous union	2,916	24.6	23.3	1.2	4,528	14.8	13.7	1.1
In polygynous union	151	29.1	25.8	3.3	590	20.0	18.6	1.4
Widowed	87	21.8	20.7	1.2	660	15.9	14.7	1.2
Divorced/separated	242	21.5	20.3	1.2	677	13.9	12.7	1.2
Birth in past 5 years								
No	n/a	n/a	n/a	n/a	4,833	17.2	15.9	1.2
Yes	n/a	n/a	n/a	n/a	4,074	14.3	13.2	1.1
Regular exposure to media sources per week								
None	2,055	18.6	17.3	1.4	4,037	12.4	11.2	1.2
One source	1,736	19.4	17.8	1.6	1,779	15.2	14.4	0.8
Two sources	1,429	21.8	20.9	0.9	1,716	19.1	17.5	1.5
All three sources	1,629	31.4	30.3	1.1	1,375	23.1	21.7	1.4

(Cont'd)

Table 2 – cont'd

Characteristic	Males				Females			
			Reasons for non-response				Reasons for non-response	
	Number interviewed	Non-response rate	Refused	Other/ missing	Number interviewed	Non-response rate	Refused	Other/ missing
Smokes cigarettes or uses tobacco								
No	5,306	23.1	21.9	1.2	8,825	15.8	14.7	1.2
Yes	1,543	20.6	19.1	1.6	82	19.5	17.1	2.4
Number of years in current residence								
<3 years	882	23.7	22.7	1.0	993	17.5	16.4	1.1
3-9 years	1,029	25.5	24.0	1.5	1,871	17.1	15.8	1.3
10+ years	4,938	21.7	20.5	1.3	6,043	15.2	14.1	1.2
Away from home in past 12 months								
Never	3,142	21.0	19.7	1.2	n/a	n/a	n/a	n/a
Less than 1 month	2,356	24.3	23.1	1.2	n/a	n/a	n/a	n/a
1+ month	1,307	22.4	21.0	1.5	n/a	n/a	n/a	n/a
Missing/DK (don't know)	44	(40.9)	(40.9)	(0.0)	n/a	n/a	n/a	n/a
Number of times slept away in past 12 months								
0	3,142	21.0	19.7	1.2	n/a	n/a	n/a	n/a
1-2	1,494	20.4	18.7	1.6	n/a	n/a	n/a	n/a
3-4	756	24.1	23.0	1.1	n/a	n/a	n/a	n/a
5+	1,428	27.3	26.3	1.1	n/a	n/a	n/a	n/a
Missing/DK	29	(27.6)	(27.6)	(0.0)	n/a	n/a	n/a	n/a
Participates in 2+ major household decisions								
No	n/a	n/a	n/a	n/a	3,974	16.5	15.3	1.2
Yes	n/a	n/a	n/a	n/a	4,933	15.3	14.2	1.2
Circumcision								
No	6,127	22.7	21.4	1.3	n/a	n/a	n/a	n/a
Yes	698	21.4	20.8	0.6	n/a	n/a	n/a	n/a
Missing/DK	24	*	*	*	n/a	n/a	n/a	n/a

(Cont'd)

Table 2 – cont'd

Characteristic	Males				Females			
			Reasons for non-response				Reasons for non-response	
	Number interviewed	Non-response rate	Refused	Other/ missing	Number interviewed	Non-response rate	Refused	Other/ missing
Age at first sexual intercourse								
Never had sex	1,852	19.9	18.8	1.1	1,865	17.2	16.0	1.2
<15	272	25.4	23.9	1.5	617	18.0	16.7	1.3
15-17	1,345	20.2	18.5	1.7	2,727	14.4	13.2	1.2
18-19	1,319	24.3	23.4	0.9	1,821	14.6	13.6	1.0
20+	1,996	24.8	23.6	1.3	1,572	18.7	17.1	1.6
Missing/DK	65	27.7	26.2	1.5	305	9.8	9.5	0.3
Number of lifetime partners								
0	1,852	19.9	18.8	1.1	1,865	17.2	16.0	1.2
1	963	26.8	25.6	1.3	4,558	16.2	15.1	1.2
2	899	23.7	22.3	1.5	1,504	13.5	12.6	0.9
3+	3,034	21.8	20.5	1.3	950	15.1	13.3	1.8
Missing/DK	101	40.6	40.6	0.0	30	26.7	26.7	0.0
Number of partners in past 12 months								
Never had sex	2,518	20.6	19.5	1.2	3,061	17.1	15.8	1.2
1	3,744	24.1	22.7	1.4	5,769	15.2	14.1	1.1
2	491	19.4	18.7	0.6	70	15.7	12.9	2.9
3+	89	29.2	27.0	2.3	7	*	*	*
Missing/DK	7	*	*	*	0	*	*	*
Higher-risk sex in past 12 months								
No sex in past 12 months	2,518	20.6	19.5	1.2	3,061	17.1	15.8	1.2
Sex with non-marital, non-cohabiting partner	1,555	21.5	20.1	1.4	693	15.9	14.4	1.4
Sex with spouse/partner only	2,776	24.9	23.6	1.3	5,153	15.1	14.0	1.1

