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RESEARCH

Far behind 90-70-90's screening target: the prevalence and determinants of cervical cancer screening among Sub-Saharan African women: evidence from Demographic and Health Survey

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Abstract

Background Cervical cancer screening is the primary goal in 90-70-90 targets to reduce cervical cancer incidence and mortality by identifying and treating women with precancerous lesions. Although several studies have been conducted in Sub-Saharan African (SSA) countries on cervical cancer screening, their coverage was limited to the regional or national level, and/or did not address individual- and community-level determinants, with existing evidence gaps to the wider SSA region using the most recent data. Hence, this study aimed to assess the pooled prevalence and multilevel correlates of cervical cancer screening among women with SSA.

Methods This study was conducted using the Demographic Health Survey data (2015–2022) from 11 countries, and a total weighted sample of 124,787 women was considered in the analysis. Using multilevel mixed-effects logistic regression, the influence of each factor on cervical cancer screening uptake was investigated, and significant predictors were reported using the adjusted odds ratio (aOR) with their respective 95% confidence intervals (95% CI).

Results The overall weighted prevalence of cervical cancer screening was 10.29 (95% CI: 7.77, 11.26), with the highest and lowest screening rates detected in Namibia and Benin at 39.3% (95% CI: 38.05, 40.54) and 0.5% (95% CI: 0.36, 0.69), respectively. Higher cervical screening uptake was observed among women aged 35–49 [aOR = 4.11; 95% CI: 3.69, 4.58] compared to 15–24 years, attending higher education [aOR = 2.71; 95% CI: 2.35, 3.23] than no formal education, being in the richest wealth quintile [aOR = 1.45; 95% CI: 1.26, 1.67], having a recent visit to a health facility [aOR = 1.83; 95% CI: 1.71, 1.95], using contraception [aOR = 1.54; 95% CI: 1.45, 1.64], recent sexual activity [aOR = 3.59; 95% CI: 2.97, 4.34], and listening to the radio [aOR = 1.78; 95%CI: 1.60, 2.15].

Conclusion The overall prevalence of cervical cancer screening in SSA countries was found to be low; only one in every ten women has been screened. Strengthening universal health coverage, and promoting screening programs with an emphasis on rural areas and low socioeconomic status are key to improving screening rates and equity.

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Additionally, integrating cervical cancer screening with existing reproductive health programs, e.g. contraceptive service would be important.

Keywords Cervical cancer, Screening, Sub-Saharan Africa, Determinants

Background

Cervical cancer is one of the most common cancers and causes of cancer-related death in women worldwide [1]. One of its main causes is persistent infection with one or more of the high-risk oncogenic forms of human papillomavirus (HPV), which disrupt normal cell functioning and result in alterations in cervical epithelial cells [2]. Cervical cancer is the fourth most frequent malignancy in women globally, with 604,127 new cases and 341,831 deaths in 2020, with low- and middle-income countries, including Africa, accounting for 90% of the deaths [3]. In 2040, over four-fifths of the increase is projected for cases (847,306) and deaths (524,214), with about a double increase in Africa (e.g., 93.3% for deaths), while only a quarter increase in Europe (e.g., 28.7% for deaths) [3]. Sub-Saharan Africa (SSA) is among the highest regards poor cervical cancer outcomes, including high mortality and low survival, reflecting late diagnosis, low access to screening and treatment services as well as the existence of its risks such as high HIV prevalence and low socioeconomic factors and poverty [1, 3–5].

Early identification of cervical cancer through screening is related to improved outcomes, and the World Health Organization (WHO) has released a Global Strategy to Accelerate Cervical Cancer Elimination, which outlines three critical measures: immunisation for human papillomavirus (HPV), screening and treatment [1]. In resource-constrained settings, visual inspection of the cervix with acetic acid followed by treatment (screen and treat) provides an alternative strategy to secondary prevention [6, 7]. If executed properly, this three-pronged strategy is predicted to avert more than 40% of new incidents of the disease and five million related deaths by 2050 [8]. Similarly, the WHO Secretariat modeled the health and socioeconomic implications of meeting the 90-70-90 targets by 2030 in 78 low- and lower-middle-income countries that focus on the following: (i) 90% of girls will be properly vaccinated for HPV, (ii) 70% of women will be screened for cervical cancer, and (iii) 90% of women diagnosed with cervical cancer will receive treatment at the end of 2030 [9].

Effective screening programs and interventions for screening identified abnormal results can reduce cervical cancer cases by 80% [10]. The key strategies to achieve this 70% screening are understanding barriers to services, integrating screening packages with the existing primary healthcare, promoting a screen-and-treat approach, ensuring affordable and high-performance screening tests and treatment devices, and strengthening laboratory capacity and quality assurance programs [9, 11, 12].

Despite the ongoing activities and targets, cervical screening uptake is suboptimal in most low and middle-income countries, including in Sub-Saharan Africa, highlighting unmet needs and less attention to implementing screening initiatives [13–15]. For example, in 2020, only below half of women had been screened for cervical cancer in low-income (35%) or lower-middle-income countries (55%), which is lower compared to the rates in high-income countries (80%) [1]. Cervical cancer screening uptake could be attributed to individual factors, including low awareness about cancer or the screening program, limited time to attend the screening, or low preference and acceptance, and community and system-level factors, including limited coverage and access, low health insurance coverage, limited resources, including educational and screening materials [16].

