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## High unmet needs for cervical cancer screening among women living with HIV in six African countries: A population-based study

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### Abstract

**Background:** Cisgender women living with HIV (WLWH) are disproportionately impacted by cervical cancer. Nevertheless, disparities in uptake and implementation of cervical cancer services persist in sub-Saharan Africa, where population-level estimates of screening coverage remain scarce.

**Methods:** We pooled data from nationally representative Population-based HIV Impact Assessment (PHIA) surveys conducted in Ethiopia, Malawi, Rwanda, Tanzania, Zambia, and Zimbabwe (2015–2019). After estimating the prevalence of self-reported lifetime cervical

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Declaration of conflicting interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical statement

Ethical approval

The study protocol for each PHIA survey was reviewed and approved by the Columbia University, the U.S. Centers for Disease Control and Prevention, and Westat, in addition to the following national research ethics bodies: the Ethiopian Public Health Institute, the National Research Ethics Review Committee of Ethiopia, the Rwanda National Ethics Committee, the National Health Sciences Research Committee (Malawi), the National Institute for Medical Research (Tanzania), the Zanzibar Medical Research and Ethics Committee (Tanzania), the Tropical Diseases Research Centre Ethical Review Committee (Zambia), the Zambia National Health Research Authority, the Medical Research Council of Zimbabwe, and the Research Council of Zimbabwe.

Informed consent

All individuals provided written informed consent prior to study enrollment and procedures.

cancer screening (overall and by country), survey-weighted multivariable log-binomial regression identified socio-demographic and clinical correlates of screening uptake among WLWH aged 25–64 years.

**Results:** Overall, 6933 WLWH (mean age: 39.6 years) were included in the multi-country sample. The pooled prevalence of lifetime cervical cancer screening was 18.5% (range: 8.5% [Rwanda] to 25.3% [Zambia]). Screening uptake varied by HIV clinical status, with serostatus-aware (21.3% vs 9.0%), antiretroviral therapy-experienced (22.0% vs 10.5%), and virally suppressed (22.1% vs 11.6%) WLWH, respectively, reporting significantly ( $p < 0.001$ ) higher screening rates. Screening was especially low among WLWH aged <35 years (14.7%), with no formal education (12.1%), in the poorest households (7.9%), and residing in rural areas (14.0%).

**Conclusions:** Fewer than one-fifth of WLWH had ever screened for cervical cancer, suggesting expanded availability and access to tailored, integrated services are critically needed.

### Keywords

HIV care and treatment; cervical malignancies; human papillomavirus; pap smear; sub-Saharan Africa; population-based HIV impact Assessment

## Background

Cervical cancer is a leading contributor of morbidity and mortality among cisgender women in low and middle-income countries (LMICs). Many cervical cancer cases occur in East and Southern Africa, where incidence exceeds 40 and 36 cases per 100,000 women, respectively; these estimates are six-to-seven times higher than in North America.<sup>1</sup> While higher-income countries have experienced remarkable reductions in cervical cancer incidence and mortality, most cervical cancer deaths occur in LMICs; sub-Saharan Africa, a region where most persons living with HIV worldwide reside, shoulders the most significant burden of cervical cancer-related mortality, with 87% of global cervical cancer deaths occurring in the region.<sup>1–3</sup>

Women living with HIV (WLWH), irrespective of treatment or virologic status, experience outsized burdens of cervical cancer incidence and mortality, with HIV infection increasing a woman's lifetime risk of cervical cancer six-fold.<sup>4</sup> Consequently, in countries with generalized HIV epidemics and limited availability of human papillomavirus (HPV) vaccination, screening and treatment for cervical dysplasia and reducing the rate of high-grade cervical intraepithelial lesions is essential for preventing invasive cervical cancer. Accordingly, the World Health Organization (WHO) recommends routine (every 3–5 years) cervical cancer screening using a screen-triage-treat approach.<sup>5</sup> Cervical cancer screening encompasses various methods including HPV DNA testing, visual inspection with acetic acid (VIA) or Lugol's iodine (VILI), and cytology.<sup>6</sup> While VIA is the primary method used across LMICs due to its affordability and ease of implementation, the WHO currently recommends screening with HPV DNA sampling for WLWH, given its superior diagnostic sensitivity (98%) and specificity (89%) to VIA.<sup>5,7</sup>