(Cont'd)

Table 2 – cont'd

Characteristic	Males				Females			
			Reasons for non-response				Reasons for non-response	
	Number interviewed	Non-response rate	Refused	Other/ missing	Number interviewed	Non-response rate	Refused	Other/ missing
Condom use at last sex in past 12 months								
No sex in past 12 months	2,518	20.6	19.5	1.2	3,061	17.1	15.8	1.2
Used condom	1,101	21.9	20.7	1.2	494	18.8	17.6	1.2
Did not use condom	3,230	24.2	22.9	1.4	5,352	14.9	13.7	1.2
Paid sex in past 12 months								
Paid sex	253	26.9	23.7	3.2	n/a	n/a	n/a	n/a
No paid sex	4,078	23.4	22.2	1.2	n/a	n/a	n/a	n/a
No sex in past 12 months	2,518	20.6	19.5	1.2	n/a	n/a	n/a	n/a
Alcohol use during sex in past 12 months								
No sex in past 12 months	2,518	20.6	19.5	1.2	3,061	17.1	15.8	1.2
Did not use alcohol	3,895	24.0	22.6	1.4	5,236	15.6	14.4	1.2
Used alcohol (either/both)	405	21.0	20.7	0.3	606	12.1	10.7	1.3
Missing/DK	31	(16.1)	(9.7)	(6.5)	4	*	*	*
Perceived risk of acquiring HIV								
Small	2,010	24.2	23.1	1.1	2,337	12.9	11.7	1.2
Medium	1,062	22.3	20.8	1.5	1,508	14.5	13.5	0.9
High	525	19.4	16.8	2.7	701	15.3	14.0	1.3
No risk/DK	3,252	22.1	21.0	1.0	4,361	18.0	16.8	1.2
Previously tested for HIV								
Never tested	5,651	21.7	20.5	1.2	6,631	15.9	14.8	1.2
Tested, not in past 12 months	706	25.9	24.4	1.6	1,641	14.5	13.4	1.2
Tested in past 12 months	492	26.8	25.6	1.2	635	18.6	17.2	1.4
STI or STI symptom in past 12 months								
No	6,475	22.8	21.7	1.1	8,215	16.3	15.1	1.2
Yes	374	17.7	14.2	3.5	692	11.1	9.8	1.3

(Cont'd)

Table 2 – cont'd

Characteristic	Males				Females			
			Reasons for non-response				Reasons for non-response	
	Number interviewed	Non-response rate	Refused	Other/ missing	Number interviewed	Non-response rate	Refused	Other/ missing
Knowledge of ABC prevention methods								
0	181	28.2	24.9	3.3	523	23.5	22.6	1.0
1	503	21.9	19.1	2.8	946	16.2	15.5	0.6
2	1,637	22.8	21.5	1.3	2,382	15.3	14.4	0.9
3	4,528	22.3	21.3	1.0	5,056	15.3	13.8	1.4
Attitude toward people living with HIV (PLHIV) (scale)								
Lowest	101	35.6	33.7	2.0	309	23.6	22.0	1.6
Lower	848	19.9	18.5	1.4	843	16.1	15.4	0.7
Middle	1,793	20.9	20.0	1.0	2,391	15.7	14.6	1.1
Higher	3,283	22.4	21.0	1.4	3,860	15.8	14.4	1.4
Highest	824	27.7	26.6	1.1	1,504	14.6	13.6	1.1
Number of injections in the last 12 months: professionals								
0	6,428	22.5	21.3	1.2	7,642	16.1	14.9	1.2
1-3	317	23.3	21.1	2.2	1,105	14.4	13.0	1.4
4+	104	23.1	23.1	0.0	160	15.6	15.0	0.6
Total		**22.5**	**21.3**	**1.3**		**15.9**	**14.7**	**1.2**
Number	**6,849**	**1,543**	**1,457**	**86**	**8,907**	**1,413**	**1,307**	**106**

* based on <25 unweighted cases; () based on 25-49 unweighted cases.

