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Antenatal HIV testing in Zimbabwe

INDIVIDUAL- AND COMMUNITY-LEVEL DETERMINANTS OF ANTENATAL HIV TESTING IN ZIMBABWE

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Summary. This study contributes to the dialogue on the prevention of mother-to-child HIV transmission (PMTCT) through the use of HIV and antenatal care (ANC) integrated services. The determinants of antenatal HIV testing in Zimbabwe were explored. Multilevel logistic regression models were applied to data for 8471 women from 406 clusters who gave birth in the 5 years preceding Zimbabwe Demographic and Health Surveys conducted in 2005/6 and 2010/11. The uptake of antenatal HIV testing was found to be determined by a wide range of individual-level factors relating to women's economic and demographic status, as well as HIV-related factors, including HIV awareness and stigma within the community. Important individual-level enabling and perceived need factors included high socioeconomic status, not having observed HIV-related stigma and knowledge of HIV status (based on a previous HIV test), such that these groups of individuals had a significantly higher likelihood of being tested for HIV during pregnancy than their counterparts of lower socioeconomic status, and who had observed HIV-related stigma or did not know their HIV status. The results further revealed that community HIV awareness is important for improving antenatal HIV testing, while stigma is associated with reduced testing uptake. Most contextual community-level factors were not found to have much effect on the uptake of antenatal HIV testing. Therefore, policies should focus on individual-level predisposing and enabling factors to improve the uptake of antenatal HIV testing in Zimbabwe.

Introduction

The persistent high rates of paediatric HIV transmission in sub-Saharan African countries have prompted calls for a scaling-up of access to antenatal health care services in order to reduce mother-to-child HIV transmission (MTCT). This has culminated in MTCP prevention programmes (PMTCT) being integrated with antenatal care (ANC) services as a means of reaching out to pregnant women who are HIV positive and those who are vulnerable to HIV infection. The rationale for the integration of these services is to increase the coverage of PMTCT services as pregnant women who use ANC services can also benefit from PMTCT services, and vice versa (Obure *et al.*, 2016). It is acknowledged that prevention of parent-to-child HIV transmission (PPTCT) is the currently preferred term, but PMTCT is used in this research to reflect the fact that antenatal HIV testing services do not extend to include women's partners in Zimbabwe. Thus, the focus of this paper is on the HIV testing of mothers during antenatal care visits, rather than both parents.

There has been widespread international recognition that the goal of PMTCT cannot be met without increasing antenatal HIV testing uptake (Granich *et al.*, 2015). World Health Organization guidelines state that routine antenatal HIV testing should be offered to all pregnant women during their first contact with maternal health care services (WHO, 2015). This is particularly crucial in high HIV prevalence settings of sub-Saharan Africa such as Zimbabwe. While the rationale for incorporating HIV testing into ANC services is strong in order to increase the uptake of antenatal HIV testing (WHO, 2015), it has been documented that even when HIV testing is offered as a part of antenatal care, many pregnant women in Zimbabwe are still only tested for the first time when they go into labour, putting their infants at risk of HIV MTCT (Heemelaar *et al.*, 2014; Maruva *et al.*, 2014; Buzdugan *et al.*, 2015). Although the 2010/11 Zimbabwe Demographic and Health Survey (ZDHS) reported that 90% of pregnant women in Zimbabwe had at least one ANC visit, only 59% received counselling and accepted an HIV test as part of their antenatal care. The level of antenatal HIV testing remains far below the 90% target adopted in the country (WHO, 2015; ZNASP, 2015–2018). In order to improve the efficacy of the PMTCT programme in Zimbabwe, it is imperative that the factors responsible for the low uptake of antenatal HIV testing are identified.

It is difficult to quantitatively measure the efficacy of integrated services, but stand-alone studies have been able to shed light on the determinants of antenatal HIV testing uptake in sub-Saharan African countries (Chandisarewa *et al.*, 2007; Asefa & Beyene, 2013; Heemelaar *et al.*, 2014; Jayleen *et al.*, 2016). The determinants

of antenatal HIV testing may be classified into community- and individual-level predisposing, enabling and perceived risk/need factors. Low antenatal HIV testing uptake has been linked to individual-level predisposing factors such as place of residence, education, age, marital status, unwanted pregnancy, religion and parity (Ahmed *et al.*, 2010; Jayleen *et al.*, 2016; Ochako *et al.*, 2016). It has been noted that place of residence shows a particularly strong association with health service utilization. Pregnant women living in urban areas have been shown to be more likely to have antenatal HIV testing than those from rural areas (Titaley *et al.*, 2010; Munjoma *et al.*, 2010; Semali *et al.*, 2014; Rutaremwa & Kabagenyi, 2016) due to easier accessibility of health care services (Allam *et al.*, 2015).

Besides place of residence, a demographic predisposing factor that has been noted to show a particularly strong association with antenatal HIV testing is maternal age. Older women have been demonstrated to be more likely to have an antenatal HIV test than younger women (Jayleen *et al.*, 2016; Rutaremwa & Kabagenyi, 2016). This has been attributed to older women having a greater awareness of the dangers associated with HIV/AIDS (Byamugisha *et al.*, 2010; Asefa & Beyene, 2013; Birhane *et al.*, 2015; Sama *et al.*, 2017) or better resources, enabling them to access maternal health care services (Aremu *et al.*, 2011; Tarekegn *et al.*, 2014). A critical issue surrounding access to antenatal HIV testing for pregnant teenage women in sub-Saharan African countries is pregnancy wantedness and acceptance by the community (Magadi *et al.*, 2007). Studies in Zambia and Uganda have shown that pregnant teenagers are more likely to experience violence from parents, expelled from school and to experience stigma (Denison *et al.*, 2008; Rutaremwa and Kabagenyi, 2016). The fact that ANC services in sub-Saharan African countries are not often oriented to the needs of teenage mothers makes the health risks associated with their pregnancies and HIV more pronounced than those of older women (Matthews *et al.*, 2009; Renju *et al.*, 2010). There is on-going debate on the relative importance of parity as opposed to maternal age in access to HIV and ANC services. However, it has been shown that higher-order parity is associated with increased uptake of antenatal HIV testing (Tweya *et al.*, 2014).