Although several studies have been conducted in SSA countries, they were undertaken at one country or sub-country level, and there was a lack of evidence showing the pooled prevalence of screening in the region using the most recent data [17–19]. In addition, those previous studies did not explore the individual and beyond individual contextual factors that affect screening uptake. Hence, the current study addressed the evidence gap by estimating the prevalence and identifying multilevel correlates of cervical cancer screening among women in SSA using the most recent standard Demographic Health Survey data (2015–2022). To do this, this study employed a multilevel regression analysis, which allowed it to demonstrate the influence of factors at the individual and community levels, independently and collectively. The quantitative evidence from screening uptake will provide insights into the coverage, optimal participation, and effectiveness of existing screening programs, which often motivates collective efforts to scale up screening implementation. In addition, the evidence from the pooled prevalence is essential in guiding clinical practice and policy decisions and advancing research efforts to reduce the burden of cervical cancer globally. Moreover, identification of the factors that facilitate or impede cervical cancer screening would be crucial for tailoring interventions by leveraging the facilitators and tackling the barriers through targeted awareness campaigns, educational initiatives, resource allocation, and mobilisation. The WHO's 90-70-90 targets for cervical cancer elimination by 2030 underscore the urgency of ensuring early detection and improving screening rates [9]. This study could

Table 1 Description of the countries included in the analysis with their respective sample size, 2015–2022

Country	Year	Un weighted sample size (%) (tab v000)	Weighted sample size (%) (tab v000 [iw = wgt])
Benin	2018	7,712(6.1)	7,706(6.2)
Burkina Faso	2021	17,659 (14.0)	17,659(14.2)
Cote d'Ivoire	2021	14,877 (11.8)	14,877(11.9)
Cameroon	2018	13,527(10.8)	13,616(10.9)
Gabon	2021	7,911(6.3)	7,640(6.1)
Kenya	2022	16,901(13.4)	16,716(13.4)
Madagascar	2021	9,597(7.6)	9,597(7.7)
Mauritania	2021	7,930(6.3)	7,959(6.4)
Namibia	2015	6,499(5.2)	5,933(4.8)
Tanzania	2022	15,254(12.1)	15,254(12.1)
Zimbabwe	2015	7,889(6.3)	7,830(6.3)
Total	2015–2022	125,756(100.0)	124,787(100.0)

provide the SSA's progress toward these ambitious goals, allowing for evidence-based adjustments and refinements to strategies, ultimately promoting equity in screening access and uptake and ensuring equity in cervical cancer prevention and outcome.

Methods

Data source, study period, and population

The study was based on the appended woman file (IR) of the most recent Demographic and Health Surveys (DHS) of 11 African countries (2015–2022). The data was accessed from DHS office on a reasonable request via https://dhsprogram.com/Countries/. The study comprised all women who had complete information on the variables of interest: a total of 124,787 women aged 15 to 49 years. In the analysis of DHS data, weighting was performed using a weighting factor 'wgt' which was calculated by dividing the variable v005 (women's individual sample weight of six decimal point) by 1,000,000. All the descriptive statistics were performed by running a STATA command *'tab varlist [iw=wgt]'*, where *varlist*=variable of interest and wgt=weighting factor. For instance, the weighted sample sizes listed in Table 1 were generated using the STATA command *'tab v000 [iw=wgt]'*. This approach was employed to ensure that the data accurately represented the population being studied, thus allowing for more reliable and meaningful conclusions to be drawn from the analysis (Table 1).

Sampling procedures and data collection tools, and sample size

The respondents were accessed using a stratified two-stage cluster sampling technique and the data were collected through face-to-face interviews by trained data collectors. A detailed elaboration of the sampling technique is described in the DHS Sampling and Household Listing Manual [20]. Initially, women's (IR) files of 12 countries containing data on cervical cancer screening were appended. After excluding missing values, the final analysis was based on 125,756 records (weighted sample size of 124,787) (Fig. 1).

Measurement of variables of the study

Outcome variable

Cervical cancer screening was defined if the women reported yes to either of the following questions prior to the survey [15]: 'Have you ever been screened for cervical cancer?' or 'Have you ever been tested for cervical cancer?' 'Have you had a cervical examination before?' Further details on the cervical cancer screening questionnaires can be found elsewhere [21]. The response was dichotomised as yes=1 or no=0 and was used as an outcome variable [15].

