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Assessment of human immune deficiency virus (HIV) prevalence estimate among women of childbearing age in Nigeria: Relative inclusion fertility ratios approach

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Globally, human immune deficiency virus (HIV) constitutes a public health problem. Researchers have been curious about the true estimate of HIV prevalence in Nigeria. Therefore, the current study was designed to assess the reliability of the existing estimate in Nigeria. The study was cross-sectional in design and utilized data originally collected by National human immune deficiency virus (HIV)/acquired immune deficiency syndrome (AIDS) and Reproductive Health Survey (NARHS) in Nigeria. Analysis was performed using Chi-square, logistic regression and relative inclusion ratio (Alpha = 5%). Mean ages of HIV-positive and HIV-negative women were 29.65 ± 8.5 and 27.88 ± 9.4 years, respectively. Overall fertility rate was higher among HIV positive women than HIV negative women. The multivariate analysis shows that women in the South-west were 0.428(C.I=0.202-0.908; p=0.027) less likely to contact HIV than their counterparts in the North-west. Also women who formally married were approximately 5 (C.I=2.401-9.367; p<0.001) times more likely to contact HIV than those who never married. The relative inclusion ratio (RIR) was higher in urban (1.16) than rural (0.97) areas, and the overall RIR was 1.02. The RIR found in our study is an indication of over-estimation of HIV prevalence in Nigeria. However, HIV prevalence was overestimated and underestimated in urban and rural areas respectively. Accurate statistics on HIV prevalence is necessary in Nigeria. This will assist HIV programmers in their strategies to combat HIV in Nigeria.

Key words: Relative inclusion ratio, fertility rate, human immune deficiency virus (HIV), prevalence, Nigeria.

INTRODUCTION

Human immune deficiency virus (HIV) is a public health concern. Recent estimate of the people living with human immune deficiency virus (HIV)/acquired immune deficiency syndrome (AIDS) (PLWHA) worldwide was 33.4 million, comprising 15.7 million women and 2.1 million children aged below 15 years (United Nations Programme on HIV/AIDS (UNAIDS)/World Health Organization (WHO), 2009). Nigeria is the second largest with the burden of the disease (4.5%) in sub-Saharan Africa and first in West Africa sub-region (Federal Ministry of Health (FMOH), 2012). The disease has serious impact on virtually every facets of human endeavor including socioeconomic activities, particularly fertility of the infected individuals.

Fertility is one of the key components of population change of a country; therefore any disease affecting it will have serious impact on demographic transition and future age structure of the country. Nigeria has experienced high fertility levels over the last two decades despite numerous policy oriented programmes by the government and international agencies. For instance, the past three consecutive National Demographic and Health Survey (NDHS) results show that the total fertility rate (TFR) for 1999, 2003 and 2008 were 5.6, 5.7 and 5.7, respectively.

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The influence of HIV/AIDS on fertility had been widely explored and most findings revealed that the disease tends to reduce fertility (Chin, 1998; Zeba et al., 1998; Stover, 2004).

Researchers have adopted different techniques to link HIV/AIDS with fertility. One of such methods is the comparison of relative age-specific fertility rates of women who are HIV positive with those of HIV negative (Stover, 2004). The method is referred to as relative inclusion ratio (RIR). To substantiate this, Carpenter et al., (1997) in their study established a relationship between HIV and fertility using this approach. In the study, it was found that for all reproductive age groups, the proportions of women infected with HIV were much lower for those who gave birth than those who did not give births.

The RIR is the ratio of the fertility rate in HIV positive women of reproductive age to the fertility rate of HIV negative women of reproductive age (15 to 49 years). Nicoll et al. (1998) used this ratio to compare the relative fertility in HIV infected and uninfected women. A ratio of 1.00 is indications of accurate estimation of HIV prevalence in the general population while a ratio of less than and above 1.00 show an underestimation and overestimation, respectively.

