Infect Dis Ther (2020) 9:881–900
https://doi.org/10.1007/s40121-020-00336-z

ORIGINAL RESEARCH

Seroprevalence and Determinants of Human Immunodeficiency Virus Infection Among Women of Reproductive Age in Mozambique: A Multilevel Analysis

Michael Ekholuenetale · Faith Owunari Benebo · Amadou Barrow ·
Ashibudike Francis Idebolo · Chimezie Igwegbe Nzoputam

Received: July 13, 2020 / Published online: September 10, 2020

ABSTRACT

Background: Human immunodeficiency virus (HIV) has continued to be one of the foremost public health problems globally. Even as more people living with the disease can now have access to antiretroviral therapy (ART), there are still some regions in the world with high transmission rates. The objective of this study was to examine the prevalence and individual-, household- and community-level factors associated with HIV infection among women of reproductive age in Mozambique.

Methods: We used nationally representative cross-sectional data from the 2015 Survey of Indicators on Immunization, Malaria and HIV or Acquired Immunodeficiency Syndrome (AIDS) in Mozambique. A sample of 4726 women of reproductive age was included in this study. Prevalence was measured in percentage and the factors for HIV infection were examined using a multivariable multilevel logistic regression model. The level of significance was set at $P < 0.05$.

Results: The seroprevalence of HIV among women in Mozambique was 10.3% (95% CI 9.2%, 11.6%). Furthermore, women who had two, three and four or more total lifetime number of sex partners were 2.73, 5.61 and 3.95 times as likely to have HIV infection when compared with women with only one lifetime sex partners, respectively. In addition, women of Islam religion had 60% reduction in HIV infection when compared with Christian women (adjusted odds ratio, AOR = 0.40; 95% CI 0.16, 0.99). The individual-level model (model B) had the best model fitness with the lowest Akaike information criterion (AIC) = 500.87 and Bayesian information criterion (BIC) = 648.88. The variations in the odds of HIV infection across communities ($\sigma^2 = 9.61 \times 10^{-8}$; SE = 0.55) and households

Digital Features To view digital features for this article go to https://doi.org/10.6084/m9.figshare.12855485.

M. Ekholuenetale
Department of Epidemiology and Medical Statistics, Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan, Nigeria

F. Owunari Benebo
Clinical Case Management Unit, Management Sciences for Health, Abuja, Nigeria

A. Barrow (✉)
Department of Public and Environmental Health, School of Medicine and Allied Health Sciences, University of The Gambia, Kanifing, The Gambia
e-mail: abarrow@utg.edu.gm

A. Francis Idebolo
Department of International Public Health, Liverpool School of Tropical Medicine, Liverpool, UK

C. Igwegbe Nzoputam
Department of Community Health, Center of Excellence in Reproductive Health Innovation (CERHI), College of Medical Sciences, University of Benin, Benin City, Nigeria

($\sigma^2 = 1.02 \times 10^{-4}$; SE = 1.02) were estimated. Results from the median odds ratio (MOR = 1.00) did not show any evidence of community and household contextual factors shaping HIV infection. MOR equal to unity (1) indicated that there were no community or household variances given the ICC of 0.0%. At both community and household levels, the explained variances were each 100%. This implied total variances in HIV infection has been explained by the individual-level factors.
Conclusion: In this study, we found that having multiple total lifetime number of sexual partners and religion were predisposing factors for HIV infection at individual woman level. Female headship and wealth quintiles were associated with HIV infection at household level. Community illiteracy, intimate partner violence, poverty and geographical region were associated with HIV infection at community level. Therefore, multifaceted health intervention by stakeholders in the healthcare system will be useful in addressing the multilevel predisposing factors of HIV infection among Mozambican women.

Keywords: AIDS; HIV; Sexually transmitted infection; STI; Sub-Saharan Africa; Women

Key Summary Points

Why carry out this study?

The prevalence of human immunodeficiency virus (HIV) infection has remained highest in the southern region of sub-Saharan Africa (SSA) than anywhere else in the world. Moreover, women are disproportionately affected by HIV infection among adults (aged 15 years and older) in SSA.

We aimed to examine HIV prevalence and the individual-level and/or contextual factors associated with HIV infection among women of reproductive age in Mozambique.

What was learned from the study?

We found that approximately one-tenth of women of reproductive age are HIV positive in Mozambique. In addition, increased total lifetime number of sex partners and religion are individual-level factors associated with HIV infection among women of reproductive age in Mozambique. Furthermore, at household level, female headship households and household wealth quintiles were associated with HIV infection and community illiteracy, intimate partner violence, poverty and geographical region were associated with HIV infection at community level.

There is staggering HIV prevalence in Mozambique. Furthermore, increased number of sex partners is a predisposing factor of HIV infection.

The reasons for women's involvement in multiple sexual relationships should be identified and addressed. High-risk religious groups should be targeted for health education. Also, there is a need for a multifaceted health education programme to target advantaged women at household and community levels.

DIGITAL FEATURES

This article is published with digital features to facilitate understanding of the article. You can access the digital features on the article's associated Figshare page. To view digital features for this article go to https://doi.org/10.6084/m9.figshare.12855485.

INTRODUCTION

In 2016, it was estimated that 17.8 million women aged 15 years and older were living with human immunodeficiency virus (HIV), and this constituted about 52% of adults who were living with HIV worldwide [1]. Moreover, approximately 790,000 (48%) of the total estimated 1.7 million new cases of HIV infections among adults were women [1]. Regional disparities exist in the new HIV infections as well as among the 37.9 million people living with HIV, out of which Africa accounted for 25.7 million [2]. In sub-Saharan Africa (SSA), women comprise about 56% of the total new HIV cases among adults (aged 15 years and older). Albeit, there could be key populations among women that are disproportionately affected. There have been reductions in the number of HIV-related deaths globally, as a report has shown that 0.95 million deaths occurred in 2017, which is substantially fewer compared to the 2006 report when HIV-related mortality reached its peak with about 1.95 million deaths from complications of the disease. Moreover, new cases of HIV peaked by 1999 (3.16 million), but reduced to 1.94 million by 2017 worldwide [3].

