original reports abstract

Burden of Risk Factors for Cervical Cancer Among Women Living in East Africa: An Analysis of the Latest Demographic Health Surveys Conducted Between 2014 and 2017

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PURPOSE In East Africa, cervical cancer is a leading cause of morbidity and mortality among women diagnosed with cancer. In this study, we describe the burden of risk factors for cervical cancer among women of reproductive age in five East African countries.

METHODS For each country, using STATA13 software and sampling weights, we analyzed the latest Demographic and Health Survey data sets conducted between 2014 and 2017 in Burundi, Kenya, Rwanda, Tanzania, and Uganda. We included women age 15-49 years and considered six risk factors (tobacco use, body mass index, age at first sexual intercourse, age at first birth, number of children, and hormonal contraceptive use).

RESULTS Of the 93,616 women from the five countries, each country had more than half of the women younger than 30 years and lived in rural areas. Pooled proportion of women with at least one risk factor was 89% (95% CI, 87 to 91). Living in a rural area in Burundi (adjusted incidence rate ration 0.94; 95% CI, 0.9 to 0.99; $P = .019$) and Rwanda (adjusted incidence rate Ration 0.92; 95% CI, 0.88 to 0.96; $P < .001$) was associated with a lower number of risk factors compared with living in an urban area. In all the countries, women with complete secondary education were associated with a lower number of risk factors compared with those with no education.

CONCLUSION This study reveals a high burden of risk factors for cervical cancer in East Africa, with a high proportion of women exposed to at least one risk factor. There is a need for interventions to reduce the exposure of women to these risk factors.

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INTRODUCTION

Cervical cancer is one of the leading causes of morbidity and mortality among women in the low- and middle-income countries.[1] In East Africa, cancer of the cervix is the leading cause of cancer-related morbidity and mortality, with one of the incidence rates above 40 cases per 100,000 of the population.[1]

In August 2020, the World Health Assembly adopted the global strategy to accelerate the elimination of cervical cancer as a public health problem.[2] To eliminate cervical cancer, all countries must reach and maintain an incidence rate of below four per 100,000 women. Understanding where countries stand in terms of the burden of risk factors for cervical cancer can enable countries to design interventions that reduce the exposure of women to these risk factors.

Tobacco smoking, age at first sexual intercourse (AFSI), diet, parity, and use of hormonal contraceptives are associated with cervical cancer risk.[3,4] Among the smokers, the duration of the oncogenic human papillomavirus (HPV) infection increases with a reduction in the probability of self-clearing of oncogenic infections, resulting in early carcinogenic events.[3] The risk of developing cervical adenocarcinoma in obese and overweight women is twofold than for other women.[4] Early AFSI and age at first pregnancy are interrelated in most low-income countries. A case-control study done by Louie et al[5] found that the risk of invasive cervical carcinoma was 2.4-fold among women who reported the age of first sexual intercourse and age of first pregnancy ≤ 16 years compared with those with an age of first sexual intercourse and age of first pregnancy ≥ 21 years. In a population-based cohort study with a follow-up period of 13 years, women with a persistent HPV infection who had given birth had a significantly increased risk for CIN3+, with a hazard ratio for diagnosis of CIN3+ of 1.78.[6] Current or recent long-term use (more than 5 years) of oral contraceptives is associated with an increased risk of cervical cancer of about 2- to 3-fold.[4,7]

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CONTEXT

Key Objective

Various risk factors such as tobacco use, overweight or obesity, early sexual debut, early age at first birth, number of children, and hormonal contraceptive use have been associated with the risk of developing cervical cancer among women. This study sought to describe the burden of known risk factors for cervical cancer in the population of East Africa using nationally representative population-based surveys.

Knowledge Generated

Overall, there was a high burden of risk factors for cervical cancer with majority of women having at least one risk factor. Factors associated with these risk factors vary by country.

Relevance

To achieve cervical cancer control, there is need to design interventions to reduce the exposure to cervical cancer risk factors identified by this study. Also, the interventions need to be tailored to country-specific cancer control plans.

The Demographic and Health Surveys (DHS) program conducts nationally representative household sample surveys with coverage of a range of population health indicators in low- and middle-income countries.[8] The DHS program was established in 1984, and by 2011, surveys had been conducted in 85 countries, with at least two surveys conducted in 57 of these countries.[8] By 2011, Uganda, Kenya, Tanzania, and Rwanda had conducted five surveys each, and Burundi had conducted only two surveys.[8]

In this study, we describe the burden of the risk factors for cervical cancer in five East African countries, using data from the recent Demographic and Health Surveys conducted in these countries, to inform interventions that can reduce the incidence of cervical cancer.

METHODS

Study Design and Setting

The DHS are internationally comparable household surveys that collect information on demographic, socioeconomic, and health-related variables among nationally representative samples of households in developing countries. Details of the DHS sampling design and strategies are described elsewhere.[8]

The data used in this study were obtained from the latest standard DHS conducted between 2010 and 2019 in five East African countries, such as Burundi, Kenya, Rwanda, Tanzania, and Uganda. South Sudan was not included because they had not performed any DHS between 2010 and 2019. The latest DHS in Burundi was conducted in 2016-2017, Kenya in 2014, Rwanda in 2014-2015, Tanzania in 2015-2016, and Uganda in 2016.

Study Population

In this study, we analyzed data of women age 15-49 years found in the DHS final data sets of their respective countries. In the DHS in the countries included in this study, these women were interviewed as part of the household.

Data Management

DHS final data sets for the respective countries were obtained after seeking permission from the DHS program website. The variables from the DHS that were used in this study which measured the six risk factors for cervical cancer are described in Table 1.