This study aimed to assess the level of accuracy of the estimate of HIV prevalence with the view to knowing the direction of the estimate. It also strives to identify factors that are predictors of being infected with HIV virus in Nigeria. These objectives would provide information on how to strengthen HIV estimate and create an avenue for the implementation of various evaluations of HIV programmes in Nigeria and other countries with similar population structure. This will assist in actualization of the sub-theme of Millennium Development Goals (MDGs) to combat HIV/AIDS in Nigeria.

MATERIALS AND METHODS

The study area

Nigeria is a democratic Federal Republic in West Africa comprising thirty-six states and one Federal Capital Territory, with capital city in Abuja. The country which consists of over 160 million inhabitants was made up of 36 states formally grouped into six geopolitical zones: North West, North East, North Central, South West, South East and South-South.

Sampling procedure and data collection

The study was cross-sectional in design and utilized data originally collected by National HIV/AIDS and Reproductive Health Survey (NARHS) in Nigeria which focused on women of reproductive age who must have given birth to at least a child. It adopted a multi-stage cluster sampling technique to select the eligible respondents. Ethical clearance was obtained from the Institutional Review Board (IRB) of the National Institute of Medical Research (Nigeria) prior the commencement of the primary survey. Oral and written informed consents were sought from each respondent before a questionnaire was administered, and each sero-test conducted. Pre and post test counseling were provided to all respondents who agreed to be tested. Where a respondent chose not to participate, the questionnaire was returned as refusal. Respondents who were sero positive were referred to a hematopoeitic cell transplant (HCT)/anti-retroviral therapy ART site for follow up. In order to protect the anonymity of the results during the processing phase, the master survey data file was kept at FMOH; all hard copies and files were stored in locked cabinets.

During the actual survey, primary data were collected by personal interview using well-structured questionnaire which included socio-demographic characteristics, knowledge and perception of HIV/AIDS, attitude and use of family planning, knowledge about family planning among others. Two questionnaires were used for the primary data collection: an individual questionnaire for each respondent and a one page questionnaire for the biomarker component. These instruments were based on the questionnaires developed by the NARHS National programme which was adapted from International standard questionnaires such as the Demographic Health Survey (DHS) and adapted to Nigeria's specific data needs. The questionnaires as well as all survey procedures including those relating to the HIV was translated and piloted prior to implementation of the main survey.

Laboratory method

HIV testing was done using National guidelines for rapid-test as outlined in the UNAIDS/WHO guidelines (UNAIDS/WHO, 2005). Therefore, for ethical reasons, pre and post test counseling were conducted using Determine and Statpak or Determine and Bundi for parallel testing. Individuals who tested positive or whose tests were indeterminate were referred to the nearest HIV treatment facility for confirmatory testing and follow up. A unique random identification number (bar code) was assigned to each dried blood spot (DBS) and labels containing that code affixed to the filter paper card, the questionnaire, and a field tracking form at the time of the collection of the sample. After fieldwork was completed in a sampled cluster, the questionnaires, dried blood spot and sample transmittal forms were sent to the central office of the technical management committee for logging and checking prior to data entry. DBS samples were checked against the transmittal form and then forwarded to designated testing laboratories. No identifier other than the unique identification label affixed at the time of the collection of the samples accompanied the specimen to the laboratory.

Data analysis

Data were analyzed using relative inclusion ratio approach, Chi-square and logistic regression model. The dependent variable was HIV status (either positive or negative) whereas, socio-demographic variables such as age, gender, marital status, place of residence etc. were the independent variables. The logistic regression model was used to identify predictors of HIV status determination. This is of the form;

$$\log\left(\frac{\gamma_i}{1-\gamma_i}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n$$

Where γ is 1 if HIV status is positive and 0 if otherwise. The parameters $\beta_0, \beta_1, \beta_2, \ldots, \beta_n$ are to be estimated. The odd ratio of each parameter is estimated as exp (β_i); I = 1, 2, 3...n.