The prevalence of HIV has remained highest in the southern region of SSA [3]. Specifically, there are staggering reports of HIV prevalence among adult population in Eswatini (27.3%), Lesotho (23.6%), South Africa (20.4%), Botswana (20.3%), Zimbabwe (12.7%), Mozambique (12.6%), Namibia (11.8%) and Zambia (11.3%) [4]. Although there have been efforts to reduce HIV-related mortality over time, the rate of reduction in incidence, together with the current contextual interventions, shows that several countries are yet to be on the pathway to attain the 2020 and 2030 global targets which aimed to decrease the incidence and mortality due to HIV. Besides, with a growing population of people living with HIV, it will remain a great threat to public health.

In a bid to forestall the high burden of HIV, the United Nations General Assembly in 2001, during a special session on HIV or acquired immunodeficiency syndrome (AIDS), set the first global HIV prevention target. The session called for a one-quarter (25%) reduction in HIV prevalence among late adolescents and young people (that is people aged 15–24 years), and by 2005 in the world's most affected countries, extending to all other countries by 2010 [5]. In a future review of the intervention, it was reported that the 25% targeted decline in HIV prevalence was achieved in many countries highly affected, but the HIV prevalence decrease could not be associated with achievements of the programme, somewhat because of the lack of proper tracking and operational targets [6].

Consequently, at the 2011 United Nations (UN) high-level meeting on the reduction of sexually transmitted and injection-related HIV transmission, another target for the reduction of HIV transmission by 50% by the year 2015 was set. From the evaluation of the 2011–2015 implementation period, it can be said that setting an ambitious target for the reduction of HIV infection without corresponding efforts for proper implementation of the guidelines was not enough to achieve the desired progress. The 70% reduction observed in the new HIV infections among children from 2000 to 2015 has been the most consistent achievement recorded in HIV prevention worldwide [7]. However, in 2011, a global plan geared towards the elimination of new HIV infections in children was launched. This plan, among other things, reiterated that by 2015 through a defined minimum number of operational targets and priorities, the lives of children and mothers should no longer be at risk of HIV [7].

In 2014, the Joint United Nations Programme on HIV/AIDS made a call for a concerted effort in ending the HIV/AIDS epidemic by the year 2030 [8]. The goal was to reduce the adult new cases of HIV from the current status to half a million cases (500,000) by the year 2020 and one-fifth of a million (200,000) by the year 2030 [8]. This corresponds to a three-quarter (75%) reduction in rate by 2020 and a 90% reduction in rate by 2030, from the 2 million cases recorded in the year 2010. These targets were strengthened by the United Nations Political Declaration [9]. Effective programmes are available and ongoing in many countries, and quite a lot of these countries have reported considerable reductions in new HIV infections among the adult population. Unfortunately, on a global perspective, progress has been slow because of inadequate commitment from government and private agencies, minimal focus, scale-up, and quality of implementation of prevention and treatment interventions [10].

In Africa as well as most resource-constrained settings, HIV has remained endemic primarily because of numerous factors including women's increased number of sex partners [11], violence against women and girls including sexual violence, which increases the risk of HIV infection as reports have shown that as much as 50% of adolescents girls' sexual debut was forced [12–14]. Moreover, early marriage, which often limits women's access to information about HIV prevention and the power of protection against HIV infection [15], and factors which include lack of proper information on HIV prevention measures and the willpower to utilize such information for sound sexual and reproductive health decision-making have been reported to undermine women's capability to negotiate the use of a condom during sexual intercourse or engage in safe sexual practices [16]. Furthermore, behavioural, biological, cultural, socioeconomic and structural factors have also been implicated [17]. Other factors that have the capacity to influence women's vulnerability to HIV infection include heterosexual infections, poor knowledge of HIV/AIDS, lack of access to HIV preventive and therapeutic services, poor education systems, gender inequality and high levels of poverty [18].

The prevalence of HIV infection among 5809 Mozambican women of reproductive was approximately 15.4% with variations by sexual behaviour, sociodemographic and socioeconomic characteristics [19]. Despite the numerous factors that have been reported elsewhere in the world to be associated with HIV infection, it is possible that there could be peculiar determinants of HIV infection among Mozambican women. In previous studies conducted to provide a road map for the current state and evolution of the Mozambican HIV epidemic within women of reproductive age, women who were formerly married (widowed, divorced or not living with a partner), living in households with female headship, aged 25–29 years and living in richer households had higher odds of being HIV-positive [20]. In another study, HIV was associated with low educational attainment, age of first sex for money, current age and having had a genital ulcer [21]. Furthermore, lower educational level, older age, genital infection symptoms and multiple lifetime HIV test were identified to be associated with HIV infection [22]. To date, there is a dearth of studies in Mozambique that examined individual, community and contextual factors associated with HIV infection among women. It is against this backdrop that this study was conducted to examine the multilevel factors associated with HIV infection among women of reproductive age in Mozambique.

METHODS

Data Source

We used nationally representative cross-sectional data from the 2015 Survey of Indicators on Immunization, Malaria and HIV/AIDS in Mozambique. A sample of 4726 women of reproductive age was included in this study. In the year 2015, under the supervision and sponsorship of the Mozambican Demographic and Health Surveys (DHS) Program, a survey indicator titled "Survey of Indicators on Immunization, Malaria and HIV/AIDS in Mozambique (IMASIDA)" was conducted. This survey served as an update to the previously obtained estimated indicators on the health of the mother and child, malaria and HIV/AIDS. This survey was intended to make available data at the nationwide and regional levels, the participants' residential areas and in accordance with some of their background characteristics. In collaboration with the Mozambique National Institute of Statistics, the implementation of the project IMASIDA was carried out by the National Institute of Health. The collection of data was done between 8 June and 20 September 2015. Technical support throughout the survey programme was made possible by the Inner City Fund (ICF) with funds from the US Agency for International Development (USAID). The survey's implementation process was overseen by the Mozambican Government through her health ministry, other national establishments, as well as other international agencies and organizations. The economic and technical backing came from the National Council to Combat HIV and AIDS of

Mozambique and the US Centers for Disease Control and Prevention in cooperative agreement with The Global Fund, Health Alliance International/University of Washington (HAI/UW), World Health Organization (WHO), and President's Emergency Plan for AIDS Relief (PEPFAR), United Nations Population Fund (UNFPA) and United Nations Children's Emergency Fund (UNICEF). The data is publicly available and can be accessed at https://dhsprogram.com/data/available-datasets.cfm. Details of the DHS sampling procedure have been previously reported [23].