Nevertheless, a constellation of social and structural forces can impede cervical cancer screening among WLWH, especially in under-resourced, higher burden settings. At the

individual level, lower perceived risk (susceptibility and severity) of cervical cancer and limited awareness of cervical cancer screening services can attenuate service-seeking and screening uptake.<sup>8–10</sup> Further, internalized and enacted stigmas at the intersection of HIV and cervical cancer may disincentivize women from accessing vital screening services, fearing judgment or discrimination from family members, peers, or others in their community.<sup>8–10</sup> Structurally, implementing cervical cancer screening services at scale in sub-Saharan Africa is constrained by several factors, namely incompatible infrastructure, funding/resource insufficiencies, competing priorities, and workforce shortages.<sup>11–13</sup>

Achieving the global 90–70–90 interim targets (90% HPV vaccination coverage among age-eligible girls, 70% cervical cancer screening uptake by age 35, 90% treatment of precancerous cervical cells and management of invasive cervical cancer) is the cornerstone of the WHO's cervical cancer elimination strategy, which aims to reduce cervical cancer incidence to <4 per 100,000 women by 2030.<sup>14</sup> A thorough understanding of the gaps in implementing cervical cancer screening is best achieved through assessment of cervical cancer screening uptake at the population level.<sup>15</sup> However, at present, there has been a notable absence of population-level data characterizing the prevalence and socio-demographic disparities in cervical cancer screening among WLWH in sub-Saharan Africa.

Accordingly, this study attempted to close these gaps in the literature by: (i) estimating cervical cancer screening at population-level in six sub-Saharan African countries with high HIV and cervical cancer burdens; and (ii) identifying correlates of cervical cancer screening in a socially and geographically heterogeneous sample of African WLWH.

## Methods

### Study design and procedures

The Population-based HIV Impact Assessments (PHIAs) are nationally representative, HIV-seroprevalence surveys, which use multistage cluster sampling to measure progress and outcomes in the HIV epidemic response at the population level in sub-Saharan Africa.<sup>15</sup> To measure HIV burdens and other HIV-related clinical outcomes (e.g., detectable antiretroviral therapy, viral load suppression) in a population-based sample of males and females aged 15–64 years, PHIA participants submit plasma or, if unavailable, dried blood spots (DBS) for HIV testing. HIV serostatus is confirmed via plasma or DBS samples, collected in the household, using national rapid HIV test algorithms. All samples that yield a positive HIV test result are retested with a supplemental confirmatory test, per national HIV testing algorithms—after which HIV-1 viral load quantification is performed on all serologically confirmed specimens. Qualitative screening of plasma or DBS samples for select antiretroviral drugs is performed using high-resolution liquid chromatography with tandem mass spectrometry.

The population for the present study included cisgender women (people assigned female at birth identifying as women) aged 25–64 years with serologically confirmed infection who participated in a PHIA survey in one of the following countries: Ethiopia (2017–2018), Malawi (2015–2016), Rwanda (2018–2019), Tanzania (2016–2017), Zambia (2016), and Zimbabwe (2015–2016). These countries exhibit elevated HIV burdens (female HIV

prevalence: 3.7–13.6%) and high rates of cervical cancer incidence/mortality (see Table 1). To align with the WHO's cervical cancer screening recommendations,<sup>5</sup> inclusion criteria for the present study was restricted to cisgender WLWH aged 25 years or older. All participants included in the present study provided written informed consent prior to enrollment and study procedures.

## Measures

The primary dependent variable of interest was lifetime cervical cancer screening uptake, measured by self-report and dichotomized to identify women who had ever been screened, irrespective of method, for cervical cancer.