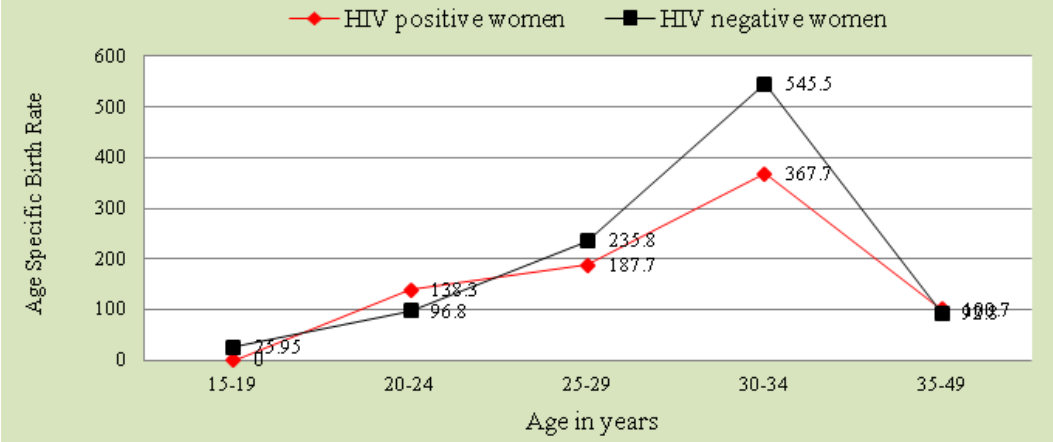

Figure 1. Age specific births per 1000 women years of exposure of HIV positive and HIV negative women in Nigeria.

RESULTS

Socio-demographic characteristics of women according to their HIV status

The data as shown in Table 1 is evidenced that the prevalence of HIV among the women studied was 4.1%. The mean ages for HIV-positive and HIV-negative women were 29.7±8.4 and 27.9±9.4 years respectively ($p<0.001$).

The prevalence of HIV increases consistently from age 15-19 (1.4%) to 30-34 (7.6%) years with a slight reversal at ages 35 years and above. Differential also existed in HIV prevalence across all the six geo-political zones in Nigeria with the highest prevalence recorded by Northcentral (6.3%) and least in the Northwest (2.3%). In Nigeria, women who were formally married (10.6%) had higher prevalence of HIV than their counterparts who were either not married (2.9%) or currently married (4.0%).

The prevalence of HIV also varied according to the women's religion with Christian religion having higher proportion of its members being HIV positive (5.3%) than Muslim women (2.6%) ($p<0.001$). There was a significant association between ever had Antenatal Care (ANC) and HIV status. Of all the women who had gone for ANC during their last pregnancy, 4.8% of them were HIV positive as against 2.8% of those who did not attend ANC.

Table 2 shows Fertility rates and Relative Inclusion Ratios for HIV positive and HIV negative women of reproductive age in urban and rural Nigeria. In urban area, the fertility rates increases from 0 births per 1000 women years of exposure among HIV+ women in age group 15-19 to 819 births per 1000 women years of exposure for those in age group 30-34, but falls to 46.1 for women in ages 35 years and above. Similar pattern existed for the women who tested positive to HIV in urban area of Nigeria.

The data further show that in the rural area, the fertility rates were consistently higher among HIV negative women than their counterparts who tested positive except for the last age group (35+) where the fertility rate was higher for HIV+ women (133.8 births per 1000 women years of exposure) than HIV negative women (99.5 births per 1000 women years of exposure).

The overall fertility rate for all HIV+ women in urban (314.6 births per 1000 women years of exposure) was lower than that of rural (395.0 births per 1000 women years of exposure). The reverse of this pattern was observed for HIV negative women (272.3 and 406.0 for urban and rural areas respectively). For all women who participated in the study, fertility rates were higher among HIV negative women in age groups 15-19, 25-29, and 30-34 years than HIV positive women but lower in age group 20-24 and 35-49 years.

The relative inclusion ratio (RIR) was higher in urban (1.16) than rural (0.97) and the overall RIR was 1.015. In urban and rural areas, the RIR peaked at age group 20-24 (RIR=4.2, C.I=3.78-4.62) and 35-39 (RIR=1.35, C.I=1.29-1.39) respectively. In overall sample, RIR was 1.015 (C.I=1.00-1.02) and mostly prominent among women aged 20-24 years (RIR=1.43, C.I=1.38-1.48).