Selection and Measurement of Variables

Outcome

The dependent variable was dichotomous with an indication of the seropositivity of the HIV status: a value of 1 and 0 was used to indicate whether a participant was seropositive (1) or seronegative (0). The determination of the serostatus of the participants was done by collecting a blood sample from each participant. Women's HIV status (positive vs. negative) was explored in this study.

Individual-Level Factors

The maternal ages were grouped as 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49; intimate partner violence: yes vs. no; religion: Christianity, Islam and no religion/others; parity: nil, 1–2, 3–4 and 5+; place of delivery: health facility vs. home; antenatal care visit: yes vs. no; total lifetime number of sex partners: 1, 2, 3, 4+; age at sexual debut: not had sex, < 15, 15–17, 18+; marital status: never in marriage, currently married/living with a man, formerly married; health insurance coverage: covered vs. not covered; occupation: not working, professional/managerial, sales/services, agricultural/manual, clerical/household domestic work; educational: no formal education, primary and secondary or higher; neighbourhood socioeconomic disadvantaged status: low, medium and high; exposure to print or electronic media was measured dichotomously (yes vs. no) if a respondent used any of newspaper/magazine, radio or television. The inclusion of these factors was based on the outcome of the examined factors associated with HIV from previous studies [12, 24–26].

Household-Level Factors

Household headship: male vs. female. The wealth index of the household was measured as a cumulative composite of the living standard of each of the surveyed households. It was calculated through the use of easy-to-collect data on each of the selected assets owned by the surveyed household. These selected assets include bicycles and televisions; the materials with which the houses were built or constructed; the type of water to which the households have access as well as their sanitation facilities. The individual households were placed on a continuous relative wealth scale, as the households' wealth index, generated by the principal component analysis. The interviewed households were separated primarily, by DHS, into five wealth quintiles using principal component analysis (PCA) to compute the household variables. PCA has been proven and validated to be a useful technique for describing how socioeconomic status of a given population is differentiated within that population. It has also been used in the reduction of the number of variables in a given data set [27]. *Z* scores and factor loadings (factor coefficient) for each household were calculated. The loadings were multiplied by the indicator values of each household and summed, thereby producing the value of each household's wealth index. The overall assigned scores of the poorest/poorer/middle/richer/richest categories were disentangled with the aid of standardized *z* score [28].

Community-Level Factors

We used enumeration areas (EAs) to represent communities because the DHS did not collect aggregate-level data at the community level. Hence, community-level variables included in the analysis were based on women's characteristics, particularly those that have implications for HIV infection. The aggregate community-level variables were constructed by aggregating individual-level characteristics at the community (cluster) level and categorization of the aggregate variables was done as low or high for each community. Residential status: urban vs. rural. Geographical region: Niassa, Cabo Delgado, Nampula, Zambézia, Tete, Manica, Sofala, Inhambane, Gaza, Maputo Provincia, Maputo Cidade. The level of sexual violence within the community [whether half (50%) of the clustered population experience sexual violence or not]. The distribution of uneducated women (illiteracy) within the community [whether half (50%) of them had any form of formal education or not]. The poverty concentration within the community (whether half (50%) of the women fall within the least wealth quintiles or not). The concentration of intimate partner violence within the community (whether half (50%) of the women experience intimate partner violence or not). The exposure to print and electronic media within the community (whether half (50%) of the women within the community use any of the print and electronic media including newspaper/magazine, radio or television or not). This approach is similar to the methods of a previous study [29].

Ethical Considerations

In this study, we utilized population-based secondary data sets available in the public domain/online with all identifier information removed. The authors were granted access to use the data by MEASURE DHS/ICF International. The DHS Program is consistent with the standards for ensuring the protection of respondents' privacy. ICF International ensures that the survey complies with the US Department of Health and Human Services regulations for the respect of human subjects. No further approval was required for this study. More details about data and ethical standards are available at https://goo.gl/ny8T6X. The Demographic and Health Survey is a de-identified open-source data set. Therefore, the requirement of consent for publication is not applicable.

Statistical Analysis

We used the 'svy' module to adjust for data strata, clusters and sample weights. A multivariable multilevel logistic regression model was employed in the estimation of the fixed and random effects of the associated factors to HIV infection. Binary response in a three-level model was specified as at level 1 (individual woman), at level 2 (a household) and at level 3 (living in a community). Out of the five models constructed, model A is an unconditional or empty model with no explanatory variables. This first model was employed to specifically decompose the sum of discrepancy that occurred between households and community levels. The null or empty model is important for understanding the community and household variations, and we used it as the point of reference in estimating the extent to which the household and community factors varied. It was also used to justify our usage of the multilevel statistical framework. This is so because in the empty model, if the community variation is not significant, it will be better to use the single-level logistic regression. We determined the level of statistical significance to be at less than 0.05, while data was analysed using Stata version 14 (StataCorp., College Station, TX, USA).