The marital status of pregnant women is also an important predisposing factor for both HIV testing and use of ANC services. Heemelaar *et al.* (2014) noted that married women are more likely to be HIV tested during pregnancy if they make more decisions in the household, if they are educated and if they regularly watch television or read newspapers. Unlike single women (i.e. the unmarried, divorced or widowed), married women may have a lower perceived risk of acquiring HIV infection (assuming the partners are mutually faithful) – a potential barrier to HIV testing (Keogh *et al.*, 2009; Mapuranga *et al.*, 2015).

A number of enabling factors, including socioeconomic factors (e.g. wealth, education, media exposure and physical access to health facility), HIV/AIDS factors (e.g. HIV awareness, HIV stigma) and perceived risk and need factors (e.g. history of HIV testing, acquaintance with a person living with HIV) have been linked to antenatal HIV testing in sub-Saharan African countries (Ahmed *et al.*, 2010; Gustav *et al.*, 2014; Jayleen *et al.*, 2016). There is evidence in the literature that pregnant women from wealthier households are more likely to have antenatal HIV testing than their counterparts from poorer households. This may be due to women from wealthier households having the ability to afford the cost of health care services and being more likely to be educated, and women who are educated being more likely to have access to information and enjoy greater freedom to seek health care without seeking the permission of their husbands (Houweling *et al.*, 2007; Fotso *et al.*, 2009; Ahmed *et al.*, 2010). It has also been a consistent finding that those with the highest levels of educational attainment are more likely to be tested for HIV during pregnancy than those at the lower end of the education spectrum (Killam *et al.*, 2010; Sahlu *et al.*, 2014), partly due to better access to mass media (Sama *et al.*, 2017). Several authors have documented the role of mass media in disseminating information on health-related issues through radio, television, newspapers and magazines (Jesmin *et al.*, 2013; Gustav *et al.*, 2014). In recent years, HIV prevention and sexual and reproduction health promotion information have been disseminated through posters, mobile phones and the internet (Underwood & Schwand, 2014) and this intervention has explicitly tended to increase knowledge relating to mother-to-child HIV transmission and PMTCT programmes.

Although the association between individual demographic characteristics, socioeconomic status and cultural practices is well understood in Zimbabwe and elsewhere in sub-Saharan Africa (Kevany *et al.*, 2012; Jesmin *et al.*, 2013), this is not true of the possible impact of HIV/AIDS enabling/disabling factors on HIV and ANC integrated services. Due to the stigma attached to HIV/AIDS, pregnant women living with HIV and those who perceive themselves to be at risk of HIV infection may be less likely to have antenatal HIV testing within the integrated services. The studies of Turan *et al.* (2008) and Angotti *et al.* (2009) suggested that the requirement of antenatal HIV testing when seeking ANC services may increase the potential for involuntary and unwanted disclosure of HIV status. It has been found that involuntary and unwanted disclosure of HIV status may heighten fears of experiencing stigma and discrimination, not only from health care providers, but also from friends, family and the community after diagnosis (Turan *et al.*, 2008). Multiple studies in various countries have reported that perceived lack of confidentiality decreases the likelihood of HIV and ANC service utilization (Angotti *et al.*, 2009; Mucheto *et al.*, 2011; Hardon *et al.*, 2012; Sahlu *et al.*, 2014). This is because, in most sub-Saharan Africa countries, hospital records and information are recorded in hand-held notes, and these may be seen by friends and family members, thereby inadvertently discouraging pregnant women from utilizing HIV and ANC integrated services (Demissie *et al.*, 2009; Washington *et al.*, 2015).

Personal perceived risk of HIV infection and the need to seek health care as a protective measure against HIV have also been found to be associated with an increased likelihood of HIV testing and use of ANC services (Lepine *et*

al., 2014). Depending on past sexual behaviour, HIV awareness and personal acquaintance with people infected with HIV/AIDS, individuals construct their own perceived probability of being infected, affecting their health-seeking behaviour. Being personally affected by HIV, especially seeing a close person die of HIV, may be associated with a higher perceived risk of HIV infection, and perception of personal vulnerability leads to the adoption of protective behaviour (Angotti *et al.*, 2009; Sahu *et al.*, 2014). Therefore, being HIV positive or knowing someone living with HIV is expected to influence the perceived need to access HIV and ANC integrated services as a protective measure against MTCT (Maruva *et al.*, 2014).

The bulk of studies on maternal health care in Zimbabwe have largely focused on individual-level demographic and socioeconomic factors (Muchabaiwa *et al.*, 2012; Maruva *et al.*, 2014; Makate & Makate, 2017), but the role of HIV/AIDS was not considered in these studies. Only one study, Maruva *et al.* (2014), made reference to the effect of knowledge of HIV status on maternal health service utilization, and this supported the claim that maternal health uptake has been decreased by the requirement for HIV testing during pregnancy. While studies in Zimbabwe may shed light on the determinants of HIV and ANC service utilization, the overall drawback of these has been an apparent failure to separate community-level factors from individual-level variables. The importance of contextual community factors has been established by other studies (Magadi *et al.*, 2007; Alam *et al.*, 2015; Chitalu & Koch, 2015), explaining the significant cluster variations that remain after controlling for the effect of individual-level variables. The context within which individuals live matters because the broader environment not only provides opportunities to learn and reassure, but also generates general norms regarding activities within the community (O'Meara *et al.*, 2013). For example, due to observed stigma and discrimination against people living with HIV in communities, women living with HIV, and those who perceive themselves to be at risk of HIV infection, may be less likely to use integrated reproductive health care services (Sharma *et al.*, 2017). This study therefore aimed to address this evidence gap by implementing a multilevel modelling approach (Goldstein, 2003) to explicitly examine both the individual- and contextual-level determinants of using integrated HIV and ANC services. Understanding and addressing individual and community barriers to antenatal HIV testing could potentially contribute to the current goal of eliminating the MTCT of HIV in Zimbabwe.