HIV clinical indicators assessed in the present study were defined and operationalized as follows: *HIV serostatus knowledge*, defined as awareness of HIV serostatus at the time of survey by self-report and/or detection of antiretroviral drugs in plasma or DBS; *current antiretroviral therapy (ART) use*, measured via self-report and/or detection of antiretroviral drugs in plasma or DBS; and *viral load suppression*, defined as <1000 HIV RNA copies/mL in plasma or DBS—consistent with WHO guidelines.<sup>16</sup>

Other independent variables—all measured via self-report—assessed in the present study were: *age*, measured in discrete years and 10-year groups; *marital status* (never married vs married or in union vs separated, widowed, or divorced); *relationship type* (monogamous union vs polygynous union vs no union); *educational attainment* (no formal vs primary vs secondary vs tertiary or higher); *household wealth*, ascertained from an asset-based index of household possessions and grouped into quintiles using principal components analysis;<sup>17</sup> *residence type* (urban vs rural); and *parity* (nulliparous vs multiparous).

## Statistical analysis

After restricting the sample to cisgender women with serologically confirmed HIV infection aged 25–64 years, the prevalence of lifetime cervical cancer screening was estimated, overall (in the pooled sample) and by country. Cervical cancer screening estimates in the pooled and country-specific samples were further compared by HIV serostatus knowledge, current ART use, and viral load suppression. Design-based F-tests were then implemented to identify statistically significant ( $p < 0.05$ ) differences in lifetime cervical cancer screening by socio-demographic characteristics and HIV clinical outcomes, respectively.

Next, generalized linear models with a log link function, binomial family distribution, and Taylor-series (linearized) variance estimation were used to identify demographic and clinical correlates of lifetime cervical cancer screening in the pooled multi-country sample—reported as adjusted prevalence ratios (adjPR) with 95% confidence intervals (CI). Covariates emerging as significantly associated with cervical cancer screening at the  $p < 0.05$  level in unadjusted analyses were included in the final multivariable model. To ensure results were generalizable to the underlying source population of WLWH aged 25–64 years across countries, analytic weights were implemented across descriptive and multivariable analyses to account for differential probabilities of survey selection and non-response. Data were managed and analyzed in Stata/IC 18.0 (StataCorp LLC, College Station, Texas, United States).

## Ethics

The Johns Hopkins University Bloomberg School of Public Health Institutional Review Board (Baltimore, Maryland, United States of America) approved the protocol for de-identified secondary data analyses of the PHIA surveys. All PHIA participants provided written informed consent prior to enrollment.

## Results

Table 2 shows the demographic composition of the study population, which consisted of 6933 WLWH aged 25–64 years from Ethiopia ( $n = 420$ ), Malawi ( $n = 1341$ ), Rwanda ( $n = 555$ ), Tanzania ( $n = 1124$ ), Zambia ( $n = 1452$ ), and Zimbabwe ( $n = 2041$ ). The mean age was 39.6 years (CI: 39.2–39.9 years). The largest fraction of WLWH were aged 35–44 years (36.8%), married (50.7%), educated through primary school (55.2%), rural residents (50.7%), and multiparous (92.3%). With respect to HIV clinical indicators, 77.2% (CI: 75.7–78.6%) were aware of their HIV serostatus; 70.7% (CI: 69.2–72.2%) were currently on ART; and 65.9% (CI: 64.3–67.4%) were virally suppressed.

Fewer than one-fifth (18.5%, CI: 17.1–20.0%) of WLWH reported screening for cervical cancer in their lifetimes. Figure 1 illustrates the prevalence of lifetime cervical cancer screening by country, ranging from 8.5% in Rwanda to 25.3% in Zambia. In the pooled multi-country sample (see Table 3), lifetime cervical cancer screening was significantly higher among WLWH who were aware of their HIV status (21.3% vs 9.0%,  $p < 0.001$ ), currently on ART (22.0% vs 10.5%,  $p < 0.001$ ), and virally suppressed (22.1% vs 11.6%,  $p < 0.001$ ). Results were similar across countries, with the notable exceptions of Ethiopia and Malawi, where estimates of cervical cancer screening were comparable at each stage of the HIV care continuum (i.e., knowledge of HIV serostatus, current ART use, viral load suppression).