Adjusted prevalence among respondents eligible for HIV testing in the survey

Table 3 shows how the predicted prevalence among the non-tested differs from the observed prevalence among the tested respondents and what impact this non-response bias has on the adjusted prevalence of HIV for all men and women eligible for testing.

The results indicate that non-tested men (but not women) had a slightly higher predicted prevalence of HIV than those tested. Of particular importance are men with a secondary or higher level of education and those in the highest wealth quintile, among whom the predicted HIV prevalence among the non-tested was substantially higher than the observed HIV prevalence. The overall effects of non-response bias on observed prevalence estimates for both men and women were small and statistically not significant. This pattern holds regardless of place of residence, level of education, or household wealth status.

Table 3. Predicted HIV prevalence among non-respondents and adjusted HIV prevalence estimates for all eligible males, females, and all adults (males and female combined) age 15-49, by selected background characteristics, ZDHS 2005-06

	Males			Females			Combined		
Characteristic	Observed HIV prevalence among tested	Predicted HIV prevalence among non-tested respondents	Adjusted HIV prevalence among all eligible	Observed HIV prevalence among tested	Predicted HIV prevalence among non-tested respondents	Adjusted HIV prevalence among all eligible	Observed HIV prevalence among tested	Predicted HIV prevalence among non-tested respondents	Adjusted HIV prevalence among all eligible
Age group									
15-19	3.1	3.1	3.1	6.2	5.5	6.0	4.6	4.4	4.6
20-24	5.8	6.3	6.0	16.3	15.5	16.1	11.6	11.4	11.5
25-29	13.1	13.1	13.1	28.8	27.5	28.5	21.8	21.2	21.6
30-34	29.5	28.4	29.0	35.5	35.1	35.4	32.9	31.8	32.6
35-39	32.1	32.7	32.3	34.5	35.1	34.7	33.4	33.5	33.4
40-44	32.9	31.4	32.4	25.7	28.1	26.4	28.9	29.6	29.1
45-49	26.0	23.4	25.1	18.0	17.1	17.8	21.4	19.9	21.0
Residence									
Urban	15.7	18.1	16.7	21.6	21.1	21.5	18.9	20.1	19.3
Rural	13.8	13.3	13.7	20.8	20.6	20.8	17.6	17.1	17.5
Province									
Manicaland	16.6	13.4	15.7	22.3	18.9	21.5	19.7	16.9	19.0
Mashonaland Central	13.8	14.6	14.0	22.9	22.9	22.9	18.5	18.3	18.4
Mashonaland East	14.4	13.7	14.2	21.3	21.7	21.4	18.0	17.6	17.9
Mashonaland West	15.4	15.9	15.5	22.5	25.7	23.4	19.1	21.0	19.7
Matabeleland North	14.4	17.3	15.3	22.8	19.7	22.1	19.0	19.5	19.1
Matabeleland South	15.6	14.7	15.3	24.6	22.0	23.9	20.8	19.0	20.2

(Cont'd)