Tobacco smoking in the DHS data sets was measured as either never used tobacco (nonexposure) or ever used/uses tobacco (exposure). Body mass index (BMI) in the DHS data set was measured as a continuous variable but was transformed (Table 1) into a binary variable with BMI $\geq$ 25 kg/m^2 being the exposure and BMI $<$ 25 kg/m^2 being the nonexposure. AFSI was initially measured as a continuous variable but was transformed into a binary variable with AFSI $\leq$ 17 years being the exposure and AFSI $>$ 17 years being the nonexposure.[9] Age at first birth (AFB) was initially measured as a continuous variable but was transformed into a binary variable with AFB $\leq$ 19 years being the exposure and AFB $>$ 19 years being the nonexposure.[9] The number of children (NoC) was initially measured as a continuous variable but was transformed into a binary variable with NoC $>$ 2 being the exposure and NoC $\leq$ 2 being the nonexposure.[9] The family planning (FP) method used in the DHS was measured as a categorical variable but was transformed into a binary variable with exposure being the use of hormonal FP methods and nonexposure as either the use of nonhormonal contraceptives or no use of any FP method.[4] The total number of risk factors per woman was not a variable in the DHS but was generated by first giving a score of 1 for every exposure to a cervical cancer risk factor and a score of 0 for every nonexposure, and then summing up the scores for each woman. The minimum possible score is 0 while the maximum possible score is 6 (Table 1).

Data Analysis

All the analysis in this study was performed in STATA13, and each country's data set was analyzed separately.[10]

TABLE 1. Description of Risk Factor Variables for Cervical Cancer From the DHS and Risk Factor Variables Used in This Study

	Original Variable Label in DHS Data Set	Original Variable Name in DHS Data Set	How Variable Was Measured in the DHS Data Set	Creation of New Variable	How Variable Used in the Study Was Transformed	How Variable Was Measured
1	Does not use cigarettes and tobacco	v463z	0. No 1. Yes, smokes nothing	Tobacco use (uses tobacco)	A new variable was generated and recoded	0. Never used tobacco 1. Ever used or uses tobacco
2	Weight Height	v437 v438	Woman's weight in kilograms (one decimal) Woman's height in centimeters (one decimal)	1. Weight and height are both divided by 10 2. Height is converted to meters 3. BMI is calculated by dividing weight by the square of height in meters	Transformed into a binary variable (low-risk BMI *v* high-risk BMI)	0. Low-risk BMI: under and normal weight if BMI is < 25 kg/m^2 (nonexposure) 1. High-risk BMI: overweight and obese if BMI is ≥ 25 kg/m^2 (exposure)
3	AFSI	v525	Measured in complete years	At $>$ 17 years versus at 17 years or less	Categorized into a binary variable (at $>$ 17 years *v* at 17 years or less) Values 0, 96, 97, and 98 were removed	0. Delayed sexual debut if AFSI is $>$ 17 years (nonexposure) 1. Early sexual debut if AFSI is $\leq$ 17 years (exposure)
4	AFB	v212	Measured in complete years	At $>$ 19 years versus at 19 years or less	Categorized into a binary variable (at $>$ 19 years *v* at 19 years or less)	0. Delayed AFB ($>$ 19 years) (nonexposure) 1. Early AFB (earlier than 19 years) (exposure)
5	NoC	v201	Count of the NoC	Two or fewer children versus more than two children	Categorized into a binary variable (two or fewer children *v* more than two children)	0. Women with two or fewer children (nonexposure) 1. Women with more than two children (exposure)
6	FP method	v312	0. Not using 1. Pill 2. IUD 3. Injections 4. Diaphragm 5. Male condom 6. Female sterilization 7. Male sterilization 8. Periodic abstinence 9. Withdraw 10. Other traditional 11. Implants/ Norplant 12. Prolonged abstinence 13. Lactational amenorrhea 14. Female condom 15. Foam or jelly 16. Emergency contraception 17. Other modern methods 18. Standard days methods 19-23. Other nonhormonal methods	0 coded as no FP use 1, 3, 11, and 16 recoded as hormonal contraception 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, and 23 recoded as nonhormonal contraception	Categorized into a binary variable (no FP use *v* use hormonal FP methods)	0. No FP use when a woman uses neither any FP method nor nonhormonal FP method (nonexposure) 1. Hormonal FP method when a woman used hormonal FP methods (exposure)

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TABLE 1. Description of Risk Factor Variables for Cervical Cancer From the DHS and Risk Factor Variables Used in This Study (Continued)

	Original Variable Label in DHS Data Set	Original Variable Name in DHS Data Set	How Variable Was Measured in the DHS Data Set	Creation of New Variable	How Variable Used in the Study Was Transformed	How Variable Was Measured
7	NA	NA	NA	Number of risk factors	This is a new variable created from the total number of risk factors a woman is exposed to out of the six risk variables studied	Minimum is 0 and maximum is 6

Abbreviations: AFB, age at first birth; AFSI, age at first sexual intercourse; BMI, body mass index; DHS, Demographic and Health Surveys; FP, family planning; IUD, intrauterine device; NA, not available; NoC, number of children.

Weighting was performed for all the descriptive statistics using the weight variable (v005) after dividing it by 1,000,000.

$$\text{weight (wgt)} = \frac{\text{v005 (weight variable)}}{1,000,000}$$

For the regression analysis in STATA13, weighting was also performed using the primary sampling unit and strata as the variables v021 and v022 in the DHS data sets for the respective countries and weight (wgt) calculated previously. The STATA13 code below was used to apply weights for regression analysis.

svyset v021 [pw = wgt], strata (v022) singleunit (centered)

where pw is the probability weight (sampling weight), PSU is primary sampling unit, v021 is the variable for the primary sampling unit, and v022 is the variable in the DHS that indicates the strata used in the DHS.