Conceptual framework

In order to examine the community- and individual-level determinants of antenatal HIV testing, the conceptual framework of Andersen (1995) was adopted. Figure 1 provides a schematic display of this framework. The model was conceptualized based on predisposition, enablement and need for health care use. The predisposing factors (individual and community level) were assumed to operate through enabling and perceived need factors. The enabling factors included the social and economic status of a pregnant women (i.e. household wealth, access to media, education, women's autonomy) and HIV enabling or disabling factors (i.e. HIV awareness, stigma and confidentiality concern). While enabling factors are assumed to facilitate access to HIV and ANC services, pregnant women must perceive themselves to be at risk and believe the seriousness of HIV infection to induce the need to access HIV and ANC services (Iriyana, 2007). For example, witnessing the death or illness of a close friend or a family member due to HIV may compel pregnant women to have antenatal HIV testing if they know the effectiveness of PMTCT programmes in reducing MTCT (Catania, 1990). For that reason, the perceived need for antenatal HIV testing or whether pregnant women knew someone living with HIV were also considered in the framework. The framework also recognizes that community variables have independent effects on health care services and may also influence enabling and need factors. For example, individuals resident in communities with higher HIV prevalence may be more likely to perceive themselves to be at risk of HIV infection, and perceived risk of HIV infection is a major determinant of HIV testing (Turan *et al.*, 2008).

In this study, community-level factors included HIV prevalence, stigma and awareness in the community.

Methods

Data

The study was based on data from the 2005/6 and 2010/11 Zimbabwe Demographic and Health Surveys (ZDHS). A total of 18,078 women were interviewed in the two surveys. To construct the sample for analysis from merged ZDHS datasets, the selection was initially restricted to all women who had given birth during the 5 years preceding the surveys (DHS code; V208>0). Thus women who did not give birth within the specified period were excluded, generating an unweighted sample of 8471 women who gave birth to a total of 10,620 children. To avoid clustering of multiple births per woman and to reduce the likelihood of recall bias on sensitive questions (Uthman *et al.*, 2017), the sample was further limited to the last birth in the 5 years preceding the surveys (DHS code; BIDX\$01=1). This restriction gave a final sample of 8471 women with at least one live birth in the 5 years preceding the surveys. Of these, 92.4% ($n=7879$) had at least one ANC visit, whilst 7.6% ($n=648$) did not, representing near-universal access to ANC services. From this sample, dependent and independent variables of interest were extracted.

HIV testing during ANC

The key outcome variable for the study was whether the respondent had antenatal HIV testing during the last pregnancy. In the ZDHS, pregnant women who attended ANC services for the most recent birth were asked the following questions: (a) Were you tested for the AIDS virus during any of the ANC visits? If yes, (b) Did you get the results of the AIDS test? Pregnant women have to get tested and know their HIV status before they can be enrolled in a PMTCT programme, so women who answered 'yes' to these two questions were classified as having been tested for HIV during the ANC visit. Those who answered 'no' to both questions were considered not to have been tested for HIV during the ANC visit (Staveteg *et al.*, 2013). The measure was based on the DHS code V840-1. Women who were tested for HIV were coded '1' and those who were not were coded '0', i.e. this was a dichotomous response variable.

Explanatory variables

Based on the literature and the conceptual framework, a number of predisposing factors were selected as explanatory variables, including individual demographic factors (i.e. age, marital status, religion, place of residence, year of survey, parity, wanted child) and community HIV factors that predispose pregnant women to using integrated services (i.e. HIV awareness, stigma and prevalence). Enabling factors included the logistic and resource aspects of obtaining care, which comprised household income, access to media, and availability and accessibility of health care facilities. The HIV and psychological enabling factors included HIV stigma, awareness, disclosure and confidential concern. The need factors related to the perceived and evaluated assessment of an individual's own health status, which may inform the need to seek health care (Lepine *et al.*, 2014). In line with other studies, 'ever been tested for HIV' (a proxy for knowledge of HIV status) and 'knowing someone living with HIV' were considered as proxies for the perceived risk and need factors that may have influenced the health-seeking behaviour of the women. Community-level HIV awareness, stigma and media exposure variables were imputed from relevant individual-level factors. A description of the individual-level and community-level variables included in the analysis is given in Table 1.

Analysis

Multilevel binary logistic regression analysis was used, with community at Level 2 and last birth in the last 5 years at Level 1. The logit of the probability of an outcome can be modelled as follows:

$$f(\pi_{ij}) = \log \log \left[\frac{\pi_{ij}}{1-\pi_{ij}} \right] = \beta_0 + \beta_1 X_{1ij} + \beta_2 C_{2ij} + \mu_{0j}$$
$$Var(\mu_{0j}) = \sigma_{u0}^2$$

where π_{ij} is the probability of an outcome for a pregnant women, i , in the j^{th} community. The intercept β_0 is shared by all communities; β values denote fixed coefficients; X and C are vectors of covariates at individual and community levels, respectively; and $\mu_{0j} \sim N(0, \sigma_{u0}^2)$ shows the random effects for the j^{th} community. The random intercept is shared by all individuals from the same community (defined by a primary sampling unit or cluster) and serves as an indirect control for community factors not included in the models that may affect antenatal HIV testing.