Fixed and Random Effects

The selection criteria in building the last four models: Models B–D require that only individual-, household- or community-level variables which were significant in the univariate analysis were added in the adjusted model. Model E is the full model for all significant variables irrespective of the level. The results obtained from the measures of association (fixed effects) were reported as adjusted odds ratios (AORs) with confidence interval (CI) set at 95%. Intra-class correlation (ICC) and the median odds ratio (MOR) were used for the probable contextual effects. We used ICC to measure any variance in respondents in the same household and within the same community. This tool (ICC) presents the percentage of the overall variation in the probability of HIV infection which is in relation to the household and the community levels. The second or third level (household or community) variance was measured by the MOR, as the odds ratio, and it estimates the probability of HIV infection that can be accredited to household and community context. A MOR value of unity suggests that no household or community was at variance. Contrariwise, higher value suggests that the contextual effects for the understanding of the probability of HIV infection are more important. The Bayesian and Akaike information criteria were used as measurement criteria to determine how well the different models we employed were fitted to the data. When the values on the two criteria are low, it implies a better fit of the model [30].

RESULTS

Distribution of HIV Prevalence and Measures of Associations

The seroprevalence of HIV among women in Mozambique was 10.3% (95% CI 9.2%, 11.6%). On the basis of the results from Table 1, about 17.5% of women with intimate partner violence had HIV. The prevalence of HIV increased with increasing levels of parity and the total lifetime number of sex partners. Women who had institution-based delivery (9.5%) and who were formerly married (21.7%) reported a higher prevalence of HIV. Those from female-headed households (15.3%) and higher household wealth quintiles reported higher prevalence of HIV. Furthermore, women from the community with a high level of media use (13.5%) and intimate partner violence (13.0%) had a higher prevalence of HIV. Those from the community with low poverty level (13.6%) and community illiteracy (12.5%) had higher HIV prevalence. Women from Gaza (22.2%) and Maputo Provincia (17.4%) reported the highest prevalence of HIV (Table 1).

Results from the individual-level model (model B) of Table 1 showed that women who had 2, 3 and 4+ total lifetime number of sex partners were 2.73, 5.61 and 3.95 times as likely to have HIV infection when compared with women with only one lifetime sex partner, respectively. In addition, women of Islam religion had 60% reduction in HIV infection when compared with Christian women (AOR = 0.40; 95% CI 0.16, 0.99). Results from model B are presented on the basis of the selection criteria from model fit statistics.

Measures of Variations

Results from Table 2 showed that the individual-level model (model B) had the best model fitness with the lowest AIC = 500.87 and BIC = 648.88. The variations in the odds of HIV infection across communities ($\sigma^2 = 9.61 \times 10^{-8}$; SE = 0.55) and households ($\sigma^2 = 1.02 \times 10^{-4}$; SE = 1.02) were estimated. Results from the median odds ratio (MOR = 1.00) did not show any evidence of community and household contextual factors shaping HIV infection (model B). MOR equal to unity (1) indicated that there was no community or household variance given the ICC of 0.0% (model B). At both community and household levels, the explained variances were each 100% (model B). This implied that total variances in HIV infection were explained by the individual-level factors (Table 2).

DISCUSSION

The current study examined the seroprevalence of HIV as well as its determinants among Mozambican women of reproductive age. At the individual level, the total number of lifetime sexual partners and religion were significant factors of HIV infection among women of reproductive age. Results showed that HIV prevalence was about one-tenth among women aged 15–49 years. However, the initial report from 5809 reported 15.4% [19]. This prevalence is comparable with the findings in other South African countries [4]. In their study on HIV prevalence and risk factors, Macicame et al. revealed that the prevalence of HIV amongst women of aged 18–35 years was 10.7% [31]. Studies from Eastern and Central Africa have reported prevalence rates among women ranging from 14.5% in Eastern Africa to 39.5% in Southern Africa [32].

Table 1 Distribution of HIV prevalence and the fixed effect of individual-, household- and community-level factors of HIV among women in Mozambique

Variable	Number of respondents (%)	Weighted HIV infection among women; % (95% CI)	*P*	Model A	Model B	Model C	Model D	Model E
Individual-level factors								
Intimate partner violence			< 0.001*					
No	1558 (73.3)	11.1			1.00			1.00
Yes	567 (26.7)	17.5			1.09 (0.62, 1.93)			0.95 (0.51, 1.75)
Religious belief			< 0.001*					
Christianity	3721 (78.7)	13.0			1.00			1.00
Islam	617 (13.1)	4.9			0.40 (0.16, 0.99)*			1.50 (0.46, 4.82)
No religion/other	388 (8.2)	10.8			1.29 (0.54, 3.12)			1.10 (0.44, 2.77)
Parity			< 0.001*					
Nil	502 (11.5)	5.8			–			–
1–2	1625 (37.2)	9.4			1.00			1.00
3–4	1146 (26.2)	14.9			1.36 (0.60, 3.08)			1.38 (0.58, 3.27)
5+	1099 (25.1)	13.7			1.51 (0.56, 4.06)			1.61 (0.57, 4.59))
Place of delivery			< 0.001*					
Health facility	1599 (82.6)	9.5			1.19 (0.57, 2.48)			0.93 (0.43, 2.03)
Home	337 (17.4)	5.3			1.00			1.00
ANC visit			0.316					
No	259 (9.2)	8.1						
Yes	2545 (90.8)	10.1						

Table 1 continued

Variable	Number of respondents (%)	Weighted HIV infection among women; % (95% CI)	*P*	Model A	Model B	Model C	Model D	Model E
Total lifetime number of sex partners			< 0.001*					
1	1891 (41.5)	5.3			1.00			1.00
2	1350 (29.6)	13.6			2.73 (1.38, 5.37)*			3.85 (1.78, 8.33)*
3	787 (17.3)	18.0			5.61 (2.67, 11.77)*			9.18 (3.72, 22.63)
4+	532 (11.7)	19.4			3.95 (1.56, 10.00)*			8.46 (2.76, 25.93)*
Age at sexual debut			0.006*					
18+	1391 (30.0)	13.5			1.00			1.00
15–17	2273 (49.1)	11.8			0.72 (0.39, 1.35)			0.64 (0.33, 1.24)
≤ 14	910 (16.7)	10.8			0.69 (0.31, 1.54)			0.70 (0.29, 1.68)
Not had sex	57 (1.2)	0.0			–			–
Marital status			< 0.001*					
Never in marriage	649 (13.7)	8.5			–			–
Currently married/living with a man	3122 (66.1)	9.5			1.00			1.00
Formerly married	955 (20.2)	21.7			1.40 (0.75, 2.59)			1.24 (0.59, 2.62)
Respondent's age			< 0.001*					
15–19	607 (12.8)	3.0			1.00			1.00