Quality Control

For all the country data sets, test analysis was done to replicate some of the tables in the DHS reports for the respective countries.

Summary Statistics

Categorical variables were summarized as weighted proportions by type of place. For the numerical variables such as age, they were summarized as weighted means with 95% CIs.[10]

Regression Analysis

We used multivariate Poisson regression to determine the association between women's demographic characteristics and the number of cervical cancer risk factors they have and reported incidence risk ratios (IRRs), *P* values, and 95% CIs. First, bivariate Poisson regression was used for the association between the number of cervical cancer risk factors a woman has and the women's demographic factors. Then, multivariate Poisson regression was used including 5-year age group, type of place (rural vs urban), literacy levels, wealth index combined, working status, education attainment, and woman's marital status.

RESULTS

Demographic Characteristics of the Study Participants

The demographic characteristics of the participants included in the study are described in Table 2. The age of the majority of the participants was 15-19 years in Burundi (22.34%), Rwanda (20.51%), Tanzania (21.89%), and Uganda (23.04%). In all the countries, the majority of the participants lived in a rural area with the highest in Burundi (87.07%) and the lowest in Kenya (59.17%). The majority of the participants in all five countries were able to read a whole sentence and were either currently in union or living with a male partner. Also, in all five countries, the participants had either incomplete primary or completed primary school education and were either in the poorest or poorer category of wealth index (Table 2).

The Proportion of Women With Various Risk Factors for Cervical Cancer

The proportion of various risk factors among women in the various countries is described in Table 3. In all the countries, the majority of the women had never used tobacco and were neither obese nor overweight, with the lowest proportion of obese or overweight women in Burundi (8.41%). The majority of the participants started sexual intercourse at 17 years or younger with the highest proportion among women from Uganda (72.38%) and the lowest among women from Burundi (52.3%). The lowest mean age (18.67 ± 3.33) at first birth was among women from Uganda, and the highest mean AFB (21.71 ± 3.56) was among women from Rwanda. In all the countries, the majority of the women had delivered two or fewer children and had used nonhormonal methods of FP. The majority of the women in all countries had one risk factor for cervical cancer (Table 3). Figure 1 displays the proportion of women with exposures to cervical cancer risk factors in East Africa.

Factors Associated With the Number of Risk Factors per Individual Woman

In adjusted Poisson regression analysis, being 20-24 years, 25-29 years, 30-34 years, 35-39 years and 40-44 years, and 45-49 years was associated with a higher number of risk factors compared with women age 15-19 years (Table 4). Being in a rural area in Burundi (adjusted IRR

TABLE 2. Demographic Characteristics of Women in East Africa Countries

	Burundi 2016-2017 DHS (n = 17,269)	Kenya 2014 DHS (n = 31,079)	Rwanda 2014-2015 DHS (n = 13,497)	Tanzania 2015-2016 DHS (n = 13,266)	Uganda 2016 DHS (n = 18,506)
Age (weighted), mean (95% CI)	28.26 (28.12 to 28.39)	28.88 (28.73 to 29.02)	28.77 (28.60 to 28.93)	28.69 (28.51 to 28.87)	27.93 (27.79 to 28.08)
5-Year age groups, No. (%)					
15-19	3,859 (22.34)	5,820 (18.73)	2,768 (20.51)	2,904 (21.89)	4,264 (23.04)
20-24	3,244 (18.79)	5,735 (18.45)	2,457 (18.21)	2,482 (18.71)	3,822 (20.65)
25-29	3,002 (17.39)	6,100 (19.63)	2,300 (11.04)	2,125 (16.02)	3,051 (16.49)
30-34	2,443 (14.14)	4,510 (14.51)	2,151 (15.93)	1,752 (13.21)	2,543 (13.74)
35-39	1,967 (11.39)	3,773 (12.14)	1,575 (11.67)	1,641 (12.37)	2,011 (10.87)
40-44	1,545 (8.95)	2,885 (9.28)	1,269 (9.40)	1,364 (10.28)	1,608 (8.69)
45-49	1,209 (7.00)	2,257 (7.26)	977 (7.24)	997 (7.51)	1,207 (6.52)
Type of place, No. (%)					
Urban	2,232 (12.93)	12,690 (40.83)	2,626 (19.45)	4,811 (36.27)	4,943 (26.71)
Rural	15,037 (87.07)	18,389 (59.17)	10,871 (80.55)	8,455 (63.73)	13,563 (73.29)
Literacy levels, No. (%)					
Cannot read at all	5,516 (31.94)	3,640 (11.74)	2,640 (19.58)	3,068 (23.13)	5,811 (31.40)
Able to read only parts of sentence	808 (4.68)	2,583 (8.33)	1,012 (7.51)	584 (4.40)	2,215 (11.97)
Able to read whole sentence	10,910 (63.18)	24,704 (79.68)	9,813 (72.80)	9,695 (72.41)	10,353 (55.94)
No card with required language	—	9 (0.03)	3 (0.03)	1 (0.01)	98 (0.53)
Blind or visually impaired	37 (0.19)	69 (0.22)	12 (0.09)	6 (0.05)	29 (0.16)
Wealth index combined, No. (%)					
Lowest (poorest)	3,310 (19.16)	4,838 (15.57)	2,561 (18.98)	2,246 (16.93)	3,247 (17.54)
Second (poorer)	3,432 (19.87)	5,457 (17.56)	2,631 (19.50)	2,274 (17.14)	3,397 (18.35)
Middle	3,456 (20.02)	6,032 (19.41)	2,597 (19.24)	2,328 (17.55)	3,460 (18.69)
Fourth (richer)	3,370 (19.52)	6,550 (21.07)	2,634 (19.52)	2,822 (21.27)	3,683 (19.90)
Highest (richest)	3,701 (21.43)	8,202 (26.39)	3,073 (22.77)	3,596 (27.11)	4,720 (25.50)
Currently working, No. (%)					
No	3,832 (22.19)	5,620 (38.48)	2,996 (22.23)	3,667 (27.66)	4,986 (26.94)
Yes	13,437 (77.81)	8,987 (61.52)	10,483 (77.77)	9,592 (72.34)	13,520 (73.06)
Women's educational attainment, No. (%)					
No education	6,259 (36.25)	2,176 (7.00)	1,665 (12.33)	1,946 (14.67)	1,781 (9.63)
Incomplete primary	4,452 (25.78)	7,989 (25.71)	5,761 (42.68)	1,559 (11.75)	8,257 (44.62)