Before including any explanatory variables in the models, it was crucial to know how much between-community variation there was in the propensity for antenatal HIV testing. To assess this, the estimated value of σ_{u0}^2 –the variance of μ_{0j} – was examined. A threshold model approach was used, which measures the intra-cluster correlation (ICC) as:

$$ICC = \sigma_u^2 / (\sigma_u^2 + \sigma_\epsilon^2)$$

where σ_u^2 is the total variance at the community level, and σ_ϵ^2 is the total variance at individual level. For the multilevel logistic regression model, the Level 1 residuals were assumed to have a standard logistic distribution with mean zero and variance $\sigma_\epsilon^2 = \pi^2/3$, where π is the constant 3.14... Thus $ICC = \sigma_u^2 / (\sigma_u^2 + 3.29)$ (Goldstein, 2003).

The proportional change in variance (PCV) was derived from:

$$PCV = V_A V_B \times 100$$

where: V_A = variance of the initial model and V_B = variance of the succeeding model.

The deviance information criterion (DIC) was used as a measure of the goodness-of-fit of the models. A lower DIC value in subsequent models indicates a better fit of the model (Aremu *et al.*, 2011).

Multilevel logistic regression analysis was used to determine the factors that may have influenced antenatal HIV testing. This was performed using MLwiN statistical software. The first model (Model 0) was an intercept-only model (a so-called empty model) with year of survey as the only covariate. This empty model was useful to show if there was sufficient variance at the community level. All the individual predisposing factors were added simultaneously in Model 1. In Model 2, enabling and perceived need factors were added and adjusted for. The community-level factors were then included in Model 3. All the fixed effects were expressed as average odds ratios (AORs) in the multilevel models in Table 5, presented with 95% confidence intervals (95% CIs). The random effects are expressed as variance partition coefficients (VPCs), also known as intra-class correlation coefficients (ICCs), and

a proportional change in variance (PCV). The multilevel fitness was tested using the deviance information criterion (DIC).

Results

Bivariate analysis

The characteristics of the sample women are presented in Table 2, and the bivariate distributions of the women by whether they had had an antenatal HIV test and by different predisposing, and enabling and need, factors are presented in Tables 3 and 4, respectively. The bivariate analysis results generally indicate that the delivery of integrated HIV and ANC health services in Zimbabwe over recent years has resulted in a substantial increase in antenatal HIV testing uptake. The uptake of antenatal HIV testing increased dramatically between the two survey periods, from 29.4% in 2005/6 to 55.9% in 2010/11 (a percentage point difference of 26.5%). The most dramatic increases in antenatal HIV testing uptake were found among women resident in rural areas, those under the age of 35 years, never-married and married women, those with secondary or higher level educational attainment, those of higher order parity and those with low to medium exposure to media. For example, antenatal HIV testing uptake increased dramatically from 24.4% in 2005/6 to 54.9% in 2010/11 among rural women (Table 3). It also increased significantly among pregnant women with medium to higher HIV awareness, women who knew someone living with HIV and among those who reported having no problem accessing a health facility. An increase in antenatal HIV testing was also observed across all wealth categories, with the rich-poor gap narrowing (Table 4).

Multilevel logistic regression analysis

Table 5 shows the results of the multilevel logistic regression analysis. The empty model (Model 0) for antenatal HIV testing (not presented in table) suggested that most of the variation in antenatal HIV testing was at the individual level. However, there was also some variation at the community level, as indicated by the significant variance. Based on the estimated VPC, the intra-community correlation (ICC) was estimated at about 8%. This indicated the extent of the variability in antenatal HIV testing that could be attributed to community-level factors. The likelihood of having antenatal HIV testing was 3.77 times higher (AOR=3.77, 95% CI=3.32–4.29) in the 2010/11 ZDHS than in the 2005/6 ZDHS.

All significant predisposing individual-level factors were included in Model 1. The variables found to be associated with antenatal HIV testing in Model 1 included place of residence, age group, marital status, women's educational attainment and parity. While urban residents may be expected to have better access to health care facilities in general, the results revealed that pregnant women from urban areas of Zimbabwe were 48% less likely (AOR=0.52, 95% CI=0.43–0.63) to be tested for HIV than their rural counterparts of similar background socioeconomic and demographic characteristics. The results also showed that age of women, being previously married (divorced or widowed) and parity were inversely correlated with antenatal HIV testing. The estimates suggested antenatal HIV testing decreased with age, such that women of age groups 25–29, 30–34 and over 35 years were less likely to have been tested for HIV during ANC visits by 29% (AOR=0.71, 95% CI=0.62–0.81), 31% (AOR=0.69, 95% CI=0.56–0.70) and 57% (AOR=0.43, 95% CI=0.36–0.52), respectively, compared with younger women in the age group 15–24. Within marital status categories, divorced women were 26% less likely to have an antenatal HIV test (AOR=0.74, 95% CI=0.57–0.96) compared with never-married pregnant women with similar background characteristics. Other marital status categories, i.e. being currently married or widowed, were not found to be significantly different from never-married women with respect to antenatal HIV testing. Women with a second-order birth were 28% less likely (AOR=0.72, 95% CI=0.58–0.90) to have antenatal HIV testing than those with first-order births. Having secondary or higher educational attainment was found to be associated with an increased odds of having an antenatal HIV test by 1.43 times (OR=1.43, 95% CI=1.28–1.61), compared with women with primary or no education. There was no evidence of an association between religious affiliation and wantedness of a child with antenatal HIV testing in Model 1.