Table 1 continued

Variable	Number of respondents (%)	Weighted HIV infection among women; % (95% CI)	*P*	Model A	Model B	Model C	Model D	Model E
20–24	1011 (21.4)	5.8			0.90 (0.22, 3.54)			1.08 (0.26, 4.53)
25–29	817 (17.3)	10.7			1.01 (0.23, 4.41)			1.31 (0.27, 6.32)
30–34	650 (13.7)	16.8			1.47 (0.31, 6.96)			1.81 (0.34, 9.48)
35–39	591 (12.5)	19.3			2.46 (0.48, 12.72)			2.89 (0.51, 16.51)
40–44	403 (8.5)	16.6			0.68 (0.10, 4.62)			0.73 (0.09, 5.65)
45+	647 (13.7)	16.7			–			–
Health insurance coverage			0.010*					
Not covered	4526 (95.8)	11.5			1.00			1.00
Covered	199 (4.2)	17.6			1.85 (0.43, 8.05)			2.17 (0.48, 9.88)
Occupation			0.048*					
Not working	2287 (48.5)	11.3			1.00			1.00
Professional/managerial	203 (4.3)	11.3			1.52 (0.33, 6.86)			1.09 (0.22, 5.37)
Sales/services	1022 (21.7)	13.7			1.22 (0.62, 2.39)			1.35 (0.65, 2.80)
Agricultural/manual	947 (20.1)	10.0			0.90 (0.46, 1.76)			0.62 (0.29, 1.33)
Clerical/household domestic work	259 (5.5)	15.1			1.19 (0.34, 4.19)			1.14 (0.29, 4.53)

Table 1 continued

Variable	Number of respondents (%)	Weighted HIV infection among women; % (95% CI)	*P*	Model A	Model B	Model C	Model D	Model E
Respondent's education			< 0.001*					
No education	842 (17.8)	11.4			1.00			1.00
Primary	2317 (49.0)	14.0			1.26 (0.63, 2.53)			1.36 (0.64, 2.90)
Secondary or higher	1567 (33.2)	8.7			0.53 (0.18, 1.52)			0.50 (0.16, 1.58)
Neighbourhood socioeconomic disadvantaged status			< 0.001*					
Low	1895 (40.1)	12.7			1.00			1.00
Medium	1739 (36.8)	15.2			1.36 (0.68, 2.76)			1.32 (0.51, 3.40)
High	1092 (23.1)	4.7			0.46 (0.18, 1.17)			0.98 (0.23, 4.13)
Read newspaper/magazine			0.426					
No	3697 (78.2)	12.0						
Yes	1029 (21.8)	11.1						
Listen to radio			0.112					
No	2540 (53.8)	12.5						
Yes	2185 (46.2)	11.0						
Watch TV			0.050*					
No	2313 (49.0)	10.9			1.00			1.00
Yes	2411 (51.0)	12.7			1.28 (0.68, 2.39)			1.06 (0.50, 2.25)

Table 1 continued

Variable	Number of respondents (%)	Weighted HIV infection among women; % (95% CI)	*P*	Model A	Model B	Model C	Model D	Model E
Household-level factors								
Household headship			< 0.001*					
Male	2730 (57.8)	9.2				1.00		1.00
Female	1996 (42.2)	15.3				1.83 (1.48, 2.26)*		0.84 (0.45, 1.56)
Household wealth quintiles			< 0.001*					
Poorest	468 (9.9)	5.6				1.00		1.00
Poorer	507 (10.7)	6.9				1.35 (0.77, 2.37)		1.35 (0.36, 5.06)
Middle	678 (14.4)	10.3				2.02 (1.21, 3.39)*		3.25 (0.98, 10.83)
Richer	1252 (26.5)	15.6				3.00 (1.85, 4.87)*		3.12 (0.89, 10.91)
Richest	1821 (38.5)	12.7				2.64 (1.63, 4.29)*		3.11 (0.66, 14.56)
Community-level factors								
Community level of sexual violence			0.329					
Low	1846 (39.1)	11.2						
High	2880 (60.9)	12.2						

Table 1 continued

Variable	Number of respondents (%)	Weighted HIV infection among women; % (95% CI)	P	Model A	Model B	Model C	Model D	Model E
Community illiteracy			< 0.001*					
Low	4361 (88.3)	12.5					1.00	1.00
High	365 (7.7)	2.7					0.39 (0.19, 0.79)*	0.50 (0.10, 2.59)
Community intimate partner violence			< 0.001*					
Low	761 (16.1)	5.7					1.00	1.00
High	3965 (83.9)	13.0					1.55 (1.02, 2.35)*	2.04 (0.90, 4.63)
Community media use			< 0.001*					
Low	1650 (34.9)	8.6					1.00	1.00
High	3076 (65.1)	13.5					0.91 (0.65, 1.27)	1.00 (0.47, 2.11)
Community poverty			< 0.001*					
Low	3716 (78.6)	13.6					1.00	1.00
High	1010 (21.4)	5.2					0.63 (0.40, 0.97)*	0.71 (0.23, 2.21)
Residential status			0.016*					
Urban	2574 (54.5)	12.8					1.00	1.00
Rural	2152 (45.5)	10.6					0.88 (0.64, 1.19)	1.64 (0.66, 4.07)