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TABLE 2. Demographic Characteristics of Women in East Africa Countries (Continued)

	Burundi 2016-2017 DHS (n = 17,269)	Kenya 2014 DHS (n = 31,079)	Rwanda 2014-2015 DHS (n = 13,497)	Tanzania 2015-2016 DHS (n = 13,266)	Uganda 2016 DHS (n = 18,506)
Complete primary	2,323 (13.45)	7,637 (24.57)	2,918 (21.62)	6,652 (50.14)	2,373 (13.82)
Incomplete secondary	3,891 (22.53)	4,922 (15.84)	2,135 (15.82)	1,283 (9.67)	4,345 (23.48)
Complete secondary	129 (0.75)	4,880 (15.78)	655 (4.85)	1,642 (12.38)	294 (1.58)
Higher	215 (1.24)	3,475 (11.18)	363 (2.69)	183 (1.38)	1,456 (7.87)
Currently, formerly, or never in union, No. (%)					
Never in union	5,967 (34.55)	8,996 (28.95)	5,100 (37.79)	33,353 (25.28)	4,783 (25.84)
Currently in union or living with a man	9,782 (56.64)	18,549 (59.68)	6,982 (51.73)	8,210 (61.89)	11,223 (60.65)
Formerly in union or living with a man	1,521 (8.81)	3,533 (11.37)	1,415 (10.48)	1,703 (12.83)	2,500 (13.51)

Abbreviation: DHS, Demographic and Health Surveys.

TABLE 3. Proportion of Women With Risk Factors for Cervical Cancer in East Africa Countries

	Burundi 2016-2017 DHS (n = 17,269)	Kenya 2014 DHS (n = 31,079)	Rwanda 2014-2015 DHS (n = 13,497)	Tanzania 2015-2016 DHS (n = 13,266)	Uganda 2016 DHS (n = 18,506)
Use of tobacco, No. (%)					
Never	16,328 (94.55)	30,869 (99.33)	13,202 (97.82)	13,145 (99.09)	18,211 (98.40)
Ever used or uses tobacco	941 (5.45)	207 (0.67)	294 (2.18)	121 (0.91)	295 (1.60)
BMI, No. (%)					
Underweight	1,530 (17.75)	1,220 (8.55)	409 (6.12)	1,140 (8.66)	486 (8.09)
Normal	6,366 (73.84)	8,374 (58.66)	4,793 (71.69)	8,230 (62.51)	4,063 (67.59)
Overweight	572 (6.64)	3,242 (22.71)	1,224 (18.30)	2,493 (18.94)	1,034 (17.20)
Obese	153 (1.77)	1,439 (10.08)	259 (3.88)	1,303 (9.89)	428 (7.12)
BMI binary, No. (%)					
Neither overweight nor obese	7,896 (91.59)	9,594 (67.21)	5,202 (77.82)	9,370 (71.17)	4,550 (75.68)
Either overweight or obese	725 (8.41)	4,680 (32.79)	1,483 (22.18)	3,796 (28.83)	1,462 (24.32)
AFSI					
Mean	19.02	17.14	18.75	16.82	16.55
95% CI	18.92 to 19.11	17.05 to 17.22	18.60 to 18.9	16.72 to 16.91	16.48 to 16.61
Binary categories of AFSI, No. (%)					
At > 17 years	8,237 (47.70)	8,867 (34.88)	2,484 (33.44)	3,997 (30.13)	5,109 (27.62)
At 17 years or less	9,032 (52.30)	16,551 (65.12)	4,944 (66.56)	9,269 (69.87)	13,386 (72.38)
Age of respondent at first birth					
Mean	20.67	19.58	21.71	19.29	18.67
95% CI	20.57 to 20.77	19.49 to 19.66	21.62 to 21.80	19.19 to 19.4	18.59 to 18.76
Binary categories of AFB, No. (%)					
At > 19 years	6,655 (58.59)	10,430 (45.40)	6,339 (71.80)	3,805 (38.46)	4,626 (33.79)
At 19 years or less	4,704 (41.41)	12,543 (54.60)	2,489 (28.20)	6,088 (61.54)	9,066 (66.21)
Total children ever born					
Mean	2.71	2.48	2.28	2.74	3.08
95% CI	2.66 to 2.77	2.43 to 2.53	2.23 to 2.32	2.67 to 2.81	3.02 to 3.14
Categories of children delivered, No. (%)					
Two or fewer children	9,478 (54.88)	18,206 (58.58)	8,397 (62.21)	7,412 (55.87)	9,555 (51.63)
More than two children	7,791 (45.12)	12,873 (41.42)	5,100 (37.79)	5,854 (44.13)	8,951 (48.37)
Contraceptive usage, No. (%)					
None	14,180 (82.11)	17,841 (57.41)	9,329 (69.12)	8,965 (67.58)	12,905 (69.73)
Nonhormonal	917 (5.31)	2,791 (8.98)	902 (6.69)	1,609 (12.13)	1,664 (8.99)
Hormonal	2,172 (12.58)	10,447 (33.61)	3,266 (24.20)	2,692 (20.29)	3,937 (21.28)
Hormonal versus nonhormonal (nonhormonal + no FP use) FP methods, No. (%)					
Nonhormonal	15,097 (87.42)	20,632 (66.39)	10,231 (75.80)	10,574 (79.71)	14,569 (78.72)
Use hormonal FP methods	2,172 (12.58)	10,447 (33.61)	3,266 (24.20)	2,692 (20.29)	3,937 (21.28)
Total number of risk factors (included missing BMI), No. (%)					
0	2,009 (11.64)	3,664 (11.79)	2,042 (15.13)	1,005 (7.58)	1,650 (8.92)
1	9,151 (52.99)	10,788 (34.71)	7,116 (52.72)	4,092 (30.85)	5,985 (32.34)
2	3,008 (17.42)	7,227 (23.25)	2,906 (21.53)	3,076 (23.19)	3,877 (20.95)