Table 4 presents unadjusted proportions and adjusted log-binomial estimates of cervical cancer screening uptake in the pooled multi-country sample, by socio-demographic factors. Cervical cancer screening peaked between ages 35–44 years (adjPR = 1.54, CI: 1.34–1.77,  $p < 0.001$ ) and 45–54 years (adjPR = 1.53, CI: 1.26–1.85,  $p < 0.001$ ), relative to ages <35 years. Compared to WLWH from the poorest households, WLWH from poorer (adjPR = 1.70, CI: 1.21–2.39,  $p = 0.002$ ), average (adjPR = 2.02, CI: 1.46–2.79,  $p < 0.001$ ), wealthier (adjPR = 1.96, CI: 1.37–2.81,  $p < 0.001$ ), and the wealthiest (adjPR = 2.61, CI: 1.86–3.68,  $p < 0.001$ ) households exhibited significantly elevated adjusted odds of lifetime cervical cancer screening. Cervical cancer screening uptake was also significantly associated with university-education or higher (adjPR = 1.68, CI: 1.14–2.48,  $p = 0.009$ ), relative to no formal education, and urban residence (adjPR = 1.28, CI: 1.04–1.59,  $p = 0.002$ ), relative to rural residence. Lastly, compared to WLWH from Rwanda (which had the lowest proportion of lifetime cervical cancer screening), WLWH from Malawi (adjPR = 2.01, CI: 1.48–2.73,  $p < 0.001$ ), Tanzania (adjPR = 1.79, CI: 1.25–2.56,  $p = 0.002$ ), Zambia (adjPR = 2.35, CI: 1.71–3.22,  $p < 0.001$ ), and Zimbabwe (adjPR = 2.14, CI: 1.58–2.89,  $p < 0.001$ ) were significantly more likely to report ever screening for cervical cancer. Of note, marital status and parity were unassociated with cervical cancer screening in univariate analysis and were, thus, excluded from the final multivariable model.

## Discussion

Despite the presence of evidence-based clinical guidelines recommending regular screening for WLWH aged  $\geq 25$  years,<sup>5</sup> <20% of age-eligible African WLWH in this multi-country, population-based study had been screened for cervical cancer in their lifetimes. Findings reveal a high unmet need for cervical cancer screening services among WLWH in sub-Saharan Africa—a region which shoulders a disproportionate burden of the HIV and cervical cancer pandemics.<sup>4</sup> Inconsistent with findings from complementary studies characterized by clinic-based recruitment,<sup>17–20</sup> the present study reported substantially lower estimates of lifetime cervical cancer screening—a potential artifact of the PHIA's population-based sampling methodology, which yielded a sample of both care-engaged and service-disengaged individuals. Given the relative scarcity of population-level data on cervical cancer screening among WLWH in LMICs,<sup>21</sup> this study spotlights major gaps in cervical cancer screening uptake and access in a population at increased risk of oncogenic cervical neoplasia.

Findings from the present study further revealed geographic heterogeneities in cervical cancer screening uptake in sub-Saharan Africa, likely attributable to access inequities by urbanicity and variations in service delivery prioritization across countries. Urban-dwelling WLWH were significantly more likely than rural-dwelling WLWH to have ever screened for cervical cancer, reaffirming gradients of cervical cancer service availability and accessibility by urbanicity shown elsewhere.<sup>22–24</sup> Furthermore, we found substantial heterogeneity in cervical cancer screening coverage across countries, which likely reflects variable cervical cancer burdens within countries with generalized HIV epidemics. Comparing Rwanda (adult female HIV prevalence: 3.7%, 18.9 cervical cancer cases per 100,000 women-years) and Zambia (adult female HIV prevalence: 14.6%, 71.5 cervical cancer cases per 100,000 women-years) (see Table 1), it is unsurprising that rates of cervical cancer screening were lower in Rwanda than Zambia, where robust investments in HIV care and treatment services have likely enhanced availability and access to integrated, affordable cervical cancer screening among WLWH.<sup>25–28</sup> This is further supported by the finding that cervical cancer screening rates were higher among WLWH progressing along each stage of the HIV care continuum (i.e., testing, treatment, viral suppression), suggesting prolonged contact with the HIV care system is associated with greater uptake of cervical cancer screening.<sup>29</sup> In the absence of universally accessible HIV treatment services, efforts to increase uptake of cervical cancer screening may be marred by siloed, under-resourced, and deprioritized service delivery.

