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Estimating risk factors for HIV infection among women in Mozambique using population-based survey data

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The use of population-based survey data together with sound statistical methods can enhance better estimation of HIV risk factors and explain variations across subgroups of the population. The distribution and determinants of HIV infection in populations must be taken into consideration. We analysed data from the HIV Prevalence and Behaviour Survey in Mozambique aiming to find risk factors associated with HIV infection among Mozambican women. The paper provides a complex survey logistic regression model to explain the variation in HIV seropositivity using demographic, socio-economic and behavioural factors. Results show that women aged 25–29 years, living in female-headed households, living in richer households and those widowed, divorced or not living with a partner have higher odds of being HIV-positive. Findings from our study provide a unique and integrated perspective on risk factors for being HIV-positive among Mozambican women and could support the implementation of programmes aiming to reduce HIV infection in Mozambique.

Keywords: complex survey, HIV/AIDS, HIV/AIDS knowledge and attitudes, logistic regression, Mozambican women

Introduction

Mozambique has one of the highest burdens of HIV in the world. According to the latest Mozambique HIV Prevalence and Behaviour Survey — National Prevalence Survey, Behavioural Risks and Information on HIV and AIDS in Mozambique (INSIDA) 2009, about 13% of Mozambican women and 9% of men aged 15–49 years are HIV-positive (MISAU, 2010). HIV prevalence among women varies substantially by region ranging from 3.3% in Niassa province to 29.9% in Gaza province and is systematically higher than the prevalence among men (MISAU, 2010). More recently, preliminary results of the Immunisation, Malaria and HIV/AIDS Key Indicator Survey (IMASIDA), conducted in 2015, found an overall HIV prevalence of 13.2% among people aged 15–49 years, 10.1% of men and 15.4% of women testing HIV-positive (INS, INE, & ICF, 2017).

A body of evidence exists on HIV/AIDS in Mozambique based on surveillance data. These include antenatal clinic (ANC) surveys run since 1988, the Mozambique demographic and health surveys in 1997 (Instituto Nacional de Estatística, Ministério da Saúde, MEASURE DHS+/ORC Macro, 1998), 2003 (Instituto Nacional de Estatística,

Ministério da Saúde & MEASURE DHS+/ORC Macro, 2005) and 2011 (Instituto Nacional de Estatística, Ministério da Saúde & MEASURE DHS+/ORC Macro, 2013); multiple cluster indicator surveys in 1995 (Gaspar et al., 1996) and 2008 (Araujo et al. 2009); and national serologic surveys in 2009 (INS, INE, & ICF Macro, 2010) and 2015 (INS, INE, & ICF Internacional, 2017) as well as other studies carried out on specific populations. Statistical methods have been extensively used to assess trends, patterns and the dynamics of HIV/AIDS epidemic in the country. Depending on the goals of the research, these methods range from estimating prevalence, finding determinants of infection, and assessing the impact of prevention and treatment approaches on the epidemic (Augusto et al., 2016; Korenromp et al., 2015; Zango et al., 2013). The success of the use of statistical methods highly depends on the quality of available data and on the validity of the statistical analysis used (Chinomona & Mwambi, 2015). Like other sub-Saharan countries, Mozambique has a generalised HIV epidemic mainly driven by heterosexual transmission, especially among those who have multiple sexual partners (MISAU, 2016). Due to a wide range of socio-economic, cultural and historical factors that have hampered the country's capacity

to respond to the epidemic, HIV prevalence and incidence rates show few signs of decreasing (Audet et al, 2010).

Findings from medical, public health, and social science research show that determinants of HIV risk are rather complex. Boerma and Weir (2005) proposed a conceptual framework for the study of the distribution and determinants of HIV infection in populations, combining both demographic and epidemiological approaches. This framework identifies a set of variables (proximate determinants) that can be influenced by changes in contextual variables and have a direct effect on the biological mechanisms to influence health outcomes (Boerma & Weir, 2005). The proximate-determinants framework can be used to analyse and interpret risk factors for HIV infection.