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TABLE 3. Proportion of Women With Risk Factors for Cervical Cancer in East Africa Countries (Continued)

	Burundi 2016-2017 DHS (n = 17,269)	Kenya 2014 DHS (n = 31,079)	Rwanda 2014-2015 DHS (n = 13,497)	Tanzania 2015-2016 DHS (n = 13,266)	Uganda 2016 DHS (n = 18,506)
3	2,291 (13.27)	5,981 (19.25)	1,118 (8.28)	3,127 (23.58)	4,816 (26.03)
4	723 (4.19)	2,976 (9.57)	283 (2.10)	1,632 (12.38)	1,982 (10.71)
5	86 (0.50)	438 (1.41)	32 (0.24)	331 (2.50)	193 (1.04)
6	0 (0)	3 (0.01)	0 (0)	2 (0.01)	3 (0.01)

Abbreviations: AFB, age at first birth; AFSI, age at first sexual intercourse; BMI, body mass index; DHS, Demographic and Health Surveys; FP, family planning.

[aIRR] 0.94; 95% CI, 0.9 to 0.99; $P = .019$) and Rwanda (aIRR 0.92; 95% CI, 0.88 to 0.96; $P < 0.001$) was associated with a lower number of risk factors among women compared with women in urban areas. In Burundi (aIRR 0.53; 95% CI, 0.46 to 0.61; $P < .001$), Kenya (aIRR 0.83; 95% CI, 0.77 to 0.89; $P < .001$), Rwanda (aIRR 0.80; 95% CI, 0.74 to 0.87; $P < .001$), Tanzania (aIRR 0.61; 95% CI, 0.57 to 0.66; $P < .001$), and Uganda (aIRR 0.65; 95% CI, 0.57 to 0.74; $P < .001$), having a complete secondary education was associated with the lowest number of risk factors for cervical cancer compared with women with no education. In Burundi (aIRR 0.94; 95% CI, 0.90 to 0.97; $P = .001$), being in the second wealth index (poorer) was associated with a lower number of cervical cancer risk factors. In Kenya (aIRR 1.08; 95% CI, 1.04 to 1.11; $P < .001$) and Uganda (aIRR 1.04; 95% CI, 1.02 to 1.07; $P < .001$), being in the second wealth index (poorer) was associated with a higher number of risk factors among women. In Kenya (aIRR 1.1; 95% CI, 1.07 to 1.13; $P < .001$) and Tanzania (aIRR 1.08; 95% CI, 1.05 to 1.11; $P < .001$), women who work were associated with a higher number of cervical cancer risk factors. In Burundi (aIRR 0.94; 95% CI, 0.91 to 0.97; $P < .001$), women who work were associated with a lower number of cervical cancer risk factors (Table 4). Figure 2 displays the number of women with a given number of risk factors ranging from none to six risk factors.

Figure 3 shows a forest plot for the meta-analysis of data on the number of risk factors an individual woman had. Pooled proportion of women with at least one risk factor for cervical cancer was 89% (95% CI, 87 to 91).

DISCUSSION

In this study, we describe the burden of risk factors for cervical cancer in women of reproductive age (15-49 years) using DHS data from five East African countries. This study found that there are consistencies in some risk factors for cervical cancer. For example, the proportion of women who smoke is generally low in all five countries. There also exist inconsistencies in the burden of risk factors, for example, Uganda and Tanzania, had earlier sexual debuts and had younger ages at first birth. Also, there is a high proportion of women with exposure to at least one risk factor for cervical cancer. From this study, age, type of place of residence