Age specific fertility rates (Births per 1000 women years of exposure) among women of reproductive age in Nigeria

Figure 1 displays the pattern of age specific fertility rates (ASFR) for rural, urban and total for Nigeria. The graph was plotted to see clearly the shape in order to know whether the data follows the expected distribution in any setting. The data show that the ASFR peaked among women in age group 30 to 34 for both HIV positive and HIV negative women. It further shows that HIV positive women have more births than HIV negative women in

Table 1. Respondents socio-demographic characteristics and HIV status.

Background characteristic	HIV status		p-value
	Positive n (%)	Negative n (%)	
Total	**170 (4.1)**	**4025 (95.9)**	
Age group*			
15-19	13 (1.4)	902 (98.6)	
20-24	38 (4.5)	812 (95.5)	
25-29	35 (4.8)	698 (95.2)	0.00
30-34	44 (7.6)	535 (92.4)	
35 and above	40 (3.6)	1078 (96.4)	
Location			
Urban	67 (4.7)	1367 (95.3)	0.14
Rural	103 (3.7)	2658 (96.3)	
Zone**			
North West	20 (2.3)	857 (97.7)	
North East	28 (4.6)	578 (95.4)	
North Central	47 (6.3)	698 (93.7)	0.00
South West	32 (4.0)	760 (96.0)	
South East	19 (3.8)	482 (96.2)	
South South	24 (3.6)	650 (96.4)	
Marital status*			
Currently married	110 (4.0)	2658 (96.0)	
Never married	34 (2.9)	1152 (97.1)	0.00
Formally married	25 (10.6)	211 (89.4)	
Contraceptive use			
Ever users	43 (7.1)	239 (92.9)	0.37
Never users	84 (4.1)	2136 (95.9)	

Table 2. Respondents socio demographic characteristics and HIV status.

Background characteristic	HIV status		P value
	Positive n (%)	Negative n (%)	
Education			
Quranic/Primary	54 (4.7)	1101 (95.3)	
Secondary	68 (4.5)	1456 (95.5)	0.88
Higher	17 (5.1)	317 (94.9)	
Religion*			
Islam	52 (2.6)	1915 (97.4)	
Christianity	116 (5.3)	2085 (94.7)	0.00
Other	2 (4.2)	23 (95.8)	
Ever had ANC visit			
Yes	65(4.8)	1297 (95.2)	0.02
No	21(2.8)	740 (97.2)	

Table 2. Contd.

Age at first sexual intercourse			
15-24	118 (4.9)	2311 (95.1)	0.15
25-34	10 (8.9)	102 (91.1)	
35+	0 (0)	2 (100)	
Mean	25.87	29.88	
Children ever born			
1-2	10 (8.5)	108 (91.5)	0.50
3-4	12 (7.8)	142 (92.2)	
5+	17 (3.5)	470 (96.5)	
Mean	5.03	6.18	

*Significant at 0.1%; **significant at 5%; ANC = antenatal clinic.

Table 3. Fertility rates and Relative Inclusion Ratios for HIV positive and HIV negative women of reproductive age in urban and rural Nigeria.