Existing literature on models combining individual and contextual factors in sub-Saharan countries is limited. The study by Magadi and Desta (2011) applied multilevel logistic regression models to demographic health survey data from 20 countries in sub-Saharan Africa. However, the evidence for Mozambique, where HIV prevalence exceeded 20% in some regions in 2009 (MISAU, 2010), is limited to studies focused on individual risk factors only (Agadjanian, Arnaldo, & Cau, 2011; Agadjanian & Hayford, 2009; Agadjanian & Menjivar, 2008), suggesting that there is need to provide a more systemic approach to the determinants of HIV infection in the country. Findings from the literature on sub-Saharan Africa show that men and women face unequal risk of HIV infection (Hertog, 2008). Women are disproportionately affected, accounting for 60% of all HIV infections in this region and Mozambique is no exception (MISAU, 2016).

The disproportionate impact of the HIV epidemic on women can be attributed to biological, social, behavioural, cultural, economic and structural factors (Ramjee & Daniels, 2013). Current evidence shows that women are at greater physiological risk of contracting HIV than men, especially young women (Ackermann & Klerk, 2002). Literature shows that sexually transmitted infections (STIs) increase the risk of HIV acquisition and women are at increased risk due to difficulty in STI diagnosis (which are often asymptomatic in presentation) and treatment (Connolly, Ramjee, Sturm, & Abdool Karim, 2002; Kalichman, Pellowski, & Turner, 2011).

Also, for women in sub-Saharan Africa, several factors influence the scale and rate of the epidemic spread, including overall HIV and STI prevalence, sexual practices, marriage and other cultural norms (Ramjee & Daniels, 2013). The dominant patriarchal culture and society in Africa exacerbates women's inferiority and their disparate health status. This is supported by many studies which explored the low negotiation role of women regarding sexual intercourse, the polygamous relationships and the vulnerability of young girls, who are often forced to marry older men (Buvé, Bishikwabo-Nsarhaza, & Mutangadura, 2002; Duffy, 2005; Ramjee & Daniels, 2013).

Poverty is also an important driving force of HIV transmission in women in sub-Saharan Africa. A body of evidence exists which shows that greater income inequality is associated with higher HIV prevalence rates (Gillespie, Kadiyala, & Greener, 2007; Piot, Greener, & Russell, 2007). Low economic status has been associated with earlier sexual experience, lower condom use at last sexual intercourse, having multiple sex partners, increased

chances that the first sexual intercourse is non-consensual, and a greater likelihood of having had transactional sex or physically forced sex (Mabala, 2006).

Alcohol abuse, understood as irregular episodes of heavy drinking, is common in many sub-Saharan African countries (Chersich & Rees, 2008). These drinking patterns may have independent effects on sexual decision-making, and on condom-negotiation skills and condom use. Studies have shown that women with heavy drinking patterns are more disposed to use condoms inconsistently and incorrectly, experience sexual violence, and acquire STIs, including HIV (Chersich & Rees, 2008; Scorgie et al., 2012).

Finally, many structural vulnerabilities place women at risk of acquiring HIV, including gender inequality and gender-based violence, migration and health seeking-related stigma (Gupta, Parkhurst, Ogden, Aggleton, & Mahal, 2008; Murphy, Greene, Mihailovic, & Olupot-Olupot, 2006). Women who live in poverty, younger women and those who are uneducated are especially affected by intimate partner violence (Jewkes, Dunkle, Nduna, & Shai, 2010; Kim, Pronyk, Barnett, & Watts, 2008). A study from South Africa found that 12% of new HIV infections in women were attributable to intimate partner violence (Jewkes et al., 2010), while gender-based violence increased the risk of HIV infection by 55% in a study from Uganda (Vyas & Watts, 2009).

Using data from INSIDA 2009 (MISAU, 2010), this study analysed the determinants of HIV infection in Mozambican women. INSIDA data were obtained through complex designs, involving stratification, clustering, multistage sampling, unequal probability of selection of participants and responding rates. Observations from the same cluster are correlated and, to have unbiased estimators, sample weighting needs to be adjusted for this cluster effect. Ignoring the sampling method in data analysis can lead to inaccurate results, as some authors have pointed out (Pettifor et al., 2005; Roberts, Rao, & Kumar, 1987). To make valid inference for the population of interest where samples were originated, appropriate statistical methods are required to analyse such complex survey data. More specifically, as suggested by Chinomona and Mwambi (2015), we analysed the association of HIV infection with socio-economic, knowledge, behavioural and biological factors (Boerma & Weir, 2005) modelling a logistic regression for complex survey data.

Our study provides a unique and integrated perspective on general patterns and risk factors of being HIV-positive among Mozambican women. The results are particularly useful to support national and local authorities in implementing programmes aimed at reducing HIV infection in Mozambique.