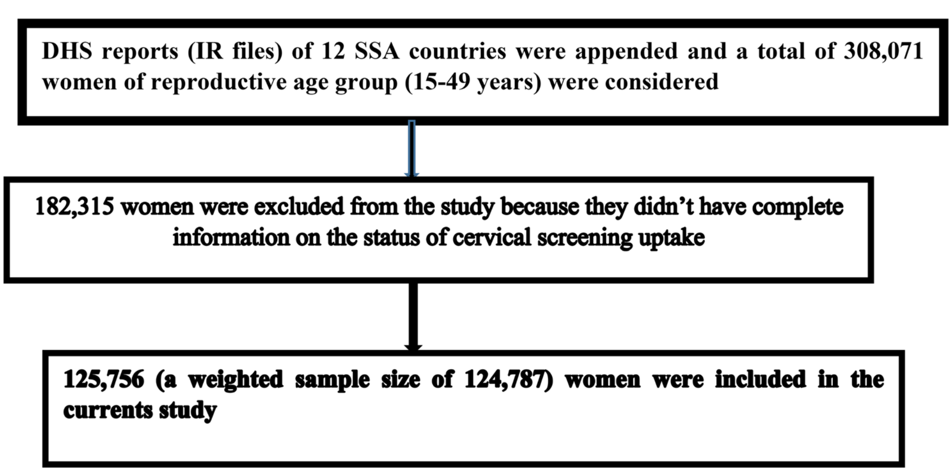

Fig. 1 Schematic presentation of the sampling procedure and sample size determination for the study

Explanatory variables

Potential variables at the individual and community levels were identified considering prior literature on the area of interest [15, 22]. Individual-level factors comprised socio-demographic, obstetric, and healthcare-related aspects unique to each woman, while community-level factors were shared by all women living in the same community (cluster), such as residency and community poverty (Table 2).

Statistical analysis and data management

The most recent datasets from the 11 SSA countries were appended, recoded, cleaned, and analyzed using STATA version 16. A weighting factor (wgt) $\left(\frac{v005}{1000000}\right)$ was applied to ensure the representativeness of the data by averting under- and over-representation, where v005=women's individual sample weight (in six decimal point). All the descriptive statistics were performed by running a command *'tab varlist [iw=wgt]'*, where *varlist*=variable of interest and wgt=weighting factor. Frequencies and percentages were computed to determine the characteristics of the respondents across the overall sample size. There was no multicollinearity among the variables (the VIF ranged from 1.08 to 1.88, with a mean of 1.39).

Multilevel mixed-effect logistic regression

Given that the DHS data were hierarchical, we used multilevel modelling; as the outcome variable was binary, we used multilevel multivariable regression analysis.

Model building and selection

Fixed effects (measures of association)

A multilevel bivariable logistic regression analysis was performed to assess the association between each explanatory variable and the response variable, and variables with p-values$<$0.25 were entered into multilevel mixed-effect multivariable logistic regression. Finally, multilevel multivariable logistic regression analysis was used to identify significant predictors of cervical cancer screening; statistical significance was declared at $p<0.05$, and adjusted odds ratios (AOR) with respective 95% confidence intervals.

Table 2 List of individual and community-level factors that were supposed to affect the uptake of cervical cancer screening in SSA, 2015–2022

Individual-level factors	
Variables	Description and categorisation
Age	The respondent's age, expressed in years, at the time of the survey and categorised as 15–24, 25–34, and 35–49
Marital status	The status of marriage or cohabitation which is categorised as cohabited, never in a union, and non-marital relation
Educational status	The highest level of education a woman attended or completed, and categorised as no education, primary, secondary, and higher education
Occupational status	Employment status of women in the 12 months preceding the survey and categorised as employed, and unemployed
Family size	Number of household members at the time of data collection and dichotomised as ≤5 and >5
Wealth index	Calculated using easy-to-collect data on a household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities. Finally, it was categorised into quintiles; poorest, poorer, middle, richer, and richest
Parity	The number of living children the woman had at the time of the survey, and was grouped as nulliparous, primiparous, multiparous, and grand multiparous
Contraceptive uptake	women who ever used any contraceptive and categorised as user and non-user
Recent sexual activity	recent sexual history of women which was grouped as never had sex, not active in the last 4wk (due to postpartum or not), and active in the last 4 weeks
Difficulty in accessing healthcare	The ease of accessing health care for themselves when they are sick was grouped as 'Not a big problem' or 'Big problem'
Covered by health insurance	Women and men ages 15–49 who were covered by any health insurance schemes.
Media exposure	Exposure status to certain media(newspaper, radio, and television) and the responses were categorised as Not at all, less than once a week, and at least once a week
Autonomy in decision-making [a]	Decision-making capacity of a woman on health care, large household purchases, and visits to family or relatives, and the responses were categorised into low, middle, and high
Community-level factors	
Residence	The area where respondents lived and categorised as urban and rural
Community level poverty	The proportion of respondents who lived in the worst living conditions in the cluster. By putting together the individual homes with the lowest wealth indices, the cluster's overall poverty can be assessed and classed as low, moderate, or high.

[a] Autonomy in decision-making: was assessed by using three questions about who makes the final decision for the family on large property purchases, visits to relatives, and health care. The response categories were (i) woman alone, (ii) woman and husband/partner, (iii) husband/partner alone, (iv) someone else, and (v) others. For each question, responses (i) or (ii) got a score of 1, indicating good decision-making capacity, whereas the remaining responses received a score of 0, indicating weak decision-making capacity. Each of the three components' responses were summed together to yield an overall score ranging from 0 to 3. Finally, a composite score was divided into two distinct groups: low and high for "0 to 2" and "3" scores [23, 24]

Random effects

Using multilevel approaches, four distinct models were fitted: model one (null model) contained no explanatory variables, model two (had eligible individual-level factors), model three (with selected community-level factors), and model four (containing all variables). The intraclass correlation coefficient (ICC) and proportionate change in variance (PCV) were estimated to quantify the random effects in each model (variability in screening levels between and across clusters).