Beyond potential variations in geographic accessibility to cervical cancer screening services, we identified significant disparities related to cervical cancer screening uptake by access to material and social assets. Even after controlling for other co-factors, WLWH from wealthier households and with higher levels of formal schooling, respectively, were significantly more likely to have screened for cervical cancer in their lifetimes—reaffirming the contribution of social resources (i.e., health literacy) and household possessions (i.e., private modes of transportation, financial autonomy) to healthcare service-seeking.<sup>28,30,31</sup> In contexts where cervical cancer screening services may not be particularly visible or affordable, access to

capital and accompanying financial resources intuitively emerges as a distinguishing feature of the minority of WLWH ever screening for cervical cancer.

Lastly, findings revealed age-related differences in cervical cancer screening uptake, with WLWH aged <35 years exhibited lower screening rates relative to women aged 35–54 years. These results are concerning, as WLWH have an increased likelihood of developing precancerous cervical lesions that may progress to cervical cancer at younger ages, especially among those who are not virologically suppressed. A recent study found that the age of cervical cancer diagnosis is younger in countries in sub-Saharan Africa with generalized HIV epidemics, with approximately 20% of persons diagnosed with cancer presenting at younger than 40 years of age.<sup>32</sup> Thus, identifying opportunities to engage WLWH in cervical cancer screening at earlier ages is critical to improving prognosis and treatment outcomes. Expanding clinical capacity for early cervical cancer screening and detection, coupled with awareness-raising and demystifying/destigmatizing cervical cancer screening, are imperative to increasing cervical cancer screening uptake among WLWH, especially for younger women.

### Limitations

Our study is not without limitations. First, data were derived from surveys implemented during the early rollout of HIV “Test and Start” policies (i.e., ART initiation at the time of HIV diagnosis), which represented a shift from established HIV treatment guidelines previously using WHO clinical staging and CD4 cell counts as criteria for ART initiation.<sup>16</sup> Because cervical cancer screening is well-integrated into HIV care services (where ART is historically dispensed) in sub-Saharan Africa,<sup>33</sup> results from the present study may have limited transferability to settings with more prolonged implementation of “Test and Start” policies. Future research should endeavor to quantify cervical cancer screening coverage and service delivery gaps in countries where “Test and Start” policies are well-established and have been implemented at scale. Second, cervical cancer screening estimates were ascertained via self-report and are, thus, subject to response and recall biases, which could over- or under-estimate the true prevalence of cervical cancer screening uptake in the population. Third, self-reported measures of cervical cancer screening did not permit estimation of the recency, frequency, or outcomes (e.g., screening outcomes, treatment uptake) of service-seeking. Longitudinal studies characterizing outcomes along the cervical cancer care continuum among WLWH at population level are, thus, urgently needed. Lastly, the study did not include an exhaustive list of covariates potentially associated with cervical cancer screening (e.g., distance from health facilities, religious or sociocultural norms, anticipated/enacted stigma from healthcare providers), rendering results susceptible to residual confounding.