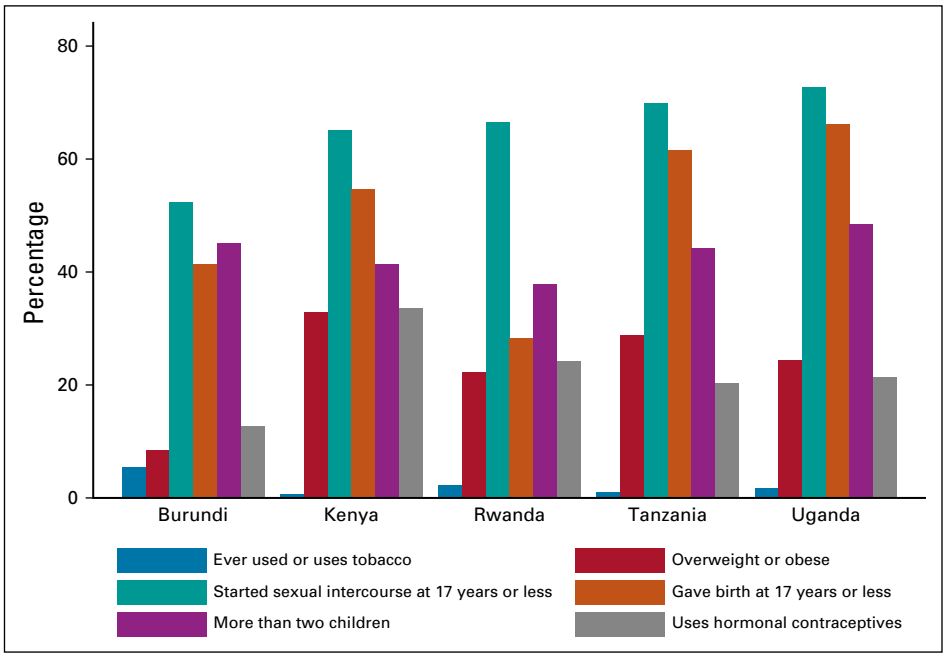

FIG 1. Proportion of women exposed to risk factors for cervical cancer among women in East Africa.

TABLE 4. Demographic Characteristics Associated With the Number of Risk Factors for Cervical Cancer Among Women in East Africa

Characteristic	Burundi aIRR (95% CI)	Kenya aIRR (95% CI)	Rwanda aIRR (95% CI)	Tanzania aIRR (95% CI)	Uganda aIRR (95% CI)
Age of the woman in 5-year groups, years					
15-19	1	1	1	1	1
20-24	0.93 (0.9 to 0.96)***	1.05 (0.99 to 1.11)*	0.85 (0.81 to 0.88)***	1.12 (1.07 to 1.17)***	1.07 (1.03 to 1.11)***
25-29	1.03 (0.98 to 1.08)*	1.23 (1.16 to 1.30)***	0.84 (0.8 to 0.89)***	1.27 (1.22 to 1.33)***	1.31 (1.26 to 1.36)***
30-34	1.20 (1.15 to 1.26)***	1.36 (1.28 to 1.44)***	1.08 (1.02 to 1.14)***	1.42 (1.36 to 1.48)***	1.45 (1.40 to 1.50)***
35-39	1.21 (1.15 to 1.27)***	1.37 (1.29 to 1.45)***	1.25 (1.18 to 1.32)***	1.43 (1.37 to 1.49)***	1.48 (1.42 to 1.53)***
40-44	1.16 (1.10 to 1.22)***	1.35 (1.27 to 1.43)***	1.22 (1.15 to 1.29)***	1.42 (1.35 to 1.49)***	1.42 (1.36 to 1.48)***
45-49	1.12 (1.06 to 1.18)***	1.34 (1.26 to 1.42)***	1.12 (1.05 to 1.18)***	1.44 (1.37 to 1.50)***	1.32 (1.27 to 1.37)***
Type of place					
Urban	1	1	1	1	1
Rural	0.94 (0.9 to 0.99)**	1.01 (0.97 to 1.04)*	0.92 (0.88 to 0.96)***	0.99 (0.96 to 1.03)*	1.02 (0.99 to 1.06)*
Literacy levels					
Cannot read at all	1	1	1	1	1
Able to read only parts of sentence	0.88 (0.83 to 0.93)***	0.98 (0.93 to 1.03)*	0.96 (0.91 to 1.02)*	1.00 (0.95 to 1.06)*	1.00 (0.97 to 1.03)*
Able to read whole sentence	0.88 (0.85 to 0.91)***	0.99 (0.95 to 1.03)*	0.90 (0.87 to 0.94)***	1.00 (0.96 to 1.04)*	0.96 (0.94 to 0.98)**
No card with required language	—	0.79 (0.75 to 0.84)***	0.93 (0.85 to 1.02)*	1.07 (1.03 to 1.12)**	0.76 (0.65 to 0.88)***
Blind or visually impaired	0.89 (0.7 to 1.13)*	0.99 (0.87 to 1.14)*	0.85 (0.67 to 1.08)*	0.42 (0.11 to 1.68)*	0.98 (0.87 to 1.11)*
Wealth index combined					
Lowest (poorest)	1	1	1	1	1
Second (poorer)	0.94 (0.90 to 0.97)**	1.08 (1.04 to 1.11)***	0.97 (0.93 to 1.003)*	1.02 (0.98 to 1.05)*	1.04 (1.02 to 1.07)***
Middle	0.96 (0.92 to 0.99)**	1.10 (1.07 to 1.14)***	0.99 (0.95 to 1.03)*	1.05 (1.01 to 1.09)**	1.05 (1.02 to 1.08)***
Fourth (richer)	0.98 (0.94 to 1.02)*	1.1 (1.06 to 1.15)***	0.997 (0.96 to 1.04)*	1.09 (1.05 to 1.13)***	1.07 (1.03 to 1.1)***
Highest (richest)	1.01 (0.97 to 1.06)*	1.06 (1.01 to 1.11)**	1.02 (0.97 to 1.07)*	1.05 (1.002 to 1.1)**	1.08 (1.04 to 1.12)***
Currently working					
No	1	1	1	1	1
Yes	0.94 (0.91 to 0.97)***	1.1 (1.07 to 1.13)***	1.01 (0.98 to 1.04)*	1.08 (1.05 to 1.11)***	1.02 (0.99 to 1.04)*
Women's educational attainment					
No education	1	1	1	1	1
Incomplete primary	0.99 (0.95 to 1.03)*	1.20 (1.14 to 1.27)***	0.98 (0.94 to 1.03)*	0.99 (0.95 to 1.04)*	1.03 (1.00 to 1.06)**
Complete primary	0.91 (0.86 to 0.95)***	1.11 (1.05 to 1.18)***	0.95 (0.9 to 1.001)*	0.92 (0.87 to 0.96)***	0.98 (0.94 to 1.02)*
Incomplete secondary	0.83 (0.8 to 0.95)***	1.11 (1.04 to 1.19)***	0.95 (0.89 to 1.01)*	0.85 (0.8 to 0.90)***	0.87 (0.83 to 0.90)***
Complete secondary	0.53 (0.46 to 0.61)***	0.83 (0.77 to 0.89)***	0.80 (0.74 to 0.87)***	0.61 (0.57 to 0.66)***	0.65 (0.57 to 0.74)***
Higher	0.61 (0.55 to 0.67)***	0.64 (0.59 to 0.7)***	0.69 (0.62 to 0.77)***	0.45 (0.39 to 0.52)***	0.52 (0.49 to 0.56)***
Currently, formerly, or never in union					