In Model 2, enabling and HIV need factors were added to Model 1. When these factors were controlled for, most patterns for predisposing factors remained unchanged, but the association between place of residence and antenatal HIV testing ceased to be significant. Being wealthier was found to be associated with increased odds of antenatal HIV testing. The estimates suggest that women in the richer and richest household quintiles were 1.45 (AOR=1.45, 95% CI=1.11–1.91) and 1.67 (AOR=1.67, 95% CI=1.16–2.41) times more likely to have had an antenatal HIV test, compared with women from poor (poorest, poorer or middle quintiles) households. This association between antenatal HIV testing with household wealth continued into Model 3, which included contextual community-level factors. The likelihood of antenatal HIV testing was also found to be significantly associated with media exposure. Pregnant women who had medium or high media exposure were more likely to have antenatal HIV testing than those with low media exposure. For example, women who had high media exposure were 1.30 times (AOR=1.30, 95% CI=1.06–1.61) more likely to have had an antenatal HIV test, compared with those with low media exposure. Women with higher media exposure continued to have a higher likelihood of antenatal HIV testing, even after community-level factors were controlled for. The odds of having an HIV test during an ANC visit were on

average 14% lower among women who reported having problems in accessing health care centres in Model 2 and 3, compared with those who said access was not a major problem. The effect of religion and child wantedness turned significant in Models 2 and 3. Apostolic women were more likely to have had antenatal HIV testing than Roman Catholic women. On the other hand, women who said they wanted a child later were less likely to have had an antenatal HIV test than those who reported wanting a child then. There was no evidence that women's decision-making/autonomy in the household or parity had a significant effect on antenatal HIV testing when other considered variables were controlled for in the model.

Model 2 also considered HIV-related factors, i.e. being previously tested for HIV (a proxy for knowledge of HIV status), awareness and confidentiality concerns. These were not found to be significantly associated with antenatal HIV testing across the models. However, knowing someone living with HIV was associated with an increased odds of antenatal HIV testing. Women who knew someone living with HIV were on average 1.24 times more likely to have had an antenatal HIV test compared with their counterparts who knew no one with HIV.

Community-level variables included in Model 3 were HIV stigma, HIV awareness and HIV prevalence. The fixed effects from Model 3 were about the same as with Models 1 and 2. There was no evidence of a significant association between HIV prevalence at the community level and antenatal HIV testing. However, women residing in communities with high HIV awareness were 2.08 times (2.08, 95% CI=1.05–4.11) more likely to have been tested for HIV compared with their peers who lived in communities with low HIV awareness. The results also showed that living in a community with a high proportion of individuals with stigma was associated with reduced odds of antenatal HIV testing. Compared with Model 2, the final ICC remained at 7%, with zero proportional change in variance being observed. The successive reduction in DIC from Models 0 to 3 demonstrates a better fitting model over every previous one.

Discussion

The main objective of this study was to provide an overall picture of the individual- and community-level determinants of antenatal HIV testing in Zimbabwe. Some correlation was found among individuals from the same community (Aremu *et al.*, 2011). This was as expected, given the different tribal, cultural and religious contexts in Zimbabwe, which to some extent serve as markers of attitudinal identities, socioeconomic status and health beliefs towards health care service utilization (Kayeyi *et al.*, 2009). After controlling for the study's selected variables, the intra-community correlation for antenatal HIV testing was 7%, suggesting that over 90% of the total unexplained variation in antenatal HIV testing was due to unobserved individual-level factors.

The study found that antenatal HIV testing had increased significantly between 2005/6 and 2010/11 in Zimbabwe. Individual predisposing and enabling socioeconomic status factors appeared to be more important than community-level factors for antenatal HIV testing within integrated HIV/ANC services in the country. Most of the factors that were found to be associated with antenatal HIV testing were largely consistent with patterns observed in other sub-Saharan African countries (e.g. place of residence, age, marital status, education, parity, child wantedness and religion). The observed patterns for place of residence contradicted the results of earlier studies, which found that women from urban areas were more likely to have antenatal HIV testing due to easier access to ANC services, including PMTCT (Martin-Herz *et al.*, 2006; Mucheto *et al.*, 2011; Maruva *et al.*, 2014). The lack of significance in the association between place of residence and antenatal HIV testing when key factors were controlled for suggests that PMTCT programmes in Zimbabwe are now achieving comparable HIV testing coverage in urban and rural areas.

The finding that older women were less likely to have antenatal HIV testing was not consistent with the findings of previous studies in other settings, which found that antenatal HIV testing increased with women's age (Koech *et al.*, 2014; Tweya *et al.*, 2014). Previous studies have suggested that older women have higher odds of accepting antenatal HIV testing due to their accumulated knowledge of HIV, especially that HIV can be transmitted to a child during pregnancy, as well as their knowledge of the existence of PMTCT programmes (Semali *et al.*, 2014; Woldesenbet *et al.*, 2015). A possible explanation for this could be that older women may have previously given birth to presumably healthy children, and thus see no reason to be HIV tested in future pregnancies. They may also have had a perceived low risk of HIV infection if they were married, assuming their partners were faithful (Byamugisha *et al.*, 2010). It may also be that older women have already witnessed discrimination against, and isolation from, HIV-positive women (Rutarembwa & Kabagenyi, 2016), and having an HIV diagnosis during pregnancy may increase their sense of discrimination and isolation. These feelings of discrimination, isolation and low perception of risk of HIV infection could be overcome through effective communication and campaigns to reduce stigma and increase knowledge of MTCT among older pregnant women (Mtumbuka *et al.*, 2012). There is a need to develop new methods of communication and tools targeted at older women (Maruva *et al.*, 2014).