Table 3 – cont'd

Characteristic	Males			Females			Combined		
	Observed HIV prevalence among tested	Predicted HIV prevalence among non-tested respondents	Adjusted HIV prevalence among all eligible	Observed HIV prevalence among tested	Predicted HIV prevalence among non-tested respondents	Adjusted HIV prevalence among all eligible	Observed HIV prevalence among tested	Predicted HIV prevalence among non-tested respondents	Adjusted HIV prevalence among all eligible
Province (cont'd)									
Midlands	11.5	13.1	11.8	20.1	19.5	20.0	16.1	16.3	16.1
Masvingo	12.1	13.2	12.4	17.3	18.5	17.5	15.1	16.0	15.3
Harare	17.3	19.6	18.3	21.1	20.5	20.9	19.3	20.5	19.8
Bulawayo	12.8	17.2	14.9	19.6	19.8	19.7	16.8	19.0	17.7
Education									
No education	23.4	16.8	19.5	20.0	19.4	19.8	20.6	17.7	19.6
Primary	15.0	14.8	15.0	22.4	22.4	22.4	19.4	19.1	19.3
Secondary or higher	14.2	16.4	15.0	20.5	20.4	20.5	17.4	18.8	17.8
Household wealth quintile									
Lowest	13.4	11.7	12.9	17.7	17.2	17.6	15.9	14.4	15.5
Second	15.1	14.0	14.8	21.1	20.3	21.0	18.4	17.4	18.2
Middle	12.2	12.2	12.2	22.7	22.5	22.7	17.9	17.7	17.9
Fourth	17.1	18.7	17.7	26.8	26.8	26.8	21.9	23.1	22.3
Highest	13.5	17.3	15.2	17.1	18.0	17.5	15.6	17.8	16.5
Total	**14.5**	**16.1**	**15.1**	**21.1**	**20.9**	**21.1**	**18.1**	**18.8**	**18.3**
Weighted N	**5,848**	**3,011**	**8,860**	**6,947**	**2,384**	**9,331**	**12,796**	**5,389**	**18,184**
Unweighted N	**5,306**	**3,036**	**8,342**	**7,494**	**2,376**	**9,870**	**12,800**	**5,412**	**18,212**

* Significantly different from the observed HIV prevalence at 5%.

Non-response bias due to exclusion of non-household population

Table 4 shows potential effects of exclusion of non-household population in the ZDHS sample on the observed household-based estimates of HIV prevalence, for men and women age 15-49. Four scenarios were used to gauge this effect. The first assumes that HIV prevalence is the same for both the household and non-household populations, and the other three assume that non-household HIV prevalence is, respectively, double, triple, and quadruple that of the surveyed population.

As Table 4 shows, the estimated effects of exclusion of non-household population from the ZDHS are negligible. For the total adult population (men and women combined), scenarios 2, 3 and 4, which assume 36.2%, 54.3% and 72.4% HIV prevalence for the non-household population produce estimates of 18.3%, 18.6%, and 18.8%, respectively, compared with the observed prevalence of 18.1% based on the household sample of adults tested in the ZDHS.

Simulations in which male non-household populations are assumed to have 29.0%, 43.5%, and 58.0% HIV prevalence rates under scenarios 2, 3 and 4 yield final estimates of 14.8%, 15.0%, and 15.5%, respectively. Similarly, simulations for female non-household populations that assume HIV prevalence of 42.2%, 63.3%, and 84.4 % for scenarios 2, 3 and 4 yield estimates of 21.3%, 21.5%, and 21.6% , respectively.

Table 4. Potential effects of exclusion of non-household population in the 2005-06 ZDHS sample on national HIV estimate for males, females, and all adults (males and females combined) age 15-49, Zimbabwe

Scenario	Population age 15-49 in 2002	Projected population age 15-49 in 2005	HIV prevalence among adults age 15-49		Estimated number of HIV+ adults age 15-49 in population	Estimated HIV prevalence among all adults age 15-49 in population (HH + NHH)*
Males						
Scenario 1 (baseline)						
Household male population	2,689,591	2,779,327	Observed HH%	14.5%	403,002	
Non-household male population	50,780	52,474	NHH% = HH%	14.5%	7,609	
Total male population	2,740,371	2,831,802			410,611	14.5%
Scenario 2						
Household male population	2,689,591	2,779,327	Observed HH%	14.5%	403,002	
Non-household male population	50,780	52,474	NHH% = 2*HH%	29.0%	15,218	
Total male population	2,740,371	2,831,802			418,220	14.8%
Scenario 3						
Household male population	2,689,591	2,779,327	Observed HH%	14.5%	403,002	
Non-household male population	50,780	52,474	NHH% = 3*HH%	43.5%	22,826	
Total male population	2,740,371	2,831,802			425,829	15.0%
Scenario 4						
Household male population	2,689,591	2,779,327	Observed HH%	14.5%	403,002	
Non-household male population	50,780	52,474	NHH% = 4*HH%	58.0%	30,435	
Total male population	2,740,371	2,831,802			433,438	15.3%

(Cont'd)