### Conclusions

Despite these limitations, this is among the first studies to leverage nationally representative, population-based data to assess the prevalence of, and underlying disparities in, cervical cancer screening uptake among WLWH in sub-Saharan Africa—a region with the highest burdens of HIV and cervical cancer mortality globally.<sup>4</sup> Cervical cancer screening rates

varied significantly not only by national (from 8.5% in Rwanda to 25.3% in Zambia) and subnational (from 14.0% in rural settings to 23.1% in urban areas) geographies, but also by key socio-demographic strata—with younger, less-educated, and poorer WLWH exhibiting the lowest rates of screening. These sobering findings reinforce the urgency with which HPV vaccination efforts should be redoubled, especially for girls and women living with or at increased risk of acquiring HIV—as cervical cancer elimination requires sustained commitments across prevention, screening, and treatment pillars. Moreover, inconsistent with WHO recommendations, fewer than one-fifth (18.5%) of WLWH reported ever screening for cervical cancer, and estimates were particularly suboptimal among WLWH who had fewer touchpoints with the HIV care system—highlighting substantial gaps in the provision and uptake of a life-saving measure for secondary prevention of cervical cancer. Reaching the large fraction of never-screened WLWH across settings will require multi-pronged strategies that increase awareness of risks and services, shift social norms towards cervical cancer service-seeking (including screening), increase coordination across siloed healthcare delivery systems, and enhance access through alternative service delivery platforms (e.g., mobile services, self-sampling, home-based screening).

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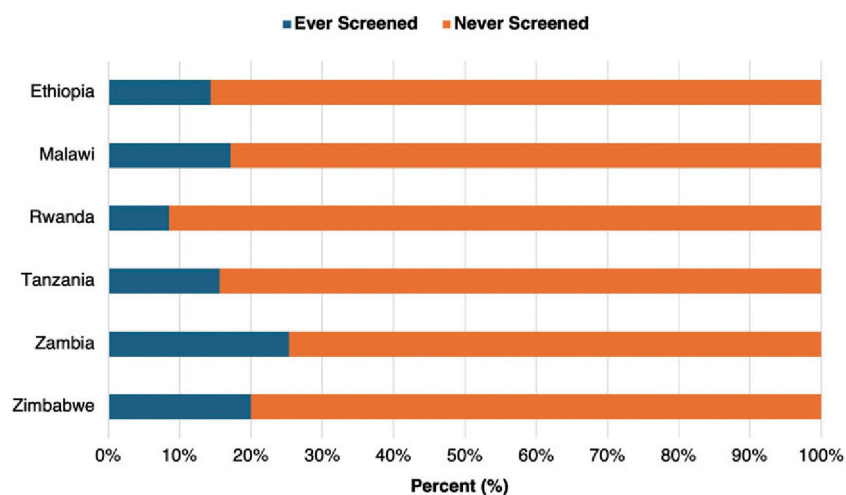


**Figure 1.**  
Prevalence of lifetime cervical cancer screening among women living with HIV aged  $\geq 25$  years, by country.

Cervical cancer and HIV epidemiologic profile of sub-Saharan African countries with population-based HIV impact assessment (PHIA) surveys included in the present study.

Table 1.

| Country  | Adult female HIV prevalence (95% CI) | Age-standardized cervical cancer incidence | Age-standardized cervical cancer mortality |
|----------|--------------------------------------|--------------------------------------------|--------------------------------------------|
| Ethiopia | 4.1% (3.6–4.7%)                      | 22.3 cases per 100,000 women-years         | 16.8 deaths per 100,000 women-years        |
| Malawi   | 12.5% (11.6–13.4%)                   | 70.9 cases per 100,000 women-years         | 54.1 deaths per 100,000 women-years        |
| Rwanda   | 3.7% (3.3–4.1%)                      | 18.9 cases per 100,000 women-years         | 13.8 deaths per 100,000 women-years        |
| Tanzania | 6.5% (6.0–7.0%)                      | 64.8 cases per 100,000 women-years         | 13.0 deaths per 100,000 women-years        |
| Zambia   | 14.6% (13.8–15.5%)                   | 71.5 cases per 100,000 women-years         | 49.4 deaths per 100,000 women-years        |
| Zimbabwe | 16.0% (15.3–16.8%)                   | 68.2 cases per 100,000 women-years         | 47.9 deaths per 100,000 women-years        |

Notes: Adult HIV prevalence was estimated among females aged 15–64 years, except in Zambia (females aged 15–59 years), and were derived from the population-based HIV Impact Assessment (PHIA) surveys.