(Continued on following page)

TABLE 4. Demographic Characteristics Associated With the Number of Risk Factors for Cervical Cancer Among Women in East Africa (Continued)

Characteristic	Burundi aIRR (95% CI)	Kenya aIRR (95% CI)	Rwanda aIRR (95% CI)	Tanzania aIRR (95% CI)	Uganda aIRR (95% CI)
Never in union	1	1	1	1	1
Currently in union or living with a man	1.38 (1.32 to 1.43)***	1.7 (1.61 to 1.78)***	1.28 (1.22 to 1.34)***	1.47 (1.42 to 1.54)***	1.67 (1.61 to 1.74)***
Formerly in union or living with a man	1.37 (1.29 to 1.44)***	1.5 (1.41 to 1.58)***	1.19 (1.12 to 1.25)***	1.43 (1.36 to 1.5)***	1.61 (1.54 to 1.69)***

NOTE. aIRRs were obtained on multivariate Poisson regression after adjusting for type of place, literacy levels, wealth index, working status, education attainment, and whether they are currently, formerly, or never in union with a man. Crude incident rate ratios and aIRR alongside respective 95% CIs and *P* values are displayed.

Abbreviation: aIRR, adjusted incident rate ratio.

*$P > .05$; **$P < .05$; ***$P < .001$.

(rural *v* urban), level of education, and wealth index are associated with the number of risk factors a woman is exposed to.

From this study, the age at first sexual debut and AFB varied between the women in the East African countries. Studies have reported that the average duration between age at first sexual debut and AFB is about 2 years and increases the risk of exposure to HPV.[5] From this study, this duration ranged from 1.65 to 2.96 years. Age at first sexual debut is influenced by peer influence, cigarette smoking, alcohol consumption, poor parental monitoring, and exposure to pornography.[11-13] A study done among 30 sub-Saharan African countries reported the prevalence of first pregnancy among all adolescent girls in SSA ranging from 7.2% in Rwanda to 44.3% in Congo. Also, among adolescents who had ever had sex, the prevalence ranged from 36.5% in Rwanda to 75.6% in Chad.[14] Early initiation of sexual intercourse has been associated with having multiple sexual partners later in life, increasing the likelihood of exposure to HPV infection.[15-17] Cultural differences between countries also account for the differences between countries.[18] Early initiation of sexual intercourse can expose a woman to various sexually transmitted infections such as HIV and the HPV.[16,19,20] From this study, more than half of the women in each country had two or fewer children, which signifies a lower risk for cervical cancer.[4,6] The NoC a woman has can be influenced by the use of FP methods, level of education, and wealth index.[21-23] Also, cultural differences can explain the between-country differences.[24,25]

From this study, less than one in three women in each of the East African countries is either obese or overweight. This is inconsistent with reports from studies from North African countries that also reported a prevalence of obesity

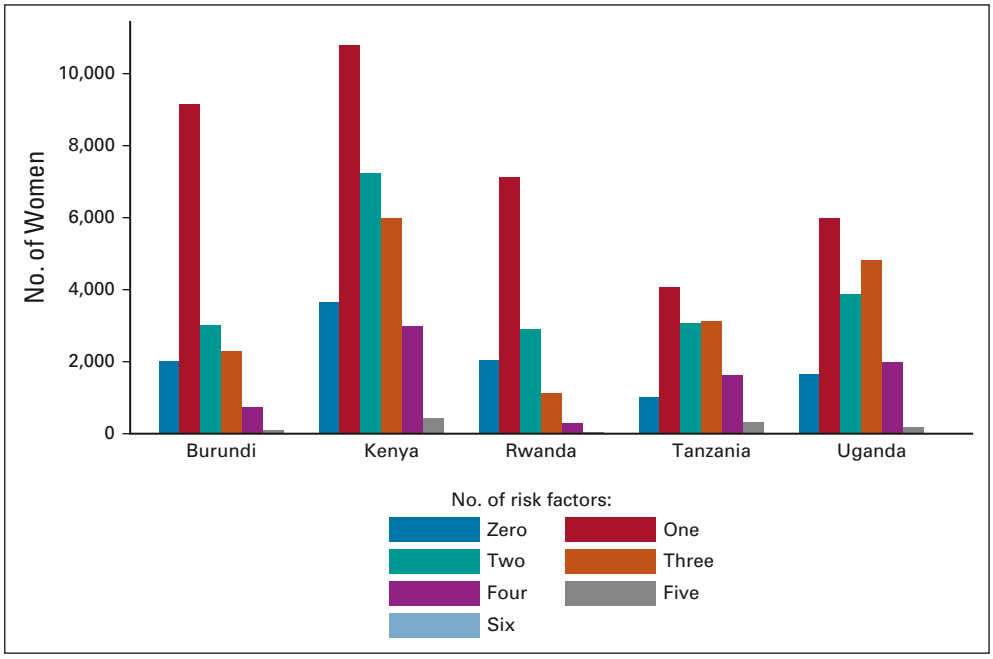

FIG 2. Number of women with an exposure to risk factors for cervical cancer in East Africa.