Methods

Data

Data for this study were from INSIDA 2009, which was the first population-based nationally representative survey on HIV seroprevalence. It is a multistage cluster sample survey representative of all 11 provinces of Mozambique. The tools for the individual interviews were based on the instruments for the AIDS indicator surveys developed by MEASURE Demographic and Health Survey (DHS Program, n.d.), the Nelson Mandela HIV/AIDS Behavioural Risk and Media

Impact Survey conducted by the Human Sciences Research Council of South Africa (Shisana & Simbayi, 2002) and the 2003 Demographic and Health Survey conducted in Mozambique (INE, MISAU, & MEASURE DHS+/ORC Macro, 2005). The instrument for individual interviews collected data on socio-demographic characteristics, fertility, marriage and sexual activity, information and communication, knowledge and perception of HIV/AIDS, testing and counselling in health, and other health problems, including STIs, consumption drugs, malaria, etc. We used information for 5 527 women aged 15–49 years obtained by the integration of two databases available at the MEASURE DHS website.

Measure

The dependent variable was dichotomous, indicating HIV seropositivity status: it is equal to 1 if the woman is seropositive and 0 otherwise. Sero-status was determined through the collection of blood samples from each individual. Following informed consent, blood samples were collected through finger prick using an automatic, sterilised and disposable lancet. Testing of blood samples took place between March and June 2010 at the Laboratory of Immunology of the National Institute of Health, Mozambique (MISAU, 2010). Samples were tested using two sequential tests: enzyme immunosorbent assay (ELISA), where the reactive sample (positive) in the first sequence of the test (Vironostika HIV Uniform II plus O) underwent to second test for confirmation (Murex VIH 1-2-O). In the case of a reactive sample in Vironostika, followed by a negative result in Murex, a third test was used for confirmation (Genscreen HIV-1/2), following the HIV testing algorithm adopted in Mozambique (MISAU, 2010). All tests used were pre-qualified by the World Health Organization (WHO) and have high sensitivity (100.0%): Vironostika HIV Uniform II plus O has a sensitivity of 100.0% (97.7–100) and a specificity of 99.0% (97.1–99.8), Murex VIH 1-2-O has a sensitivity of 100.0% (97.7–100.0) and a specificity of 99.3% (97.6–99.9), and Genscreen HIV-1/2 has a sensitivity of 100.0% (97.7–100) and a specificity of 98.3% (96.1–99.4) (WHO, 2015).

Independent variables

The different factors were grouped in four families based on their proximity to the outcome:

- Demographic and socio-economic characteristics: age, educational attainment, job status, sex of the household head; household wealth, media exposure; and area of residence (rural or urban)
- HIV/AIDS knowledge and attitudes: awareness; stigma/prejudice; previous HIV testing; and knowing someone with AIDS
- Behavioural variables: alcohol use; marital status/type; and multiple sexual partners
- Biological factors: STIs; genital sores/ulcers; and discharge

This information was collected using a face-to-face questionnaire. Four questionnaires were used in the survey, namely: a household questionnaire; an individual questionnaire for young people and adults aged 15–64 years; an individual questionnaire for adolescents aged 12–14 years; and an individual questionnaire for parents or guardians of children aged 0–11 years (MISAU, 2010).

A description of the variables included in the analysis is given in Table 1.

Some of the independent variables included in the analysis (e.g., media exposure, HIV/AIDS awareness and HIV/AIDS stigma) are summary indices resulting from Principal Component Analysis (PCA) of a set of relevant correlated variables. A principal component is a linear combination of a set of variables obtained to minimise the loss of information (Filmer & Pritchett, 2001; Lindeman, Merenda, & Gold, 1980). This is the common method used to derive the household wealth index available in the DHS data sets (Rutstein & Johnston, 2004). The PCA approach is used to derive summary indices for media exposure, HIV/AIDS awareness and HIV/AIDS stigma. The resulting PCA scores are then used to compute dummy/categorical variables: the scores are classified into several percentiles, dividing the population into x equal parts, depending on the classification that best discriminated the different categories regarding HIV status (Magadi & Desta, 2011).

Ethical considerations

Participation in the survey was made through written informed consent (or fingerprint for respondents who could not read or write) of the head of the household (for the household questionnaire) and of the adult or emancipated individual (for the individual questionnaire and the collection of blood samples).

Survey inquirers took every precaution to maintain the confidentiality of survey information during and after the interview. They also selected a location where respondents felt more comfortable and where confidentiality was guaranteed.