Table 1 continued

Variable	Number of respondents (%)	Weighted HIV infection among women; % (95% CI)	*P*	Model A	Model B	Model C	Model D	Model E
Geographical region			< 0.001*					
Niassa	396 (8.4)	5.8					1.00	1.00
Cabo Delgado	257 (5.4)	6.2					0.95 (0.45, 1.99)	0.19 (0.02, 2.27)
Nampula	349 (7.4)	1.2					0.21 (0.07, 0.65)*	0.31 (0.03, 3.44)
Zambézia	309 (6.5)	12.0					2.42 (1.29, 4.54)*	4.56 (0.88, 23.54)
Tete	385 (8.2)	6.0					1.21 (0.61, 2.40)	4.23 (0.68, 26.35)
Manica	397 (8.4)	10.6					1.86 (1.00, 3.47)*	5.70 (1.02, 31.83)*
Sofala	408 (8.6)	12.5					2.30 (1.26, 4.20)*	2.06 (0.37, 11.21)
Inhambane	463 (9.8)	11.2					1.83 (1.00, 3.33)*	1.18 (0.22, 6.39)
Gaza	702 (14.9)	22.2					4.20 (2.36, 7.45)*	3.41 (0.67, 17, 45)

Table 1 continued

Variable	Number of respondents (%)	Weighted HIV infection among women; % (95% CI)	*P*	Model A	Model B	Model C	Model D	Model E
Maputo Provincia	489 (10.3)	17.4					2.96 (1.66, 5.28)*	1.97 (0.35, 11.11)
Maputo Cidade	571 (12.1)	11.9					1.68 (0.94, 3.00)	1.84 (0.27, 12.68)

Model A—empty null model, baseline model without any explanatory variables (unconditional model). Model B—adjusted for individual-level factors only. Model C—adjusted for household-level factors only. Model D—adjusted for community-level factors only. Model E—adjusted for individual-, household- and community-level factors (full model)

*Significant at $P < 0.05$; *P* obtained from chi-square test

The increasing total number of lifetime sexual partners showed a higher odds of HIV infection. In their study, Dias et al. found that HIV the risk of HIV seropositivity was higher among women who had multiple sexual partners [20]. Similar findings have been reported in other studies [25, 33, 34]. Multiple sexual partners is a known risk factor for HIV infection, particularly when it follows a concurrent pattern, not only in women but also in men [35]. Rooted in cultural history, the practice of having multiple sexual partners is quite common in SSA compared to other parts of the world [33]. Cultural norms tends to condone the practice particularly among men, and often women cannot suggest condom use or refuse sexual advances [36]. In addition, women's religion was found to be associated with HIV infection. This is consistent with the findings from a study where religion was significantly associated with the odds of having HIV infection [37]. It will be interesting for future researchers to undertake a study to explore the predisposing factors to HIV infection for believers of some religious groups. With such studies, appropriate measures can be unraveled to address the increased HIV prevalence in some religious sects.

Our study found a significant association between household wealth quintile, female-headed household and HIV infection among Mozambican women from the household-level model. This is consistent with the findings from a previous study where living in households with female headship and living in richer households had higher odds of being HIV-positive [20]. Moreover, there are mixed reports about the association between socioeconomic status and HIV infection. While some studies suggest that people with low socioeconomic status are more predisposed to being infected by HIV, others suggest that those with high socioeconomic are more vulnerable to HIV infection [38–40]. Higher income may increase the likelihood of a lifestyle with multiple sexual partners, maybe with gender disparity. Poverty may be more associated with dropping out of school, early marriage and ultimately increased risk of HIV [14, 41, 42]. In their study, Igulot and Magadi found that household wealth increases vulnerability to HIV infection [43].

Table 2 Random effect estimates of individual-, household- and community-level factors associated with HIV infection among women in Mozambique

Random effect	Model A	Model B	Model C	Model D	Model E
Community level					
Variance (SE)	0.77 (0.09)*	9.61×10^{-8} (0.55)	0.60 (0.09)*	0.35 (0.10)*	2.00×10^{-5} (0.38)
VPC	4.4%	3.7×10^{-7}%	2.9%	1.0%	2.0×10^{-5}%
PCV (explained variance)	Reference	100.0%	22.1%	54.5%	100.0%
MOR	2.08	1.00	1.77	1.39	1.00
ICC	13.5%	0.0%	8.5%	3.1%	0.0%
Household level					
Variance (SE)	0.69 (0.25)	1.02×10^{-4} (1.02)	0.74 (0.24)	0.72 (0.25)*	4.0×10^{-5} (0.82)
VPC	4.3%	88.8%	4.7%	5.1%	96.5%
PCV (explained variance)	Reference	100.0%	− 7.2%	− 4.3%	100.0%
MOR	1.94	1.00	2.03	1.99	1.00
ICC	11.0%	0.0%	13.2%	13.3%	0.0%
Model fit statistics					
AIC	3368.34	500.87	3317.14	3247.54	506.34
BIC	3387.73	648.88	3368.83	3363.84	749.82

Model A—empty null model, baseline model without any explanatory variables (unconditional model). Model B—adjusted for only individual-level factors. Model C—adjusted for only household-level factors. Model D—adjusted for only community-level factors. Model E—adjusted for individual-, household- and community-level factors (full model)
SE standard error, *VPC* variance partition coefficient, *PCV* proportional change in variance, *MOR* median odds ratio, *ICC* intra-class correlation, *AIC* Akaike information criterion, *BIC* Bayesian information criterion
*Significant at $P < 0.05$

Several community-level factors were associated with HIV infection among Mozambican women of reproductive age. Community-level illiteracy, intimate partner violence, poverty and geographical region were associated with HIV infection. The regional disparity in HIV infection was observed in this study. Similar findings have been reported in previous studies [44, 45]. Women in the northern provinces of Cabo Delgado and Nampula had lower odds of HIV infection, while women in the southern provinces were more likely to have HIV infection [44]. The observed disparity may be due to local cultural practices or previous health interventions which may have existed in certain locations. High community-level intimate partner violence and socioeconomic status were identified as predisposing factors for HIV infection.

Strengths and Limitation

This study was based on a nationally representative data and the findings can be generalized to women aged 15–49 years in the country. Also, this study applied multilevel modeling to accommodate the hierarchical nature of the DHS data. Despite these strengths, this study has some limitations. Some behaviour-related factors were based on self-report and these may be affected by both recall and social desirability bias. The inability to measure potential covariates such as the use of alcohol, hard drugs, and involvement in extramarital relationships and other endogenous variables due to the use of secondary data was a limitation. Furthermore, the cross-sectional nature of the study means that only associations and not causality can be inferred.