On the other hand, the study results show that young adults are more likely to engage in high-risk sexual behavior, including having multiple sexual partners, and therefore may have a higher perceived HIV risk, encouraging them to seek an HIV test when they get pregnant (Musarandega *et al.*, 2017). In addition, health care service providers may believe that young adults are at a greater risk of HIV infection, and therefore be more likely to recommend an HIV test to young women than to older women (Mapuranga *et al.*, 2015). Young pregnant women have been shown to be more likely to accept an antenatal HIV test when it is offered in an appropriate and supportive

environment (Koech *et al.*, 2014). Youth-friendly HIV testing centres, such as Surestart Health Centres, are improving antenatal HIV testing uptake in Zimbabwe (Musarandega *et al.*, 2017). The study also found that antenatal HIV testing was lower among previously married women (widowed or divorced) than among never-married or married women. This might reflect the fact that ANC services in Zimbabwe are geared towards married women (Chevo & Bhatasara, 2012). Like young pregnant women, widowed and divorced women are more likely to be in multiple sexual partnerships, increasing their perceived risk of HIV infection, thus discouraging them from accepting antenatal HIV testing for fear of discrimination and isolation if they are diagnosed with HIV (Murire *et al.*, 2014). It is therefore important to provide information on, and to raise awareness of, PMTCT programmes among previously married women in Zimbabwe (Buzdugan *et al.*, 2015).

Various enabling and perceived need factors were found to be major determinants of HIV and ANC integrated health service use in Zimbabwe. In particular, household wealth was found to be associated with the likelihood of antenatal HIV testing. Previous studies have shown that being wealthier is associated with an increased likelihood of using maternal health care services (Babalola & Fatuisi 2009; Tarekegn *et al.*, 2014). This is as expected, since women from wealthier households are more likely to be able to afford health care services and their associated costs, such as transport (Semali *et al.*, 2014; Lepine *et al.*, 2014; Moindi *et al.*, 2015). Another possible explanation is that, since higher household wealth could be an indication of a higher number of educated household members, women from such households may have greater access to information and education on HIV and its implications (Chandisarewa *et al.*, 2007; Ahmed *et al.*, 2010).

The finding that educational attainment was a key factor for antenatal HIV testing supports the notion that educated women are more likely to realise the benefits of antenatal HIV testing (Tenthan *et al.*, 2015). Multiple potential pathways that can explain why maternal education is associated with antenatal HIV testing have been described, including an increased knowledge of the benefits of preventative health care and awareness of risk (e.g. PMTCT), higher receptivity to new health care information and socialization with formal services outside the home, access to financial resources, better communication with partners and increased self-worth and confidence (Byamugisha *et al.*, 2010; Asefa & Beyene, 2013; Maruva *et al.*, 2014; Birhane *et al.*, 2015; Sama *et al.*, 2017).

The study results showed mixed patterns regarding the association between enabling and perceived risk/need factors and HIV/AIDS. No evidence was found of a significant association between HIV awareness and HIV sero-status with the likelihood of antenatal HIV testing, once important background socioeconomic, demographic and other HIV/AIDS factors were controlled for. However, there was evidence of an association between HIV stigma and antenatal HIV testing. The finding that pregnant women with medium-to-high levels of stigma were more likely to have antenatal HIV testing was unexpected. The logical explanation for this is pregnant women's determination to protect their infants from HIV, notwithstanding their own experience of stigma (Mapuranga *et al.*, 2015). The fact that antenatal HIV testing is not associated with confidentiality concern may suggest that women are given private individual counselling and space to make a private decision without staff or group interference in Zimbabwe (Chevo *et al.*, 2012). Shetty *et al.* (2010) suggested that quality of care, including confidentiality concern, shapes a woman's decision to use health care services. Knowing someone living with HIV was found to be associated with an increased likelihood of antenatal HIV testing. The concept of the health belief model could explain this association. Witnessing someone living with HIV or dying from AIDS might lead pregnant women to seek an antenatal HIV test (Iriyana, 2007). This may suggest that personal acquaintance with people living with HIV may be a pointer to behavioural change to avoid MTCT, and knowing someone living with HIV is common in communities with a high HIV prevalence, such as in Zimbabwe (Magadi & Desta, 2011). The finding that higher HIV awareness at the community level is associated with an increased odds of antenatal HIV testing resonates with the findings of Buzdugan *et al.* (2015), and is suggestive of a strong and widespread campaign of PMTCT programmes (Ngome & Odimegwu, 2014).

There are some limitations to the study that have potential implications for interpretation of the findings. First, the 2005/6 and 2010/11 DHS data are relatively old and might not reflect the current situation and practices. In Zimbabwe, where there is a current scaling-up of PMTCT programmes, use of the 2015/16 DHS data would have helped capture more recent progress. However, these were not available at the time the study. The second limitation relates to the cross-sectional nature of the DHS data, which does not allow temporal ordering of the events of interests. Therefore, the patterns observed represent simple associations and cannot offer insight into cause and effect relationships. Furthermore, because DHS surveys rely on self-reported data collection, inaccuracies can arise as a result of intentional deception, poor memory or the misunderstanding of questions. Finally, the study focused on the major determinants of antenatal HIV testing in Zimbabwe with respect to demand-related factors (i.e. cultural, demographic and socioeconomic). However, as argued by Buzdugan *et al.* (2015), service-related factors are also important determinants of exclusion and need investigation. Future research should explore the impact of provider characteristics on HIV and ANC integrated service delivery. Factors such as quality of care, type of provider, actual distance and attitude of staff need to be explored. Nevertheless, the representation of the whole country is a major strength of the data analysed in this study as it allows generalization of the findings nationally.

Conclusions and recommendations

Overall, this study found little variation in antenatal HIV testing across communities in Zimbabwe, and any variations were mainly explained by individual-level variables such as background characteristics and enabling/perceived need factors. Household wealth, access to media and HIV factors such as knowing someone living with HIV were found to be critical for antenatal HIV testing. At the community level, contextual variables found to be contributing to the variations in HIV testing included HIV stigma and awareness. Controlling for community-level factors did not have much effect on community variations in HIV testing. Therefore, while recognizing the importance of some community-level factors, policies should focus on individual-level predisposing and enabling factors in order to improve HIV and ANC integrated services in Zimbabwe.