During data processing, access to questionnaires was restricted to members of the processing team and no questionnaire was reproduced or transported outside the National Institute of Health facilities. Blood samples were transported to the National Institute of Health without any information identifying the individuals from which they had been collected other than bar codes. Original questionnaires and survey files were burned.

A data file was created in which the personal identification of respondents was replaced by randomly generated codes. This process ensures the integrity of households and simultaneously makes it impossible to identify households and respondents. After verification, files containing the original (raw) data of households were destroyed.

The final, clean and anonymised database is owned by the Mozambique government, represented by Ministry of Health, and must be kept for a minimum period of 10 years. The database may be accessed by researchers or research institutions, with written authorisation from the National Institute of Health.

Statistical analysis

Descriptive statistics were used to describe the characteristics of the study sample. Since INSIDA data are a complex survey we considered the specific design features to estimate crude and adjusted odds ratio (OR). More specifically, we computed a multivariable survey logistic regression model to explain the determinants of HIV infection in Mozambican women. Under the conventional logistic regression framework, the

Table 1: Description of study variables

Name of variable	Measure
Outcome variable	
HIV seropositivity	Coded as 1 if respondent tested HIV-positive, 0 otherwise
Individual-level variables	
Background factors	
Age group (ref = 45+)	Dummy variables for 5-year age groups of respondents: 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45+
Education level (ref = secondary and higher)	Dummy variables for highest educational attainment classified into three categories: none, primary, secondary and higher
Job status	A dichotomous variable coded as 1 if respondent is currently working, 0 otherwise
Sex of household head (ref = female)	Coded as 1 if respondent was living in a female-headed household at the time of the survey, 0 otherwise
Religion (ref = no religion)	Dummy variable for religious affiliation, re-coded into five categories: Catholic, Protestant, Muslim, other religions, no religion
Wealth index (ref = richer and richest)	DHS household wealth index derived from information on household possessions and amenities using principal component analysis. The PCA scores are classified into wealth quintiles that were grouped into two groups: richer and richest; middle, poorer and poorest
Media exposure (ref = lowest)	A composite summary index derived by PCA from information on frequency of reading newspapers, listening to radio, watching TV and using the Internet by respondents. The PCA scores are classified into quartiles, the lowest being equivalent to lowest media exposure
Proximate HIV/AIDS factor	
HIV/AIDS awareness (ref = highest than the PCA score average)	A composite summary index derived by PCA from information on knowledge of modes of HIV transmission (HIV/AIDS can be transmitted during pregnancy, during delivery and during breastfeeding). The PCA scores are classified into two groups: lower than the PCA score average and higher than the PCA score average
Stigma HIV/SIDA (ref = highest than the PCA score average)	A composite summary index derived by PCA from respondents answers to three questions to assess presence of stigma (willing to care for relative with AIDS; person with AIDS allowed to continue teaching; would buy vegetables from vendor with AIDS). The PCA scores are classified into two groups: lower than the PCA score average and higher than the PCA score average
Knows someone with AIDS	A dichotomous variable coded as 1 if respondent knows anyone with AIDS, 0 otherwise
Previously tested for HIV	A dichotomous variable coded as 1 if respondent had been previously tested for HIV before the survey, 0 otherwise
Sexual behaviour factors	
Alcohol (ref = once a month or more)	A dichotomous variable coded as 1 if respondent drinks alcohol once a month or more, 0 otherwise
Marital status (ref = married monogamous)	Dummy variable for marital status at the point of the survey, classified into four categories: never married; married in a monogamous union; married in a polygamous union; and widowed, divorced or not living together
STI, genital sore/ulcer or discharge	A dichotomous variable coded as 1 if respondent had any STI, genital sore/ulcer or discharge in last 12 month before the survey, 0 otherwise
Multiple sex partners (ref = 1+ sexual partners in last 12 months)	A dichotomous variable coded as 1 if respondent had more than 1 sexual partner during the last 12 month before the survey, 0 otherwise

parameters are estimated by maximum likelihood. However, under a complex sampling design, such the one used for INSIDA 2009, the parameters must be estimated by pseudo-maximum likelihood method (Breslow & Holubkov, 1997; Broström & Holmberg, 2011; Chinomona & Mwambi, 2015). Confidence intervals are given at 95% and *p*-values for all factors.