Table 4 – cont'd

Scenario	Population age 15-49 in 2002	Projected population age 15-49 in 2005	HIV prevalence among adults age 15-49		Estimated number of HIV+ adults age 15-49 in population	Estimated HIV prevalence among all adults age 15-49 in population (HH + NHH)*
Females						
Scenario 1 (baseline)						
Household female population	2,973,660	3,072,874	Observed HH%	21.1%	648,376	
Non-household female population	25,879	26,742	NHH% = HH%	21.1%	5,643	
Total female population	2,999,539	3,099,617			654,019	21.1%
Scenario 2						
Household female population	2,973,660	3,072,874	Observed HH%	21.1%	648,376	
Non-household female population	25,879	26,742	NHH% = 2*HH%	42.2%	11,285	
Total female population	2,999,539	3,099,617			659,662	21.3%
Scenario 3						
Household female population	2,973,660	3,072,874	Observed HH%	21.1%	648,376	
Non-household female population	25,879	26,742	NHH% = 3*HH%	63.3%	16,928	
Total female population	2,999,539	3,099,617			665,304	21.5%
Scenario 4						
Household female population	2,973,660	3,072,874	Observed HH%	21.1%	648,376	
Non-household female population	25,879	26,742	NHH% = 4*HH%	84.4%	22,571	
Total female population	2,999,539	3,099,617			670,947	21.6%

(Cont'd)

Table 4 – cont'd

Scenario	Population age 15-49 in 2002	Projected population age 15-49 in 2005	HIV prevalence among adults age 15-49		Estimated number of HIV+ adults age 15-49 in population	Estimated HIV prevalence among all adults age 15-49 in population (HH + NHH)*
All Adults (males and females combined)						
Scenario 1 (baseline)						
Household population	5,663,251	5,852,202	Observed HH%	18.1%	1,059,248	
Non-household population	76,659	79,217	NHH% = HH%	18.1%	14,338	
Total population	5,739,910	5,931,418			1,073,587	18.1%
Scenario 2						
Household population	5,663,251	5,852,202	Observed HH%	18.1%	1,059,248	
Non-household population	76,659	79,217	NHH% = 2*HH%	36.2%	28,676	
Total population	5,739,910	5,931,418			1,087,925	18.3%
Scenario 3						
Household population	5,663,251	5,852,202	Observed HH%	18.1%	1,059,248	
Non-household population	76,659	79,217	NHH% = 3*HH%	54.3%	43,015	
Total population	5,739,910	5,931,418			1,102,263	18.6%
Scenario 4						
Household population	5,663,251	5,852,202	Observed HH%	18.1%	1,059,248	
Non-household population	76,659	79,217	NHH% = 4*HH%	72.4%	57,353	
Total population	5,739,910	5,931,418			1,116,601	18.8%

Note: The 2007 Government of Zimbabwe, MOH, estimates for number of HIV-positive adults was 1.08 million, and for HIV-positive adults and children was 1.3 million.

* HH: household; NHH: non-household.

DISCUSSION

Results indicate that non-response rates were substantially higher among urban men and women than among their rural counterparts. For both sexes, non-response rates were highest among respondents in the highest household wealth quintile. The principal reason for non-response was refusal to take an HIV test.

There were also clear patterns of non-response by risk behaviours. Men who engaged in the following risk behaviours were more likely to refuse an HIV test as part of the survey: no condom use in the last 12 months; commercial sex in the last 12 months; sleeping away from home more than four times in the last 12 months; lack knowledge of the three "ABC" HIV-prevention methods (abstaining, being faithful, and using condoms); having more than two sexual partners in the last 12 months; and having small perceived risk of acquiring HIV. Women exposed to the following risk behaviours exhibited high non-response rates for HIV testing: smoke/chew tobacco; do not participate in two or more major household decisions and lack knowledge of the "ABC" HIV-prevention methods.

Results also indicate that non-tested men (but not women) had a slightly higher predicted prevalence of HIV than those tested. Of particular importance are men with secondary or higher level of education and those in the highest household wealth quintile, where the predicted HIV prevalence was substantially higher than the observed HIV estimates.

Adjusting the observed HIV national estimate for tested adults, by accounting for the predicted rates among the non-tested, makes an insignificant difference to the observed prevalence HIV estimate. This pattern holds regardless of sex, place of residence, province, level of education, or household wealth status. This finding is consistent with previous research that shows that non-response in the surveys tends to have insignificant effects on the observed

national HIV prevalence estimates (Mishra et al., 2008a, 2008b; McNaghten et al., 2007; Bignami-Van Assche et al., 2005; Obare, 2005).