$ICC = \frac{\mathrm{var(b)}}{\mathrm{Var(b)+Var(w)}}$, where Var(b) is the variance at the group level and Var(w) is the predicted individual variance component, which is $\pi^2/3 \approx 3.29$.

Proportional Change in Variance (PCV) was estimated as.

$PCV = \frac{\mathrm{(Va-Vb)}}{\mathrm{Va}} * 100$, where V_a is the variance of the initial model (null model) and V_b=variance of the subsequent models (models 2, 3, and 4).

Goodness of fit

To evaluate the goodness of fit, deviance = (-2 * (Log Likelihood (LL) of each model), Schwarz's Bayesian Information Criterion (BIC), and Akaike's Information Criterion (AIC) were estimated for each model. Following the comparison, the best-fit model for this study was determined to be the fourth model with the lowest deviance, AIC, and BIC values (Table 3).

Results

Sociodemographic characteristics

This study examined a weighted sample of 124,787 women with a mean (±SD) age of 29.38 (±8.61) years. Burkina Faso had the highest number of respondents (14.2%), while Namibia had the lowest (4.8%). Two-thirds (68.6%) of women have cohabited marital status, and a quarter (24.8%) were in the richest wealth quintile. Women residing in rural areas and those without formal education constituted 53.4% and 26.5% of the respondents, respectively (Table 4).

Obstetric and health service-related characteristics

More than half of women were multiparous (2–4 living children) (53.8%) and did not use contraception (68.4%) (Table 5). About half of the women had a recent history of sexual activity within the last four weeks (52.0%) or had not visited a health facility within the last 12 months (49.2%). Three-quarters (78.6%) of women never read newspapers, while a comparable proportion never listen to the radio (45.0%) or watch television (45.4%). Obtaining money, traveling long distances, and getting permission were major barriers to seeking maternity care for 53.4%, 34.7%, and 20% of women in the region, respectively (Table 5).

The pooled estimate of women screened for cervical cancer

The overall weighted prevalence of cervical screening in SSA countries was 10.29 (95% CI: 7.77, 11.26). The highest and lowest screening rates were detected in Namibia and Benin at 39.3% (95% CI: 38.05, 40.54) and 0.5% (95% CI: 0.36, 0.69), respectively (Fig. 2).

Results of multilevel mixed effect logistic regression

Random effect *(measures of variation)*

The null model (Model I) results revealed that the variability between clusters accounted for 17.13% of the total variation in cervical cancer screening in SSA. Furthermore, individual- and community-level characteristics independently accounted for 13.6% and 15.64% of the disparities in cervical cancer screening uptake. In contrast, individual- and community-level factors together accounted for 52.94% of the variation observed in the null model (PCV=52.94%) (Table 6).

Determinants of screening for cervical cancer (fixed effect analysis)

Women's age, educational level, wealth index, residency, parity, history of recent sexual activity, contraceptive uptake, visiting health facilities, and listening to radio all had a significant association with cervical cancer screening in the multilevel multivariable logistic regression (Table 3). The odds of cervical screening were 4.11 [aOR=4.11; 95% CI: 3.69, 4.58] times higher among women aged 35–49 than women aged 15–24 years. Women who attended higher education were 2.71 [aOR=2.71; 95% CI: 2.35, 3.23] times more likely to have a cervical screening than their counterparts with no formal education. The odds of having cervical cancer screening were 3.59 [aOR=3.59; 95% CI: 2.97, 4.34] times higher in women who had sexual activity within the last 4 weeks than in those who had never had sex. Contraceptive users were 1.54 [aOR=1.54; 95% CI: 1.45, 1.64] times more likely to be screened than non-users. Similarly, the odds of being screened for cervical cancer were 1.83[aOR=1.83; 95% CI: 1.71, 1.95] times higher among women who had visited a health facility within the last 12 months than among their non-visited counterparts. Women who listened to the radio at least once a week had a 1.78 [aOR=1.78; 95%CI: 1.60, 2.15] greater chance of being screened than those who never listened to the radio. (Table 3).

Discussion

The pooled prevalence of cervical cancer screening in SSA was 10.29% (95% CI: 7.77, 11.26), which varied significantly across countries. The likelihood of screening for cervical cancer was higher among women of advanced age (35–49 years), urban residents, higher

Table 3 Distribution of sociodemographic characteristics of respondents: cervical cancer screening participation rate and bivariable analysis, SSA, 2015–2022