**Table 2.**  
Descriptive characteristics among women living with HIV aged ≥25 years (*N* = 6933).

| Characteristics                 | Number ( <i>n</i> ) | Weighted % |
|---------------------------------|---------------------|------------|
| Socio-demographics              |                     |            |
| Age, in years (mean, 95% CI)    | 39.6                | 39.2–39.9  |
| Age group                       |                     |            |
| 25–34 years                     | 2363                | 35.0%      |
| 35–44 years                     | 2591                | 36.8%      |
| 45–54 years                     | 1315                | 18.6%      |
| 55 years or older               | 664                 | 9.6%       |
| Marital status                  |                     |            |
| Never married (single)          | 477                 | 6.4%       |
| Married/cohabiting              | 3533                | 50.7%      |
| Separated, widowed, or divorced | 2910                | 42.9%      |
| Relationship type               |                     |            |
| In a monogamous union           | 2915                | 41.9%      |
| In a polygynous union           | 526                 | 8.0%       |
| No current union                | 3387                | 50.1%      |
| Educational attainment          |                     |            |
| No formal education             | 860                 | 15.2%      |
| Primary                         | 3634                | 55.2%      |
| Secondary                       | 2166                | 26.5%      |
| University-level or higher      | 266                 | 3.1%       |
| Household wealth                |                     |            |
| Poorest                         | 1145                | 15.8%      |
| Low-middle                      | 1074                | 16.4%      |
| Average                         | 1326                | 20.8%      |
| Upper-middle                    | 1558                | 24.0%      |
| Wealthiest                      | 1823                | 23.0%      |
| Residence type                  |                     |            |
| Rural                           | 3616                | 50.7%      |

| Characteristics             | Number (n) | Weighted % |
|-----------------------------|------------|------------|
| Urban                       | 3317       | 49.3%      |
| Country                     |            |            |
| Ethiopia                    | 420        | 8.8%       |
| Malawi                      | 1341       | 17.9%      |
| Rwanda                      | 555        | 0.1%       |
| Tanzania                    | 1124       | 32.6%      |
| Zambia                      | 1452       | 18.3%      |
| Zimbabwe                    | 2041       | 22.3%      |
| Health indicators           |            |            |
| Parity                      |            |            |
| Nulliparous                 | 472        | 7.7%       |
| Multiparous                 | 6438       | 92.3%      |
| Cervical cancer screening   |            |            |
| Never screened              | 5608       | 81.5%      |
| Ever screened               | 1312       | 18.5%      |
| HIV care continuum          |            |            |
| Knowledge of HIV serostatus | 5604       | 77.2%      |
| Current ART use             | 5101       | 70.7%      |
| Viral load suppression      | 4770       | 65.9%      |

Table 3.

Cervical cancer screening prevalence across the HIV care continuum among women living with HIV aged ≥25 years, overall and by country.

| Weighted (%) | Screening by serostatus knowledge |           |         | Screening by treatment status |             |         | Screening by viral load |                |         |
|--------------|-----------------------------------|-----------|---------|-------------------------------|-------------|---------|-------------------------|----------------|---------|
|              | Unaware (%)                       | Aware (%) | p-value | ART non-use (%)               | ART use (%) | p-value | HIV viremia (%)         | Suppressed (%) | p-value |
| Overall      | 9.0                               | 21.3      | <0.001  | 10.5                          | 22.0        | <0.001  | 11.6                    | 22.1           | <0.001  |
| Ethiopia     | 12.0                              | 14.7      | 0.632   | 9.8                           | 15.6        | 0.298   | 12.7                    | 14.9           | 0.248   |
| Malawi       | 12.7                              | 18.0      | 0.114   | 14.5                          | 17.9        | 0.248   | 12.9                    | 18.5           | 0.043   |
| Rwanda       | 0                                 | 9.7       | 0.009   | 1.5                           | 9.7         | <0.001  | 3.5                     | 9.7            | 0.007   |
| Tanzania     | 4.3                               | 21.0      | <0.001  | 4.8                           | 22.0        | <0.001  | 5.3                     | 22.8           | <0.001  |
| Zambia       | 15.0                              | 28.2      | <0.001  | 15.6                          | 29.8        | <0.001  | 19.8                    | 29.0           | <0.001  |
| Zimbabwe     | 11.7                              | 21.6      | 0.003   | 13.9                          | 22.1        | <0.001  | 15.2                    | 22.5           | 0.001   |