A number of policies can be recommended from the findings. First, the introduction of financial incentives may stimulate access to HIV and ANC integrated services by providing compensation for transport costs and opportunity costs, i.e. the time associated with accessing services. Monetary incentives could reduce socioeconomic barriers and HIV-related stigma as they may provide a broader reason for going to a health facility for antenatal care. More importantly perhaps, awareness creation on antenatal HIV testing should focus on avoiding stigmatizing and discriminatory behaviours, so that pregnant women can develop positive attitudes towards people living with HIV/AIDS. Lastly, policymakers should use electronic and mass media to communicate and spread awareness, taking advantage of the widespread access to electronic media such as mobile phones and radio in Zimbabwe. These could help fill the void created by a lack of formal education in some sections of the population. This method could also be used to influence decisions in cases where a pregnancy is mistimed or unwanted, and also change attitudes in the case of socio-cultural enabling factors such as religious affiliation.

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Ethical Approval. The research presented in this paper is based on secondary analysis of data from Zimbabwe Demographic and Health Surveys (ZDHS), which included already anonymized survey data, so ethical approval was not required.

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Fig. 1. Conceptual framework for determinants of HIV and ANC health integrated service utilization. Adapted from Andersen (1995).

Table 1. Description of study variables

	Definition
Outcome variable	
Antenatal HIV testing	The binary variable was constructed based on if the pregnant women had been offered and she had accepted an HIV test for her last birth during ANC visits. The measure was based on a re-code of the DHS variable V840, in which a women who had been tested for HIV as part of her ANC was coded '1' and '0' otherwise.
Individual predisposing factors	
Residence	Women's residence, coded as 1=rural, and 0=urban
Age group	Categorized into three groups: 15–24, 25–34 and 35+ years
Education	Educational attainment, classified into two groups : 'no education and primary' coded '0' and 'secondary and higher' coded '1'
Marital status	Classified into four groups: never married, currently married, widowed and divorced/separated
Religion	Religious affiliation, classified into: Catholic/ Traditional , Protestant, Pentecostal, Apostolic
Wanted last child	Three categories: wanted then, wanted later and not wanted
Parity	Total number of children ever born, classified into three groups: 1, 2 and 3+
Enabling and perceived risk/need factors	
Media exposure	A composite summary index derived from information on frequency of reading newspapers, listening to radio and watching TV by respondents. The additive scores, ranging from 0-1 , were coded: '0' for low , '2-3' was '1' 'medium' and 4-5 was '2' 'higher'
Household wealth	DHS composite wealth index (Rustein <i>et al.</i> , 2004), based on household possessions and amenities, re-classified into three groups (poor, rich and richest) based on Muchabaiwa <i>et al.</i> (2012)'s classification of poverty in Zimbabwe
Autonomy	The relevant DHS questions (mv739 to mv743b) on who makes the final decision on woman's health care elicited the categorical responses: 1=woman alone, 2=jointly and 3=husband alone/others
Ever been tested for HIV	Coded as 1=if respondent had ever been tested for HIV; 0=otherwise
HIV stigma	A composite index derived from a set of four DHS questions on HIV/AIDS stigma. The resulting score was classified as 0=low, 1-2=medium and 3-4=high
HIV awareness	A composite index derived from a series of questions on knowledge of how HIV is transmitted and ways to avoid infection. The resulting index was classified into quartiles and the higher the index, the higher the knowledge.
Knows someone living with HIV	Coded as 1=if respondent personally knows someone living with HIV and 0=otherwise
Confidentiality concern	Coded 1=if the respondent wants HIV in the family to remain secret and 0=otherwise
Contextual community/cluster HIV factors	
HIV prevalence	Proportion of individuals in cluster who are HIV positive
HIV awareness	Average HIV awareness in the cluster
HIV/AIDS stigma	Average HIV/AIDS stigma in the cluster

Table 2. Percentage distribution of sample women by selected socio-demographic factors, 2005/6 and 2010/11
ZDHS

Variable	ZDHS 2005/6		ZDHS 2010/11	
	% ^a	<i>n</i> ^b	% ^a	<i>n</i> ^b
Residence				
Urban	31.3	1136	31.2	1339
Rural	68.7	2938	68.8	3058
Age group				
15–24	38.9	1584	36.2	1592
25–29	25.9	1054	29.2	1284
30–34	18.9	759	17.9	789
35+	16.6	677	16.6	732
Marital status				
Never married	5.3	217	5.6	247
Married	81.8	3334	83.4	3669
Widowed	4.7	191	3.0	130
Divorced/separated	8.1	332	8.1	351
Education				
None/primary	39.3	1648	32.8	1480
Secondary/higher	60.7	2426	67.2	2917
Religion				
Catholic/other	28.0	1179	23.0	1107
Protestant	20.7	830	13.7	597
Pentecostal	16.6	646	19.2	799
Apostolic	34.7	1419	44.1	1894
Household wealth				
Poor	63.5	2584	63.2	2692
Rich	20.3	842	20.9	965
Richest	16.2	648	15.9	740
Wanted child				
Then	63.2	2623	66.7	2921
Later	20.2	879	20.6	1134
Not wanted	16.6	564	12.6	340

Parity				
1	30.1	1202	29.5	1301
2	25.6	1033	27.9	1225
3+	44.0	1839	42.6	1871
Media exposure				
Low	37.1	1567	31.9	1431
Medium	29.4	1192	49.7	2138
High	33.4	1315	18.8	828
All	100.0	4074	100.0	4397

^aWeighted; ^bunweighted.