Variable categories	Total Number of Population (%), [*N* = 124,787].	Tested for Cervical cancer [Frequency (%)]	cOR (95% CI)	*p*-value
Countries				
Burkina Faso	17,659(14.2)	2,579(14.6)		
Benin	7,706(6.2)	39(0.5)		
Cote d'ivoire	14,877(11.9)	837(5.6)		
Cameroon	13,616(10.9)	471(3.5)		
Gabon	7,640(6.1)	1,254(16.4)		
Kenya	16,716(13.4)	2,809(16.8)		
Madagascar	9,597(7.7)	125(1.3)		
Mauritania	7,958(6.4)	36(0.5)		
Namibia	5,933(4.8)	2,331(39.3)		
Tanzania	15,254(12.2)	1,102(7.2)		
Zimbabwe	7,830(6.3)	1,250(15.9)		
Current Age				
15–24	47,930(38.4)	1,807(3.7)	Ref.	
25–34	38,767(31.1)	4,672(12.0)	3.58(3.33, 3.85)	< 0.001
35–49	38,090(30.5)	6,355(16.7)	5.27(4.88, 5.70)	< 0.001
Marital status				
Cohabited	75,629(68.6)	8,809(11.7)	2.08(1.92, 2.27)	< 0.001
Non-marital relation*	37,518(18.7)	2,403(6.4)	2.48(2.23, 2.75)	< 0.001
Never in union	11,640(12.6)	1,622(13.9)	Ref.	
Educational status				
No education	33,011(26.5)	1,996(6.0)	Ref.	
Primary	35,609(28.5)	2,941(8.3)	1.37(1.24, 1.51)	0.011
Secondary	47,161(37.8)	5,609(11.9)	2.01(1.84, 2.21)	< 0.001
Higher	9,006(7.2)	2,289(25.4)	4.81(4.26, 5.43)	< 0.001
Residence				
Urban	58,190(46.6)	7,798(13.4)	1.87(1.71, 2.05)	0.003
Rural	66,597(53.4)	5,036(7.6)	Ref.	
Family size				
≤ 5 member	59,876(48.0)	7,282(12.2)	1.42(1.34, 1.51)	0.013
> 5 member	64,910(52.0)	5,552(8.6)	Ref.	
Wealth index combined				
Poorest	20,439(16.4)	1,027(5.0)		
Poorer	22,225(17.8)	1,632(7.3)	1.46(1.29, 1.65)	0.002
Middle	23,936(19.2)	2,061(8.6)	1.75(1.55, 1.98)	0.012
Richer	27,306(21.9)	3,138(11.5)	2.42(2.14, 2.74)	< 0.001
Richest	30,881(24.8)	4,975(16.1)	3.51(3.10, 3.98)	< 0.001
Sex of household head				
Male	87,368(70.0)	8,138(9.3)	Ref.	
Female	37,419(30.0)	4,696(12.6)	1.36(1.28, 1.45)	< 0.001
Community-level poverty				
High	40,419(32.4)	3,585(8.9)	Ref.	
Moderate	41,19(33.0)	4,041(9.8)	1.16(1.06, 1.26)	< 0.001
Low	43,171(34.6)	5,208(12.0)	1.52(1.41, 1.64)	< 0.001

*Key** divorced, widowed, separated, Ref.: Reference category, cOR: Crude Odds Ratio

educational levels, and richest wealth quintile, multiparous, with a recent history of sexual activity, contraceptive users, visiting health facilities, and listening to radio. This prevalence is lower than in a previous study conducted on DHS data from five SSA countries (19.0%) [15], a systematic review and meta-analysis in the same region by using 29 primary studies (12.87%) [22], the United States (77.5%) [25], and Europe(60.3%) [26]. The low screening rate in the current study compared to the previous study in the same region could be attributed to

Table 4 Distribution of obstetric and health service-related characteristics of respondents: status of cervical cancer screening and bivariable analysis, SSA, 2015–2022

Variable categories	Total Number of Population (%), [*N* = 124,787].	Screened for Cervical cancer [*n* (%)]	cOR (95% CI)	*p*-value
Parity				
Nulliparous	35,097(11.0)	1,410(4.02)	Ref	
Primiparous	20,451(18.7)	2,403(11.8)	3.26(2.95, 3.61)	< 0.001
Multiparous	47,926(53.3)	6,842(14.3)	4.22(3.85, 4.63)	< 0.001
Grand multiparous	21,312(17.0)	2,179(10.2)	3.04(2.74, 3.38)	< 0.001
Contraceptive utilisation				
Non-user	85,353(68.4)	6,389(7.5)	Ref	
Users	39,434(31.6)	6,445(16.4)	2.36(2.23, 2.50)	< 0.001
Recent sexual activity				
Never had sex	17,941(14.4)	214(1.2)	Ref	
Not active in the last 4wk	41,930(33.6)	5,015(12.0)	5.63(4.76, 8.04)	< 0.001
Active in the last 4 weeks	64,914(52.0)	7,605(11.7)	11.70(9.73, 14.07)	< 0.001
Visit health facility within the last 12 months				
Yes	63,370(50.8)	8,873(14.0)	2.40(2.25, 2.56)	< 0.001
No	61,417(49.2)	3,961(6.4)	Ref	
Reading newspaper				
Not at all	98,055(78.6)	7,764(7.9)	Ref	
Less than once a week	15,745(12.6)	2,386(15.2)	2.04(1.91, 2.21)	< 0.001
At least once a week	10,987(8.8)	2,684(24.4)	3.61(3.29, 3.95)	< 0.001
Listening to a radio				
Not at all	56,146(45.0)	3,835(6.8)	Ref	
Less than once a week	26,727(21.4)	2,728(10.2)	1.54(1.41, 1.68)	< 0.001
At least once a week	41,913(33.6)	6,271(15.0)	2.31(2.15, 2.49)	< 0.001
Watching television				
Not at all	56,608(45.4)	3,889(6.9)	Ref	
Less than once a week	17,434(14.0)	1,683(9.6)	1.41(1.29, 1.55)	0.013
At least once a week	50,745(40.7)	7,261(14.3)	2.13(1.98, 2.28)	0.002
Autonomy in decision-making				
Low	27,351(21.9)	2,219(8.1)	Ref	
Middle	11,399(9.1)	1,441(12.6)	1.57(1.40, 1.78)	0.003
High	86,036(69.0)	9,174(10.7)	1.25(1.14, 1.37)	0.012
Distance to a health facility				
Big problem	43,351(34.7)	3,437(7.9)	Ref	
Not a big problem	81,436(65.7)	9,397(11.5)	1.43(1.34, 1.53)	< 0.001
Getting permission to get health service				
Big problem	24,935(20.0)	1,602(6.4)	Ref	
Not a big problem	99,852(80.0)	11,232(11.3)	1.78(1.61, 1.97)	< 0.001
Getting money needed for treatment				
Big problem	67,255(53.9)	5,640(8.4)	Ref	
Not a big problem	57,531(46.1)	7,194(12.5)	1.51(1.42, 1.61)	< 0.001