All the associated factors at a significance level, $p < 0.2$, on unadjusted logistic regression analysis were further examined in multivariate logistic regression. The final model was achieved by eliminating factors one by one with $p < 0.10$. Only the type of residence (rural or urban) factor was retained in the final model to control for possible confounding.

Data were analysed using software R, namely library *survey*. Specifically, all the design features such as stratification, clustering and weighting were taken into account for the survey design function.

Results

The overall response rate for women aged 15–64 years was 95.0% (MISAU, 2010). Data were analysed for 5 257 women aged 15–49 years who undertook the HIV test, for which HIV prevalence was 13.1% (95%CI: 12.2–14.0%). The socio-demographic characteristics of the sample are shown in Table 2. The proportion of HIV prevalence ranged from 7.2 to 28.4. The lowest value occurs in the youngest group of women (15–19 years old) and the highest in the group of widowed, divorced, or women not living with a partner (Table 2).

Individual factors

Demographic and socio-economic variables

After adjusting for other factors, the highest odds of being HIV-positive were observed amongst women aged 25–29 years old (OR = 2.62, 95%CI: 1.44–3.56) when compared

Table 2: Sample characteristics and bivariate distributions of HIV prevalence, $n = 5\,257$

Characteristics	HIV-positive, n (%)	HIV-negative, n (%)	Study population, n (%)
Age group			
15–19	63 (7.2)	818 (92.8)	881 (16.8)
20–24	152 (14.4)	902 (85.6)	1 054 (20.0)
25–29	151 (16.8)	749 (83.2)	900 (17.1)
30–34	128 (15.3)	706 (84.7)	834 (15.9)
35–39	91 (13.4)	590 (86.6)	682 (13.0)
40–44	56 (13.0)	376 (87.0)	432 (8.2)
45+	48 (11.2)	427 (88.8)	475 (9.0)
Education level			
No education	151 (9.7)	1 410 (90.3)	1 560 (29.0)
Primary	438 (14.5)	2 593 (85.5)	3 031 (57.7)
Secondary and higher	99 (14.9)	566 (85.1)	667 (12.7)
Job status			
Working	458 (13.5)	2 943 (86.5)	3 401 (64.7)
Not working	230 (12.4)	1 622 (87.6)	1 852 (35.3)
Sex of household head			
Female	348 (20.1)	1 385 (79.9)	1 733 (33.0)
Male	340 (9.6)	3 184 (90.4)	3 524 (67.0)
Religion			
Catholic	156 (9.8)	1 431 (90.2)	1 587 (30.3)
Protestant	195 (13.9)	1 010 (86.1)	1 205 (23.0)
Muslim	106 (10.2)	932 (89.8)	1 038 (19.8)
No religion	79 (14.5)	465 (85.5)	544 (10.4)
Others	151 (17.4)	717 (82.6)	868 (16.6)
Wealth index			
More rich (richer and richest)	433 (19.6)	1 780 (80.4)	2 213 (42.1)
More poor (middle, poorer, poorest)	255 (8.4)	2 789 (91.6)	3 044 (57.9)
Media exposure			
Lowest	120 (13.7)	756 (86.3)	876 (16.7)
Second quarter	319 (11.3)	2 500 (88.7)	2 819 (53.6)
Third quarter	82 (14.7)	476 (85.3)	558 (10.6)
Highest	168 (16.7)	837 (83.3)	1 005 (19.1)
Area of residence			
Rural	387 (10.7)	3 243 (89.3)	3 630 (39.1)
Urban	301 (18.5)	1 326 (81.5)	1 627 (30.9)
HIV/AIDS awareness			
Lower than the PCA average	79 (10.6)	666 (89.4)	745 (14.2)
Higher than the PCA average	609 (13.5)	3 903 (86.5)	4 512 (85.8)
Stigma HIV/AIDS			
Lower than the PCA average	289 (11.5)	2 225 (88.5)	2 514 (47.8)
Higher than the PCA average	399 (14.5)	2 344 (85.5)	2 743 (52.2)
Knows someone with AIDS			
No	458 (11.7)	3 461 (88.3)	3 919 (76.0)
Yes	219 (17.7)	1 017 (82.3)	1 236 (24.0)
Previously tested for HIV			
No	354 (10.8)	2 922 (89.2)	3 276 (62.7)
Yes	330 (16.9)	1 621 (83.1)	1 951 (37.3)
Alcohol			
Do not drink alcohol	491 (12.0)	3 606 (88.0)	4 097 (78.2)
Once a month	123 (17.3)	593 (82.8)	716 (13.7)
Two or more times a month	66 (15.6)	356 (84.4)	422 (8.1)
Marital status			
Married — monogamous	324 (10.5)	2 755 (89.5)	3 079 (58.6)
Widowed, divorced, not living together	221 (28.4)	558 (71.6)	779 (14.8)
Married — polygamous	91 (13.3)	685 (86.7)	776 (14.8)
Never married	52 (8.3)	571 (91.7)	623 (11.9)
STI, genital sore/ulcer or discharge			
No	613 (12.4)	4 327 (87.6)	4 940 (94.0)
Yes	75 (23.7)	242 (76.3)	317 (6.0)
Multiple sexual partners			
No	514 (11.6)	3 929 (88.4)	4 443 (84.5)
One or more	173 (21.3)	639 (78.7)	812 (15.5)