Even after factoring in assumed prevalence rates for the non-household population, differences in estimated HIV prevalence in the total population (household and non-household) remain small compared with the household-based estimate from the 2005-06 ZDHS. For instance, an unlikely scenario in which 72.4% of adults in the non-household population are considered HIV-positive, the survey HIV prevalence estimate of 18.1% only increases to 18.8%. This result is probably because the non-household population is a relatively insignificant proportion of the total Zimbabwe population. The finding that exclusion of non-household population is likely to have minimal effect on the HIV prevalence obtained from the household-based ZDHS is consistent with a similar analysis of survey-based estimates in five other countries (Mishra et al. 2008b).

The adjustments performed in this report only partially address the non-response bias. The HIV prevalence for the 'not interviewed and not tested' group was adjusted based on limited information available from the household. Furthermore, the *de facto* method employed in the survey design excludes international out-migrants normally resident in the sampled households. The other limitations are associated with the nature of cross-sectional surveys. Cross-sectional surveys consider the exposures and outcomes at a point in time, identifying relationships but not causality. Moreover, some of the responses are based on the respondent's self-declarations, which in most cases have biases of reporting. Self-declarations are affected by social desirability bias—that is, respondents tend to provide answers that they think are acceptable.

In summary, the results of this study suggest that non-response and exclusion of non-household population in surveys do not significantly bias national HIV prevalence estimates

from population-based surveys. The study also concludes that HIV estimates from population-based surveys are reliable and nationally representative. Among others, the advantages of HIV serostatus data from surveys are that the data can be anonymously linked to socioeconomic and behavioural information of individuals to identify higher-risk and vulnerable populations and inform prevention, care, and treatment programs. Furthermore, estimates from population-based survey can be used to calibrate data from surveillance systems. Nonetheless, it is recommended that evaluation of potential bias due to non-response and exclusion of non-household population be conducted after each survey to ensure that the observed estimates of HIV prevalence from household surveys are reliable.

REFERENCES

Bignami-Van Assche S, Solomon JA, Murray CJL. Evidence from the population-based estimates of bias in HIV prevalence. Presented at Population Association of America, Annual Meeting, Philadelphia, March 31-April 2, 2005.

Boerma JT, Ghys PD, Walker N. Estimates of HIV-1 prevalence from population-based surveys as a new gold standard. *Lancet* 362(9399):1929-31, 2003.

Central Statistical Office (CSO) and Macro International Inc. Zimbabwe Demographic and Health Survey 2005-06. Calverton, Maryland: CSO and Macro International Inc., 2007.

Garcia-Calleja JM, Gouws E, Ghys PD. National population-based HIV prevalence surveys in sub-Saharan Africa: results and implications for HIV and AIDS estimates. *Sex Transm Infect* 82(Suppl 3):iii64-70, 2006.

Gouws E, Mishra V, Fowler TB. Comparison of adult HIV prevalence from national population-based surveys and antenatal clinic surveillance in countries with generalized epidemics: implications for calibrating surveillance data. *Sex Transm Infect* 84: i17-i23, 2008.

McNaghten AD, Herod JM, Dube HM, St Louis ME. Response rates for providing a blood specimen for HIV testing in population-based survey of young adults in Zimbabwe. *BMC Public Health* 7:145, 2007.

Ministry of Health and Child Welfare. Antenatal clinic surveillance report, Zimbabwe, 2006.

Mishra V, Barrere B, Hong R, Khan S. Evaluation of bias in HIV seroprevalence estimates from national household surveys. *Sex.Transm Infect* 84(Suppl 1):i63-i70, 2008b

MishraV, Hong R, Khan S, Gu Y, Liu L. DHS analytical studies 12: Evaluating HIV estimates from national population-based surveys from bias resulting from non response. *Macro International*, 2008a.

Obare F. The effects of non response on population-based HIV prevalence estimates. The case of rural Malawi. Social Networks Project working paper, Philadelphia, University of Pennsylvania, 2005.

Reniers G, Araya T, Berhane Y, Davey G, Sanders EJ. Implications of the HIV testing protocol for refusal bias in seroprevalence surveys. *BMC Public Health* 9:163, 2009.