Key: Ref: Reference category, cOR: Crude Odds Ratio

variations in sample size (124,787 vs. 28,976) and number of countries included (11 vs. 5). Overall, low coverage in the region may be due to limited access and coverage of the screening programs, limited awareness about the screening, location of the program and preferences, unmet need of resources, low prioritization by governments due to multiple competing priorities including infectious disease, limited support during the screening process, and cultural and societal factors such as stigma [16, 27]. Overcoming these challenges and implementing targeted measures are critical for increasing the cervical cancer screening rates in the region. Thus, screening necessitates political support, multisectoral collaboration, equitable access in the context of universal health coverage, effective resource mobilisation, health system strengthening, and active health promotion at all levels [1, 9, 28].

Table 5 Random intercept variances and model fit statistics comparison of multilevel mixed effect logistic regression model

Measures	Model I (null model)	Model II (individual-level factors)	Model III (community-level factors)	Model-IV (full model)
Random effects				
Variance	0.68	0.52	0.61	0.32
ICC	17.13%	13.64%	15.64%	8.86%
AIC	79817.64	68704.5	78984.79	67684.8
BIC	79837.12	68996.8	79014.0	67986.8
PCV	Ref	23.53%	10.29%	52.94%
Model fitness				
Log-likelihood	-39906.8	-34322.3	-39489.4	-34311.4
Deviance	79813.6	68644.6	78978.8	68622.8

Key Ref.: Reference category

Women with a higher level of education are more likely to receive screening services, which is supported by previous studies [15, 22, 26, 29–31]. This could be because women with a higher level of education have better access to health information about the benefits of regular cervical cancer screening, the risks associated with the disease, and the available screening methods, which motivate them to prioritise their health and seek regular screening. Furthermore, women with higher education levels may have better health literacy, decision-making autonomy [32, 33], empowerment [34, 35], and a larger social network, all of which make them more proactive in pursuing preventive measures such as cervical cancer screening. This finding emphasises the need to increase access to cervical cancer screening in women with no formal education.

Women who recently engaged in sexual activity were more likely to be screened for cervical cancer. This is supported by other studies [31, 36]. This may be because of various reasons. To begin, sexually active women are often more cognizant of the risks of cervical cancer and are more inclined to seek regular screenings as part of their overall healthcare [36]. In addition, healthcare providers may prioritise screening for sexually active women because of the higher risk associated with certain sexually transmitted viruses such as human papillomavirus (HPV), which is a key risk factor for cervical cancer. Despite this, the WHO recommends two strategies for cervical cancer prevention in the general population of women: screen-and-treat and screening, triage, and treatment commencing at the age of 30 years with regular screening every 5–10 years [37].

The odds of screening were higher among contraceptive users, which is consistent with previous studies [15, 22, 38]. These women may have better access to healthcare services related to increase screening uptake in the current study. These are more likely to contact healthcare providers for contraception counselling or follow-up, and the health visiting experience was related to a better screening rate in our study. Furthermore, contraception