with the oldest age group (45+ years). However, the significantly lower odds of being HIV-positive observed for women aged 15–19 years (OR = 1.12, 95% CI: 0.65–1.91) only becomes apparent when the other factors are added in the model, meaning that the low odds of being HIV-positive among younger females (teenagers) is to a large extent explained by these factors (Table 3). In the adjusted model, while having no education was not statistically significant when compared with a secondary education or higher, the differential between primary and secondary education or higher reversed its sign; women with primary level were more likely to be HIV-positive than those with a secondary education or higher (OR = 1.41, 95% CI: 1.01–1.96). Women living in female-headed households are more likely to be HIV-positive (Table 3). However, the higher probability of having HIV in female-headed households was to some extent explained by behavioural and biological factors: the odds ratio decreased from 2.35 to 1.59 (Table 3). In unadjusted models, women living in richer households (top quintiles of wealth index) were 2.66 (95% CI: 2.09–3.37) times more likely to be HIV-infected, than those living in poorer households (lowest quintiles of the wealth index). Controlling for the socio-demographic characteristics and other HIV risk factors attenuated the odds ratios to approximately 2.40 (Table 3).

In the unadjusted model, both job status and media exposure were not statistically significant. Therefore those factors were not analysed in the adjusted model.

Religion was significantly associated with the odds of having positive HIV sero-status in both unadjusted and adjusted models (Table 3). After controlling for relevant risk factors, Catholic women are less likely to be HIV-positive (OR < 1) when compared to women with no religion, while among Muslim women and women from other religions the odds of being HIV-positive was not statistically different from the odds of women with no religion (Table 3).

Knowledge and attitudes factors

Women who had an HIV/AIDS awareness score higher than the average were more likely to be HIV-positive and the odds were similar in both unadjusted and adjusted models (OR = 1.3). Women knowing someone with HIV/AIDS were more likely to be HIV-positive. However, when adjusting for all factors, this effect was only statistically significant at the 10% level: OR decreased from 1.63 to 1.23 (Table 3). Having been previously tested for HIV and HIV/AIDS stigma score was statistically significant in the unadjusted model, although when adjusting for all factors these effects were not statistically significant and, therefore, were removed from the final model.

Biological and behavioural factors

Women who drank alcohol once a month or twice or more a month had higher odds of being HIV-positive, as did those with multiple sex partners (OR = 2.08, 95% CI 1.67–2.57) in unadjusted models. After controlling for other relevant risk factors, only women drinking alcohol two or more times a month still associated with HIV. Women who were formerly married (widowed, divorced or separated) or not living with a partner had approximately twice the odds of being HIV-positive, after adjusting for other factors, when compared with married women in a monogamous union. In

contrast, those who were never married were less likely to be HIV-positive (OR = 0.67; 95% CI: 0.43–1.05), although it was only statistically significant at 10% level (Table 3). Women who had an STI, genital sore/ulcer or discharge had a greater likelihood of being HIV-positive. Also, women living in urban areas were more likely to be HIV-positive, but this was only statistically significant in unadjusted models. After adjusting for other factors, this variable was not relevant, however, it was considered in the final model to control for possible confounding (Table 3).

Discussion

The main aim of this paper was to provide an overall picture of the general patterns and risk factors of being HIV-positive in Mozambique to inform national efforts targeting specific population subgroups of women most adversely affected by HIV/AIDS. The main strengths of this study were the use of a complex sample and a nationally representative questionnaire.