Table 3. Bivariate analysis of antenatal HIV testing of sample women by selected individual predisposing factors, 2005/6 and 2010/11 ZDHS

Variable	ZDHS 2005/6		ZDHS 2010/11	
	Percentage tested ^a	<i>p</i> -value	Percentage tested ^a	<i>p</i> -value
Residence		<0.001		<0.001
Urban	40.5		58.0	
Rural	24.4		54.9	
Age group		<0.001		<0.001
15–24	34.6		62.5	
25–29	28.3		56.4	
30–34	27.9		54.4	
35+	20.5		42.1	
Marital status		<0.001		<0.001
Never married	27.6		64.4	
Married	29.9		56.6	
Widowed	25.2		38.1	
Divorced/separated	28.6		49.2	
Education		<0.001		<0.001
No/primary	20.9		47.0	
Secondary/higher	35.0		60.2	
Religion		<0.001		<0.001
Catholic/other	25.3		55.5	
Protestant	34.1		59.5	
Pentecostal	36.1		55.7	
Apostolic	26.8		55.0	
Wanted child		<0.001		<0.001
Then	31.5		55.6	
Later	25.8		56.2	
Not wanted	25.5		57.8	
Parity		<0.001		<0.001
1	36.9		58.3	
2	31.7		58.6	
3+	23.0		52.3	

Media exposure		<0.001		<0.001
Low	20.7		49.6	
Medium	31.6		59.5	
High	37.2		44.5	
Total	29.4		55.9	

^aWeighted values.

Table 4. Bivariate analysis of antenatal HIV testing of sample women by enabling and perceived risk/need factors, 2005/6 and 2010/11 ZDHS

Variable	ZDHS 2005/6		ZDHS 2010/1	
	Percentage tested ^a	<i>p</i> -value	Percentage tested ^a	<i>p</i> -value
HIV awareness		<0.001		<0.001
Low	26.1		48.0	
Medium	34.8		59.8	
High	26.7		59.5	
Knows someone living with HIV		<0.001		<0.001
Yes	26.9		55.9	
No	33.5		58.2	
HIV stigma		<0.001		<0.001
Low	26.2		57.1	
Medium	32.0		55.9	
High	28.8		51.3	
Household wealth		<0.001		<0.001
Poor	23.0		53.1	
Rich	37.0		59.5	
Richest	41.8		61.0	
Accessibility problems		<0.001		<0.001
No	37.1		61.5	
Yes	26.7		52.7	

^aWeighted values.

Table 5. Average odds ratios (AOR) of antenatal HIV testing of sample women from multilevel logistic regression models

Variable	Model 1	Model 2	Model 3
Predisposing factors			
2010/11 ZDHS (Ref.: 2005/6)	3.77 (3.32–4.29)*	3.10 (2.66–3.62)*	1.87 (1.58–2.21)*
Urban residence (Ref.: rural)	0.52 (0.43–0.63)*	0.83 (0.60–1.13)	0.97 (0.68–1.39)
Age group (Ref.: 15–24)			
25–29	0.71 (0.62–0.81)*	0.70 (0.61–0.80)*	0.68 (0.60–0.75)*
20–34	0.69 (0.56–0.7)*	0.65 (0.55–0.78)*	0.65 (0.55–0.77)*
35+	0.43 (0.36–0.52)*	0.43 (0.35–0.52)*	0.42 (0.35–0.51)*
Marital status (Ref.: never married)			
Married	1.10 (0.85–1.32)	1.03 (0.83–1.29)	1.02 (0.82–1.28)
Widowed	0.75 (0.54–1.06)	0.73 (0.52–1.02)	0.47 (0.47–0.93)*
Divorced/separated	0.74 (0.57–0.96)*	0.73 (0.56–0.95)*	0.73 (0.56–0.95)*
Secondary education (Ref.: primary)	1.43 (1.28–1.61)*	1.38 (1.23–1.55)*	1.32 (1.17–1.48)*
Religion (Ref.: Catholic/other)			
Protestant	1.17 (0.96–1.43)	1.13 (0.90–1.42)	1.13 (0.90–1.41)
Pentecostal	1.13 (0.91–1.38)	1.03 (0.81–1.30)	1.01 (0.80–1.28)
Apostolic	1.15 (0.97–1.36)	1.23 (1.02–1.49)*	1.23 (1.02–1.49)*
Wanted child (Ref.: now)			
Later	0.88 (0.75–1.04)	0.81 (0.68–0.98)*	0.81 (0.67–0.98)*
Not wanted	1.15 (0.93–1.43)	1.16 (0.90–1.49)	1.16 (0.90–1.49)
Parity (Ref.: 0–1)			
2	0.72 (0.58–0.90)*	0.90 (0.73–1.11)	0.90 (0.73–1.11)
3+	0.88 (0.75–1.04)	0.78 (0.61–0.99)*	0.78 (0.61–1.00)
Enabling/need factors			
Wealth (Ref.: poor)			
Rich		1.45 (1.11–1.91)*	1.35 (1.02–1.78)*
Richest		1.67 (1.16–2.41)*	1.53 (1.05–2.24)*
Media exposure (Ref.: low)			
Medium		1.35 (1.12–1.63)*	1.34 (1.10–1.64)*
High		1.30 (1.05–1.61)*	1.28 (1.03–1.60)*
Access problem (Ref.: no)		0.86 (0.75–0.98)*	0.85 (0.75–0.97)*

HIV stigma (Ref.: low)			
Medium		1.41 (1.14–1.73)*	1.36 (1.10–1.68)*
High		1.11 (0.87–1.42)	1.07 (0.3–1.38)
Knows someone with AIDS (Ref.: no)		1.23 (1.02–1.49)*	1.24 (1.02–1.51)*
Contextual factors			
Community HIV awareness			2.08 (1.05–4.11)*
HIV stigma in community			0.68 (0.52–0.87)*
Community random effects			
Variance (SE)	0.266 (0.036)*	0.25 (0.035)*	0.241 (0.034)*
(VPC)=ICC (%)	8	7	7
(PCV) (%)	12.5	0	0

95% confidence intervals in parentheses.

* $p < 0.05$.