Age group (years)	HIV status						RIR (95% CI)
	Positive			Negative			
	Number of births in the last one year	Women years of exposure (Y_2)	Fertility rate (95% CI)	Number of births in the last one year	Women years of exposure (Y_2)	Fertility rate (95% CI)	
			Urban				
15-19	0	40.3	0 (0-0)	12	1038.5	11.6 (0.4-23.5)	0 (0-0)
20-24	12	50.3	238.6 (46-430)	50	888.7	56.3 (29-84)	4.20 (3.78-4.62)
25-29	14	42.6	328.6 (23- 636)	108	800.6	134.9 (93-177)	2.4 (3.97-4.43)
30-34	15	18.3	819.7 (642-997)	217	548.9	395.3 (325-466)	2.07 (1.87-2.28)
35-49	21	45.6	46.1 (21.6-70.5)	772	979.4	78.8 (74.6-83.1)	0.58 (0.53-0.63)
Total	62	197.1	314.6 (203-426)	1159	4256.1	272.3 (249-296)	1.16 (1.13-1.18)
			Rural				
15-19	0	37.5	0 (0-0)	67	2005.5	33.4 (19-48)	0 (0-0)
20-24	5	72.6	68 (45-181)	200	1693.6	118.1 (91-145)	0.58 (0.54-0.62)
25-29	10	85.3	177 (30- 324)	426	1463.9	291 (249-333)	0.61 (0.56-0.65)
30-34	16	66.0	240 (75-404)	600	948.8	632.4 (244-338)	0.38 (0.33-0.43)
35-49	103	77.5	133.8 (75.9-343.5)	2009	2018.7	99.5 (99.0-100.0)	1.35 (1.29-1.39)
Total	134	338.9	395.0 (301-489)	3302	8130.5	406.0 (387-425)	0.97 (0.96-0.98)

Table 3. Contd.

				Urban and rural			
15-19	0	77.8	0 (0-0)	79	3044	25.95(16-36)	0 (0-0)
20-24	17	122.9	138.3 (29-248)	250	2582.3	96.80 (76-117)	1.429 (1.38-1.48)
25-29	24	127.9	187.7 (58-317)	534	2264.5	235.80 (204-267)	0.796 (0.77-0.83)
30-34	31	84.3	367.7 (225-510)	817	1497.7	545.50 (503-588)	0.674 (0.64-0.71)
35-49	124	123.1	100.7 (83.9-117.5)	2781	2998.1	92.8 (912-943)	1.086 (1.07-1.10)
Total	196	536	365.7 (293-438)	4461	12386.6	360.2 (345-375)	1.02 (1.00-1.02)

CI = Confidence interval; HIV = human immunodeficiency syndrome; RIR = relative inclusion ratio.

early childbearing period (15 to 19), but the number of births was lower in age group 20 to 24 years and consistently higher among older women.

DISCUSSION

The present HIV prevalence in Nigeria has been an issue of contemporary discourse. Researchers have diverse opinion on the estimated figure. While some were of the view that the figure was underestimated others claimed it was overestimated. Although, nobody can say what the exact prevalence was, because the estimate was based on samples of women selected from the population of women of reproductive age in Nigeria. This may obviously be subjected to sampling errors and other errors peculiar to such surveys. As an attempt to let people know the swing of the prevalence of HIV in Nigeria, we provide a means of assessing the estimated figure using relative inclusion ratio which is based on the fertility experience of HIV positive and HIV negative women. This was done against the backdrop of scarce information of such in Nigeria. We used fertility rates instead of the conventional live birth rates as reported in previous studies (Nicoll et al., 2011).

Findings from this study showed that mean age at first intercourse for HIV positive was lower compared to that found among HIV negative women (table 2). This difference might be due to the fact that both populations were exposed to various degrees of information particularly on sexual education in early part of their life. Also, the mean number of births in the past one year was higher among HIV positive women than HIV negative women (table 1). The overall fertility rates observed in HIV positive women population was higher than that of all HIV negative women. This difference may be attributed to the fact that HIV women might want to bear children quickly before their health conditions degenerates particularly those who are not attending ART clinic (Laura et al, (2003). The prevalence of HIV was higher among the formally married women (table 1. The multivariate result of this study also justified this finding. This is in line with previous study reported by Engene and Charles (Engene and Charles, 2008). Higher prevalence among formally married women might be attributed to risky sexual behavior after separation or divorced their last partner and being formally married is associated with increasing lifetime number of sexual partners (Hattingh et al, 2009). The prevalence of HIV was also higher among women in age group 30 to 34 than any other age segments of population of women under study. Though, one would have expected higher prevalence among younger women because they are more sexually active. However, no explanation could be put forward for this deviation. Poverty, low literacy levels, high rates of casual and transactional unprotected sex in the general population, particularly among youth between the ages of 15 and 24 is major factors in the transmission of HIV in Nigeria (NACA, 2007).