We identified several socio-demographic, knowledge and attitudes, behavioural and biological factors that were associated with HIV infection in this population of women aged 15–60 living in Mozambique in 2009. The variations observed across age groups show that women aged 25–29 years were more likely to be HIV-positive than those aged 45 years or older. In contrast, girls aged 15–19 years had the lowest odds of being HIV-positive. These low odds can possibly be explained by the fact that many girls aged 15–19 years are in school and are less sexually active than older age groups (Chinomona & Mwambi, 2015). In contrast, women aged 20–40 years are more sexually active and, therefore, their odds of being HIV-positive are higher.

Our analysis showed women who were widowed, divorced or not living with a partner had higher odds of being HIV-positive than those married in a monogamous union. This finding is also supported by previous research on Zimbabwe and might suggest that widowed women lost their partners due to HIV/AIDS (Chinomona & Mwambi, 2015).

Living in a female-headed household was also associated with HIV seropositivity. Previous studies also found that the risk of HIV seropositivity was significantly higher for women living in female-headed households and with no formal education (Magadi & Desta, 2011). Another study found that female heads of households were significantly more likely to be infected with HIV than their male counterparts: 17.9% vs 13.1% (Shisana, Rice, Zungu, & Zuma, 2010).

Our analysis showed that women living in richer households had higher odds of HIV seropositivity. Despite the links established in the literature that poverty increases vulnerability to HIV infection, some studies that suggest that the risk of infection is higher among individuals living in wealthier households support our findings (Lachaud, 2007; Magadi & Desta, 2011; Mishra et al., 2007).

Knowing someone with AIDS and awareness score showed some positive association with the odds of being HIV-positive at 10% level. The background factors are likely to be linked to the risk of HIV infection through proximate factors relating to HIV awareness, sexual behaviour and biological factors. Sexual behaviour is in turn influenced by a range of background socio-economic, cultural and

Table 3. Logistic regression results with complex survey: OR and 95%CI

Fixed effects	Crude OR	(95% CI)	p-value	Adjusted OR	(95% CI)	p-value
Intercept						
Age group (ref: 45 +)						
15–19	0.683	(0.435; 1.074)	0.099	1.117	(0.653; 1.912)	0.686
20–24	1.507	(1.008; 2.254)	0.047	2.262	(1.438; 3.557)	<0.001
25–29	1.805	(1.295; 2.515)	<0.001	2.615	(1.752; 3.904)	<0.001
30–34	1.620	(1.101; 2.385)	0.015	2.114	(1.383; 3.234)	<0.001
35–39	1.368	(0.887; 2.111)	0.158	1.881	(1.171; 3.022)	0.009
40–44	1.318	(0.868; 2.002)	0.196	1.468	(0.925; 2.329)	0.105
Education level (ref: secondary and higher)						
No education	0.612	(0.450; 1.283)	0.002	1.166	(0.775; 1.755)	0.462
Primary	0.968	(0.730; 1.283)	0.820	1.411	(1.014; 1.961)	0.042
Job status (ref: not working)						
Currently working	1.097	(0.861; 1.398)	0.456			
Sex of household head (ref: male)						
Female	2.354	(1.961; 2.827)	<0.001	1.588	(1.277; 1.975)	<0.001
Religion (ref: without religion)						
Catholic	0.639	(0.423; 0.967)	0.035	0.571	(0.376; 0.867)	0.009
Protestant	1.134	(0.788; 1.632)	0.499	0.896	(0.631; 1.274)	0.542
Other religions	1.238	(0.874; 1.756)	0.231	0.867	(0.608; 1.237)	0.432
Muslim	0.644	(0.424; 1.041)	0.076	0.678	(0.435; 1.055)	0.087
Wealth index (ref: more poor)						
More rich	2.656	(2.092; 3.373)	<0.001	2.359	(1.800; 3.091)	<0.001
Media exposure (ref: lowest)						
Second quarter	0.805	(0.605; 1.072)	0.139			
Third quarter	1.087	(0.746; 1.584)	0.666			
Highest	1.268	(0.936; 1.719)	0.127			
HIV/AIDS awareness (ref: lowest PCA score average)						
Highest PCA score average	1.309	(1.001; 1.711)	0.051	1.323	(0.984; 1.779)	0.066
HIV/AIDS stigma (ref: lowest PCA score average)						
Highest PCA score average	1.313	(1.052; 1.640)	0.017			
Knows someone with AIDS (ref: No)						
Yes	1.627	(1.292; 2.050)	<0.001	1.231	(0.969; 1.564)	0.089
Previously tested for HIV (ref: No)						
Yes	1.677	(1.377; 2.043)	<0.001			
Alcohol (ref: do not drink)						
Once a month	1.528	(1.139; 2.050)	0.005	1.321	(0.981; 1.778)	0.068
Two or more	1.369	(1.019; 1.839)	0.038	1.427	(1.054; 1.930)	0.022
Marital status (ref: married — monogamous)						
Widowed, divorced, not living together	3.365	(2.661; 4.256)	<0.001	2.393	(1.817; 3.150)	<0.001
Married — polygamous	1.134	(0.811; 1.586)	0.462	1.057	(0.751; 1.486)	0.751
Never married	0.771	(0.561; 1.059)	0.109	0.674	(0.434; 1.046)	0.079
STI, genital sore/ulcer or discharge (ref: No)						
Yes	2.188	(1.532; 3.124)	<0.001	1.437	(1.013; 2.037)	0.043
Multiple sexual partners (ref: No)						
One or more	2.075	(1.674; 2.570)	<0.001			
Area (ref: rural)						
Urban	1.905	(1.518; 2.392)	<0.001	1.222	(0.929; 1.607)	0.153