CONCLUSION

The findings from this study give a unique and coherent perspective on risk factors associated with HIV infection among Mozambican women. At individual woman level, religion and having multiple lifetime number of sexual partners were significantly associated with HIV infection. At household level, female headship households and household wealth quintiles were associated with HIV infection. Furthermore, at community-level, community illiteracy, intimate partner violence, poverty and geographical region were associated with HIV infection. Consequently, the reasons for women's involvement in multiple sexual relationships should be identified and addressed. High-risk religious groups should be targeted for health education. In addition, a multifaceted health education programme should also be targeted at advantaged women and communities. In that way, women in headship positions at household level, those from improved household wealth quintiles, and from high socioeconomic communities will be able to live a life devoid of HIV infection.

ACKNOWLEDGEMENTS

The authors appreciate the MEASURE DHS project for the approval and access to the original data.

Funding. No funding or sponsorship was received for this study or publication of this article.

Authorship. All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Author Contributions. ME and AB conceptualized the study, designed the methods, performed data analysis and wrote the results. FOB, AFI and CIN reviewed the literature, wrote the results and discussed the findings. ME, FOB, AB, AFI and CIN provided substantial inputs and ideas into all drafts of the paper. All authors read and approved the final version of the manuscript.

Disclosures. Michael Ekholuenetale, Faith Owunari Benebo, Amadou Barrow, Ashibudike Francis Idebolo and Chimezie Igwegbe Nzoputam declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Compliance with Ethics Guidelines. Ethics approval for this study was not required since the authors used secondary data available in the public domain. This is not applicable in this study. More details regarding DHS data and ethical standards are available at http://dhsprogram.com/data/available-datasets.cfm. The Demographic and Health Survey is a de-identified open-source data set. Therefore, the requirement of consent for publication is not applicable.

Data Availability. Data for this study were sourced from the Demographic and Health surveys (DHS) and available at http://dhsprogram.com/data/available-datasets.cfm.

REFERENCES

1. UNAIDS. Global AIDS Monitoring 2018, indicators for monitoring the 2016 United Nations Political Declaration on Ending AIDS. 2018. https://www.unaids.org/sites/default/files/media_asset/2017-Global-AIDS-Monitoring_en.pdf. Accessed 25 May 2020.

2. World Health Organization. Data and statistics about HIV/AIDS. WHO. 2018. https://www.who.int/hiv/data/en/. Accessed 25 May 2020.

3. Frank TD, Carter A, Jahagirdar D, et al. Global, regional, and national incidence, prevalence, and mortality of HIV, 1980–2017, and forecasts to 2030, for 195 countries and territories: a systematic analysis for the global burden of diseases, injuries, and risk factors study 2017. Lancet HIV. 2019;6(12):e831–e859859.

4. World Health Organization. Prevalence of HIV among adults aged 15 to 49 Estimates by country. WHO. 2018. https://apps.who.int/gho/data/node.main.622?lang=en. Accessed 25 May 2020.

5. Rodríguez DMP, Hayes R. Reducing HIV prevalence among young people: a review of the UNGASS prevalence goal and how it should be monitored. Discussion paper commissioned by WHO. 2002. https://www.who.int/hiv/pub/epidemiology/en/reducing_prev_young_people.pdf?ua=1. Accessed 25 May 2020.

6. The International Group on Analysis of Trends in HIV Prevalence and Behaviours in Young People in Countries most Affected by HIV. Trends in HIV prevalence and sexual behaviour among young people aged 15–24 years in countries most affected by HIV. Sex Transm Infect. 2010;86(Suppl 2):ii72–ii83.

7. Joint United Nations Programme on HIV/AIDS. Countdown to zero: global plan towards the elimination of new HIV infections among children by 2015 and keeping their mothers alive, 2011–2015. Geneva: UNAIDS; 2011. p. 44.

8. UNAIDS. Fast-Track—ending the AIDS epidemic by 2030. 2014. https://www.unaids.org/en/resources/documents/2014/JC2686_WAD2014report. Accessed 25 May 2020.

9. UNAIDS. Political declaration on HIV and AIDS: on the fast track to accelerating the fight against HIV and to ending the AIDS epidemic by 2030. 2016. https://www.unaids.org/en/resources/documents/2016/2016-political-declaration-HIV-AIDS. Accessed 25 May 2020

10. Dehne KL, Dallabetta G, Wilson D, et al. HIV prevention 2020: a framework for delivery and a call for action. Lancet HIV. 2016;3(7):e323–e332332.

11. Baral S, Beyrer C, Muessig K, et al. Burden of HIV among female sex workers in low-income and middle-income countries: a systematic review and meta-analysis. Lancet Infect Dis. 2012;12(7):538–49.

12. Jewkes R, Dunkle K, Nduna M, et al. Factors associated with HIV sero-status in young rural South African women: connections between intimate partner violence and HIV. Int J Epidemiol. 2006;35(6):1461–8.

13. Dunkle KL, Jewkes RK, Brown HC, Gray GE, McIntyre JA, Harlow SD. Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. Lancet. 2004;363(9419):1415–21.

14. Durevall D, Lindskog A. Intimate partner violence and HIV in ten sub-Saharan African countries: what do the demographic and health surveys tell us? Lancet Global Health. 2015;3(1):e34–43.

15. Clark S. Early marriage and HIV risks in Sub-Saharan Africa. Stud Fam Plann. 2004;35(3):149–60.

16. Greig FE, Koopman C. Multilevel analysis of women's empowerment and HIV prevention: quantitative survey results from a preliminary study in Botswana. AIDS Behav. 2003;7(2):195–208.