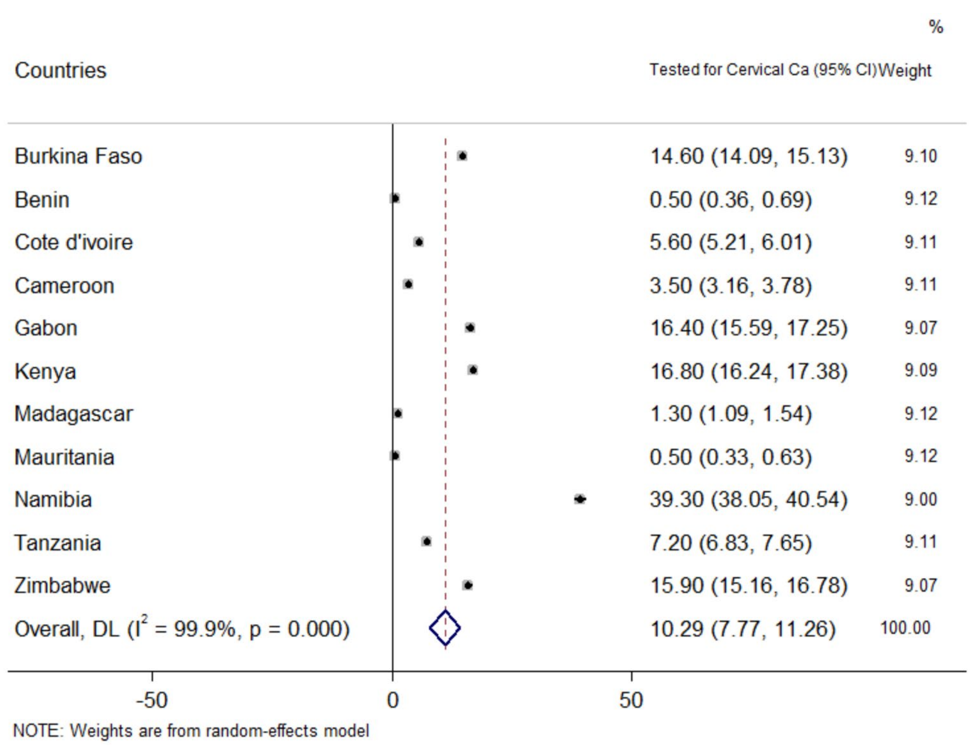

Fig. 2 A forest plot depicting the weighted prevalence of cervical cancer screening in SSA countries, 2015–2022

Table 6 Results of a multilevel mixed-effect multivariable logistic regression analysis to identify the factors affecting the uptake of cervical screening in SSA, 2015–2022

Variable categories	Model I(null model)	Model II (individual-level factors)	Model III (community-level factors)	Model-IV (full model)
	aOR(95% CI)	aOR (95% CI)	aOR (95% CI)	aOR(95% CI)
Current Age				
15–24		Ref.		Ref.
25–34		2.37(2.15, 2.61)		2.36(2.14, 2.59)
35–49		4.14(3.72, 4.61)		4.11(3.69, 4.58)
Marital status				
Cohabited		0.99(0.88, 1.11)		1.00(0.89, 1.12)
Non-marital relation*		1.02(0.89, 1.15)		1.02(0.89, 1.15)
Never in union		Ref.		Ref.
Educational status				
No education		Ref.		Ref.
Primary		1.32(1.01, 1.43)		1.12(0.98, 1.23)
Secondary		1.75(1.58, 1.93)		1.68(1.57, 1.92)
Higher		2.83(2.47, 3.24)		2.71(2.35, 3.23)
Family size				
≤ 5 member		1.05(0.98, 1.11)		1.02(0.97, 1.11)
> 5 member		Ref.		Ref.
Wealth index combined				
Poorest		Ref.		Ref.
Poorer		1.26(1.11, 1.42)		1.21(0.99, 1.40)
Middle		1.27(1.12, 1.43)		1.23(1.08, 1.40)
Richer		1.43(1.26, 1.62)		1.34(1.17, 1.52)
Richest		1.60(1.40, 1.82)		1.45(1.26, 1.67)
Head of household				
Male		0.82(0.76, 0.87)		0.86(0.77, 1.08)
Female		Ref.		Ref.
Parity				
Nulliparous		Ref.		Ref.
Primiparous		2.16(1.90, 2.45)		2.06(1.88, 2.42)
Multiparous		2.14(1.86, 2.46)		2.14(1.86, 2.46)
Grand multiparous		1.71(1.46, 1.99)		1.61(1.26, 1.79)
Contraceptive utilisation				
Non-user		Ref.		Ref.
Users		1.54(1.45, 1.64)		1.54(1.45, 1.64)
Recent sexual activity				
Never had sex		Ref.		Ref.
Not active in the last 4wk		3.19(2.63, 3.87)		3.16(2.60, 3.83)
Active in the last 4 weeks		3.62(3.00, 4.38)		3.59(2.97, 4.34)
Visit health facility within the last 12 months				
Yes		1.92(1.70, 2.04)		1.83(1.71, 1.95)
No		Ref.		Ref.
Reading newspaper				
Not at all		Ref.		Ref.
Less than once a week		1.17(1.07, 1.28)		1.20(1.00, 1.31)
At least once a week		1.40(1.30, 1.52)		1.18(0.96, 1.65)
Listening to a radio				
Not at all		Ref.		
Less than once a week		1.41(1.30, 1.51)		1.42(1.32, 1.54
At least once a week		1.99(1.81, 2.20)		1.78(1.60, 2.15)
Watching television				
Not at all		Ref.		
Less than once a week		1.05(0.95, 1.15)		1.03(0.94, 1.13)

Table 6 (continued)