demographic factors, either directly or indirectly through HIV/AIDS awareness. Thus, our finding is interesting if compared with the results reported by Magadi and Desta (2011). In their analysis, the authors found that the relative risk of HIV seropositivity in countries such as Lesotho and Burkina Faso were considerably increased when HIV/AIDS awareness/stigma factors are controlled for, suggesting that those countries have a disproportionately higher share of lower risk subgroups with respect to HIV/AIDS awareness and stigma (Magadi & Desta, 2011). It may be also the case in Mozambique.

The association between most of the sexual behaviour factors and being HIV-positive meets what would be expected. The risk for HIV seropositivity was higher among those previously married (widowed, divorced or separated) and those who had multiple sexual partners. Therefore, there is need for intensified efforts towards appropriate behavioural change, already proven to be effective in tackling the spread of HIV transmission in Mozambique.

Alcohol consumption was found to be a relevant risk factor in the integrated model, which is aligned with studies that have revealed lower rates of HIV infection in some

African communities where taking alcohol is prohibited as a requirement of their religious affiliation (Gray et al., 2000). Biological factors are particularly relevant within this context: women having STI, genital sore/ulcer or discharge had a greater likelihood of being HIV-positive (significant at 10% level). The association between STIs and HIV risk has long been described in the literature. A recent prospective cohort study in a cohort of high-risk women in Mombasa (Kenya) found that bacterial vaginosis and herpes simplex virus type two (HSV-2) have consistently been the largest contributors to HIV acquisition risk in that cohort between 1993 and 2012 (Masese et al., 2015). However, that study found that the population attributable risk percentage (PAR%) for genital warts was -0.2%.

The main limitation of our analysis was the use of data from 2009, as the more recent data collected during IMASIDA 2015 in Mozambique, are not yet available for research purposes.

Conclusion

Results showed significant variations in the risk of being HIV-positive in Mozambique. The use of population-survey data supported by valid statistical methodology for analysing complex data can enhance better estimation of HIV risk factors, both nationally and at domain level (Cassy, Natário, & Martins, 2016; Chinomona & Mwambi, 2015). Our study provides estimates of risk factors for HIV seropositivity among Mozambican women at national level. Explaining the variation of risk factors for HIV was possible since the use of population-survey data allows linking HIV status to individual and contextual factors by using the proximate-determinants conceptual framework (Boerma & Weir, 2005).

This analysis showed that HIV prevalence among Mozambican women is dependent on biological, socio-economic and sociocultural factors, including age, sex of household head, wealth status and marital status. Additionally, our analysis found that education level, religion or HIV/AIDS related stigma do not play a significant role in determining women's HIV status. We found that women aged 25–29, living in a female-headed household, living in a richer household and those widowed, divorced or not living with a partner had higher odds of being HIV-positive.

Results from our study are important to drive national policies to fight HIV/AIDS. In a time when Mozambique is committed to treating all people living with HIV/AIDS, in line with the new WHO consolidated guidelines for HIV treatment (WHO, 2016), it is important that efforts to scale-up antiretroviral therapy access go together with new prevention approaches, namely post-exposure prophylaxis (PrEP).

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