17. Ramjee G, Daniels B. Women and HIV in Sub-Saharan Africa. AIDS Res Ther. 2013;10(1):30.

18. Audet CM, Burlison J, Moon TD, Sidat M, Vergara AE, Vermund SH. Sociocultural and epidemiological aspects of HIV/AIDS in Mozambique. 2010;10:15.

19. Ministério da Saúde (MISAU), Instituto Nacional de Estatística (INE), ICF. Survey of indicators on immunization, malaria and HIV/AIDS in Mozambique 2015: supplemental report incorporating antiretroviral biomarker results. Maputo, Mozambique, and Rockville, Maryland, USA: INS, INE, and

ICF. 2019. https://dhsprogram.com/pubs/pdf/AIS12/AIS12_SE.pdf. Accessed 25 May 2020

20. Dias SS, Mbofana F, Cassy SR, et al. Estimating risk factors for HIV infection among women in Mozambique using population-based survey data. Afr J AIDS Res. 2018;17(1):62–71.

21. do Augusto ÂR, Young PW, Horth RZ, et al. High burden of HIV infection and risk behaviors among female sex workers in three main urban areas of Mozambique. AIDS Behav. 2016;20(4):799–810.

22. Zango A, Dubé K, Kelbert S, et al. Determinants of prevalent HIV infection and late HIV diagnosis among young women with two or more sexual partners in Beira, Mozambique. PLoS One. 2013. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3656941/. Accessed 9 Aug 2020.

23. Corsi DJ, Neuman M, Finlay JE, Subramanian S. Demographic and health surveys: a profile. Int J Epidemiol. 2012;41(6):1602–13.

24. Mabaso M, Sokhela Z, Mohlabane N, Chibi B, Zuma K, Simbayi L. Determinants of HIV infection among adolescent girls and young women aged 15–24 years in South Africa: a 2012 population-based national household survey. BMC Public Health. 2018;18(1):183.

25. Singh RK, Patra S. What factors are responsible for higher prevalence of HIV infection among urban women than rural women in Tanzania? Ethiop J Health Sci. 2015;25(4):321–8.

26. Bärnighausen T, Hosegood V, Timaeus IM, Newell M-L. The socioeconomic determinants of HIV incidence: evidence from a longitudinal, population-based study in rural South Africa. AIDS. 2007;21(Suppl 7):S29–38.

27. Vyas S, Kumaranayake L. Constructing socio-economic status indices: how to use principal components analysis. Health Policy Plan. 2006;21(6):459–68.

28. Rutstein SO, Staveteig S. Making the demographic and health surveys wealth index comparable. 2014; DHS Methodological Reports No. 9. Rockville, Maryland, USA: ICF International.

29. Huda TM, Chowdhury M, El-Arifeen S, Dibley MJ. Individual and community level factors associated with health facility delivery: a cross sectional multilevel analysis in Bangladesh. PLoS One. 2019;14(2):e0211113.

30. Spiegelhalter DJ, Best NG, Carlin BP, van der Linde A. Bayesian measures of model complexity and fit. J R Stat Soc B. 2002;64(4):583–639.

31. Macicame I, Bhatt N, Matavele Chissumba R, et al. HIV prevalence and risk behavior among male and female adults screened for enrolment into a vaccine preparedness study in Maputo, Mozambique. PLoS One. 2019;14(9):e0221682.

32. Ramjee G, Kapiga S, Weiss S, et al. The value of site preparedness studies for future implementation of phase 2/IIb/III HIV prevention trials: experience from the HPTN 055 study. J Acquir Immune Defic Syndr. 2008;47(1):93–100.

33. Mah TL, Halperin DT. Concurrent sexual partnerships and the HIV epidemics in Africa: evidence to move forward. AIDS Behav. 2010;14(1):11–6.

34. Pettifor AE, van der Straten A, Dunbar MS, Shiboski SC, Padian NS. Early age of first sex: a risk factor for HIV infection among women in Zimbabwe. AIDS. 2004;18(10):1435–42.

35. Halperin DT, Epstein H. Concurrent sexual partnerships help to explain Africa's high HIV prevalence: implications for prevention. Lancet. 2004;364(9428):4–6.

36. Duffy L. Culture and context of HIV prevention in rural Zimbabwe: the influence of gender inequality. J Transcult Nurs. 2005;16(1):23–31.

37. Shaw SA, El-Bassel N. The influence of religion on sexual HIV risk. AIDS Behav. 2014;18(8):1569–94.

38. Fortson JG. The gradient in Sub-Saharan Africa: socioeconomic status and HIV/AIDS. Demography. 2008;45(2):303–22.

39. Parkhurst JO. Understanding the correlations between wealth, poverty and human immunodeficiency virus infection in African countries. Bull World Health Organ. 2010;88(7):519–26.

40. Fox AM. The HIV-poverty thesis re-examined: poverty, wealth or inequality as a social determinant of HIV infection in sub-Saharan Africa? J Biosoc Sci. 2012;44(4):459–80.

41. Gillespie S, Greener R, Whiteside A, Whitworth J. Investigating the empirical evidence for understanding vulnerability and the associations between poverty. HIV Infect AIDS Impact AIDS. 2007;21(Suppl 7):S1–4.

42. Msisha WM, Kapiga SH, Earls F, Subramanian S. Socioeconomic status and HIV seroprevalence in Tanzania: a counterintuitive relationship. Int J Epidemiol. 2008;37(6):1297–303.

43. Igulot P, Magadi MA. Socioeconomic status and vulnerability to HIV infection in Uganda: evidence

from multilevel modelling of AIDS indicator survey data. AIDS Res Treat. 2018;7(2018):1–15.

44. Audet CM, Burlison J, Moon TD, Sidat M, Vergara AE, Vermund SH. Sociocultural and epidemiological aspects of HIV/AIDS in Mozambique. BMC Int Health Hum Rights. 2010;8(10):15.

45 Mocumbi S, Gafos M, Munguambe K, Goodall R, McCormack S, on behalf of the Microbicides Development Programme. High HIV prevalence and incidence among women in Southern Mozambique: evidence from the MDP microbicide feasibility study. PLoS One. 2017;12(3):e0173243.