Notes: **Bolded** values represent statistically significant ( $p < 0.05$ ) differences in the prevalence of lifetime cervical cancer screening by HIV care continuum stages. Univariate  $p$ -values were estimated using design-based F-tests.

Unadjusted weighted proportions and adjusted log-binomial estimates of lifetime cervical cancer screening among women living with HIV aged ≥25 years, by socio-demographics.

**Table 4.**

| Lifetime cervical cancer screening | Unadjusted   |         | Adjusted                |                  |
|------------------------------------|--------------|---------|-------------------------|------------------|
|                                    | Weighted (%) | p-value | adjPR (95% CI)          | p-value          |
| Age group                          |              | <0.001  |                         |                  |
| 25–34 years                        | 14.7         |         | 1.00                    | Ref.             |
| 35–44 years                        | 22.0         |         | <b>1.54 (1.34–1.77)</b> | <b>&lt;0.001</b> |
| 45–54 years                        | 21.4         |         | <b>1.53 (1.26–1.85)</b> | <b>&lt;0.001</b> |
| 55 years or older                  | 13.2         |         | 1.08 (0.82–1.42)        | 0.561            |
| Educational attainment             |              | <0.001  |                         |                  |
| No formal education                | 12.1         |         | 1.00                    | Ref.             |
| Primary                            | 16.3         |         | 1.13 (0.83–1.54)        | 0.432            |
| Secondary                          | 24.7         |         | 1.40 (0.99–1.97)        | 0.057            |
| University-level or higher         | 35.8         |         | <b>1.68 (1.14–2.48)</b> | <b>0.009</b>     |
| Household wealth                   |              | <0.001  |                         |                  |
| Poorest                            | 7.9          |         | 1.00                    | Ref.             |
| Poorer                             | 13.7         |         | <b>1.70 (1.21–2.39)</b> | <b>0.002</b>     |
| Average                            | 17.6         |         | <b>2.02 (1.46–2.79)</b> | <b>&lt;0.001</b> |
| Wealthier                          | 19.4         |         | <b>1.96 (1.37–2.81)</b> | <b>&lt;0.001</b> |
| Wealthiest                         | 29.0         |         | <b>2.61 (1.86–3.68)</b> | <b>&lt;0.001</b> |
| Residence type                     |              | <0.001  |                         |                  |
| Rural                              | 14.0         |         | 1.00                    | Ref.             |
| Urban                              | 23.1         |         | <b>1.28 (1.04–1.59)</b> | <b>0.022</b>     |
| Country                            |              | <0.001  |                         |                  |
| Ethiopia                           | 14.3         |         | 1.42 (0.91–2.22)        | 0.120            |
| Malawi                             | 17.1         |         | <b>2.01 (1.48–2.73)</b> | <b>&lt;0.001</b> |
| Rwanda                             | 8.5          |         | 1.00                    | Ref.             |
| Tanzania                           | 15.6         |         | <b>1.79 (1.25–2.56)</b> | <b>0.002</b>     |
| Zambia                             | 25.3         |         | <b>2.35 (1.71–3.22)</b> | <b>&lt;0.001</b> |
| Zimbabwe                           | 20.0         |         | <b>2.14 (1.58–2.89)</b> | <b>&lt;0.001</b> |

Notes: **Bolded** values represent statistically significant ( $p < 0.05$ ) differences in adjusted prevalence ratios for lifetime cervical cancer screening. Univariate  $p$ -values were estimated using design-based F-tests. Only covariates included in multivariable analysis are presented in the table.

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