Variable categories	Model I(null model)	Model II (individual-level factors)	Model III (community-level factors)	Model-IV (full model)
	aOR(95% CI)	aOR (95% CI)	aOR (95% CI)	aOR(95% CI)
Current Age				
At least once a week		1.20(1.10, 1.30)		1.16(0.97, 1.26)
Autonomy in decision-making				
Low		Ref.		Ref.
Middle		1.06(0.88, 1.13)		1.00(0.88, 1.14)
High		1.02(0.78, 1.14)		0.86(0.78, 1.04)
Distance to a health facility				
Big problem		Ref.		Ref.
Not a big problem		0.96(0.88, 1.04)		0.95(0.87, 1.03)
Getting permission get health service				
Big problem		Ref.		Ref.
Not a big problem		1.32(1.18, 1.49)		
Getting money needed for treatment				
Big problem		Ref.		Ref.
Not a big problem		1.03(0.97, 1.10)		1.14(0.99, 1.21)
Residence				
Urban			1.87(1.71, 2.04)	1.76(1.56, 1.98)
Rural			Ref.	Ref.
Community-level poverty				
High			Ref.	Ref.
Moderate			1.08(0.99, 1.18)	1.06(0.97, 1.17)
Low			1.31(1.21, 1.42)	0.97(0.88, 1.07)

Key Ref.: Reference category, AOR = Adjusted odds ratio; ** statistically significant at p-value < 0.05

use may be a marker of sexual activity and the perceived risk of sexually transmitted illnesses, such as human papillomavirus (HPV). As a result, they may be more motivated to seek cervical cancer screening [38], pointing the importance of integrating cervical cancer screening with existing contraceptive programs.

Urban residents and those in higher wealth quintiles had a higher chance of being screened for cervical cancer, which is in line with similar studies [15, 22, 39–42]. Women from urban settings have better access to healthcare facilities that offer cervical cancer screening services and better access to health education, and information on preventive healthcare measures [42]. Similarly, women in higher wealth quintiles may have better access to information and resources as well as financial means to access health service delivery points where screening is readily available [40]. Thus, stakeholders in the health sector need to devise policies that promote universal access to healthcare services to address residential and economic disparities in cervical cancer screening rates.

In line with other studies [43, 44], the likelihood of getting screened was higher among multiparous women. As those women are more likely to be in an age group (over 30 years) where cervical screening is highly recommended, they have a higher chance of being included in regular screening programs [37]. This was also supported by another finding of this study that there was a significant positive association between cervical cancer screening and advanced age (35–49 years). These findings should be interpreted with caution, and healthcare providers should encourage all women, regardless of parity status, to be checked for cervical cancer.

This study had both strengths and limitations. To the best of our knowledge, this is the first study in the SSA region to investigate the prevalence and determinants of cervical cancer screening with a larger sample size and most recent data from multiple countries; this makes the findings generalised to women across the region. Furthermore, due to the clustering effect of the DHS data, a multilevel analysis was performed, and the findings at the individual and community levels are vital for developing contextual interventions to improve cervical cancer screening in these regions. As the study was relied on secondary data, there were a possibilities of inherent bias (i.e. bias present in the data process itself due to sampling design, data collection methods, or respondent characteristics). In addition, because the responses were self-reported, there was a chance of social desirability and recall bias. Furthermore, due to the cross-sectional nature of the initial survey, establishing a causal relationship between the outcome of interest and predictors may be difficult.

Conclusion

The prevalence of cervical cancer screening in SSA was found to be low. Higher screening was observed among women of advanced age (35–49 years), living in urban, had higher educational levels, being in the richest wealth quintile, multiparous, had recent history of sexual activity, used contraceptive, visited health facilities, and listened radio. Strengthening awareness campaigns, health education, promoting universal health coverage, and screening program access with an emphasis on rural areas and low socioeconomic status are key to improving cervical cancer screening rates and equity. Additionally, integrating cervical cancer screening with existing reproductive health programs, e.g. contraceptive service would be important. Finally, the DHS office should enhance efforts to disseminate a consistent approach to data collection on cervical cancer (knowledge, screening, and treatment) across all countries.

Abbreviations

AOR	Adjusted odds ratio
AIC	Akaike's Information Criterion
BIC	Bayesian Information Criterion
ICC	Intraclass Correlation Coefficient
HPV	Human Papilloma Virus
PCV	Proportionate Change in Variance
SSA	Sub-Saharan African
WHO	World Health Organization

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Author contributions
AHH was involved in the design, Literature review, Screening, analysis and interpretation, and manuscript writing from the beginning. HMB and LLT contributed to data analysis and interpretation, as well as drafting and editing the manuscript for final submission. All authors read and approved the final manuscript prior to submission.

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Data availability
The data for this study were obtained from the DHS program with a reasonable request. Thus, the one who needs the data supporting the findings of this study can get it in anonymised form from the DHS website at https://dhsprogram.com/Countries/ upon reasonable request in the same manner as the authors did.

Declarations

Ethics approval and consent to participate
All methods and procedures were carried out per the relevant guidelines and regulations of the Declaration of Helsinki. The DHS office provided written permission to use the DHS datasets following registration. Furthermore, as this is secondary data, the ethics committee of Wachemo University College of Medicine and Health Sciences declared that no formal ethics approval was required, with a written letter at the reference number (WCU/337/2023).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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