Our study further revealed that higher fertility rate was observed among HIV positive women in rural than urban area (table 3). This finding is consistent with the findings from previous studies where similar pattern was also observed (Zaba et al., 2010; Gray et al, 2010). Possible explanation for the finding is that urban women are more educated, have more access to health information and health facility than rural women. They are less likely to indulge in risky sexual behavior than their rural counterparts (Helene et al, 2004). For instance, condom use which is widely known to be a protective measure against contacting HIV/AIDS during sexual intercourse is more commonly used in urban than rural areas (Adebimpe W. O and Asekun O.E.O, 2012).

The urban and rural RIR was higher and lower than one respectively (table 3), but the RIR was estimated to be higher than one for Nigeria. Higher

Table 4. Logistic regression analysis of socio-demographic characteristics influencing HIV status determination.

Background characteristic	β	Significance	Exp (β)	95% CI for Exp (β)	
				Lower	Upper
Age group					
15-19 (ref)	Ref.	Ref.	1.000	Ref.	Ref.
20-24	0.208	0.730	1.231	0.378	4.007
25-29	-0.601	0.086	0.548***	0.276	1.090
30-34	-0.497	0.157	0.608	0.305	1.212
35 and above	-0.652	0.062	0.521***	0.263	1.033
Zone					
North west (ref)	Ref.	Ref.	1.000	Ref.	Ref.
North east	-0.188	0.696	0.829	0.323	2.128
North central	-0.796	0.065	0.451***	0.194	1.051
South west	-0.849	0.027	0.428**	0.202	0.908
South east	-0.133	0.750	0.876	0.387	1.982
South south	0.016	0.973	1.016	0.402	2.568
Marital status					
Currently married (ref)	Ref.	Ref.	1.000	Ref.	Ref.
Never married	1.557	0.000	4.742*	2.401	9.367
Formally married	0.462	0.419	1.587	0.518	4.860
ANC					
Yes (ref)	Ref.	Ref.	1.000	Ref.	Ref.
No	-0.424	0.119	0.655	0.384	1.115
Religion					
Islam (ref)	Ref.	Ref.	1.000	Ref.	Ref.
Christianity	1.068	0.323	2.910	0.351	24.151
Others	0.311	0.771	1.364	0.169	10.993

*Significant at 0.1%; **significant at 5%; ***significant at 10%; ANC = antenatal clinic; ref = reference category, β = covariate, exp (β)= estimate of the odds ratio.

estimate of RIR above one in the urban area shows that HIV prevalence was over-reported in the area. The estimated RIR in our study was higher than the one reported for urban area in Cameroon by Engene and Charles (Engene and Charles, 2008). Also, an estimate of RIR lower than one in rural area indicates under-estimation of HIV in the rural areas of Nigeria. This estimate was slightly higher than the figure estimated by Desgrées du Loû and colleagues for rural area of Ivory Coast (Desgrées du Loû et al, 1999).

The multivariate analysis shows that being in the South-west is more protective against contacting HIV than being in the North-west (table 4). Also, women who were formally married were strikingly more likely to contact HIV than those never married. Possible explanation for this differential is that women in the South-west part of Nigeria are more educated and less likely to indulge themselves in HIV risk behaviors than women in the North-west. Previous studies have shown that women in the South-west were more likely to use condom during sexual intercourse than women from any parts of Nigeria (NDHS, 2003; NDHS, 2008; NPC, 2006).

Limitation

The current study used secondary data and as such, possibility of non-representative sample errors cannot be completely eliminated from the findings of this study. Relative inclusion ratio approach only uses current fertility of women in its estimation, it does not account for other factors that could lead to either under-estimation or over-estimation of HIV prevalence. Further research is thus needed in this regard.

Conclusion

The RIR found in our study is an indication of over-estimation of HIV prevalence in Nigeria. However, HIV prevalence was overestimated and underestimated in urban and rural areas respectively. Accurate statistics on

HIV prevalence is necessary in Nigeria. This will assist HIV programmers in their strategies to combat HIV in Nigeria.

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