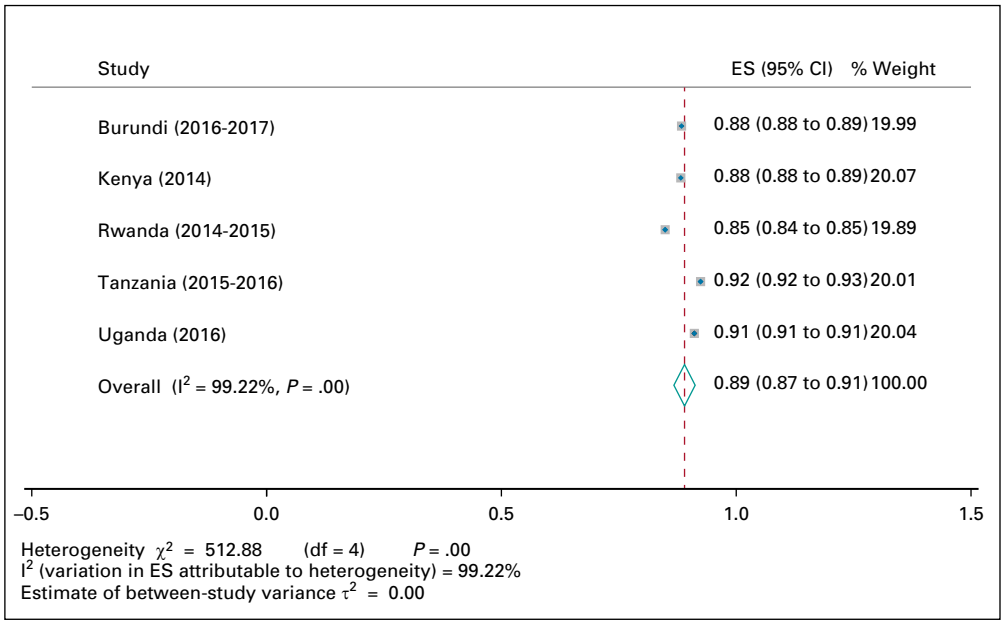

FIG 3. Forest plot of estimates for the proportion of women with at least one cervical cancer risk factor from East African countries. Weighted proportions in the meta-analysis were obtained using the sampling weights of the individual country DHS weights. The years correspond to the year the DHS data was collected. DHS, Demographic and Health Surveys; ES, effect size.

and overweight among women ranging from 1.3% to 47.8%.[26] The prevalence of obesity among women in the United States is generally higher than that reported in this study.[27] Obesity has been associated with a sedentary lifestyle and a western diet.[28-30] However, over the years, there is an increasing trend in obesity in African countries associated with a change in lifestyle.[31,32]

From this study, in all five countries, the proportion of women using tobacco was lower than 6%. This is inconsistent with studies from countries in Europe and the United States, which reported relatively higher proportions of women who use tobacco at 10% to over 30% and 13.5%, respectively.[33,34] This is consistent with studies from other countries in Africa which reported very low proportions of women who use tobacco.[35] Tobacco control policies have reduced the US adult smoking rate.[36] The low levels of tobacco use in East African like other African countries could be associated with campaigns that educate the general population on the dangers of tobacco use and the regulation of the tobacco industry.[37,38] Culture plays a role as women in African countries who use tobacco are said to be immoral and women usually smoke to reduce tension and stimulation.[39-41]

The majority (12.58%-33.61%) of the women in the East African countries do not use hormonal methods of FP. This is consistent with findings from other African countries like 49.1% in South Africa, and 25.7% in Malawi, which reported that hormonal methods of contraception were not popular among women.[42,43] This could be due to limited access, cultural norms, and beliefs.[44-46] Hormonal contraceptive use has been associated with a risk of cervical cancer, and this usually depends on the duration and consistency of use.[7]

From this study, the majority of the women have exposure to at least one risk factor of cervical cancer. Tanzania and Uganda had the highest proportion of women with at least one risk factor for cervical cancer. This perhaps explains why Tanzania and Uganda have the highest incidence of cervical cancer in East Africa.[1] There is limited literature on the level of risk for cervical cancer in women who have exposure to more than one risk factor of cervical cancer. Could this influence the etiology and pathogenesis of cervical cancer? This warrants the development of tools for quantifying the level of risk for cervical cancer in women, for example, the Gail model used to predict the risk for breast cancer in women.[47]

Some of the risk factors for cervical cancer such as HPV status and the number of sexual partners were not captured in the DHS.

The DHS for the different countries were conducted in different years with a difference of 3 years between the earliest and the latest. The incidence of some of the risk factors in some countries where the surveys were conducted earlier might have changed compared with those in countries that conducted them later.

In conclusion, this study highlights a huge burden of risk factors for cervical cancer among women of reproductive age in the five East African countries. It also explores how the various demographic factors influence the number of risk factors a woman is exposed to. A reduction in the burden of risk factors will most likely result in the reduction of the incidence of cervical cancer in East Africa, coupled with other prevention strategies.

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Data analysis and interpretation: All authors
Manuscript writing: All authors
Final approval of manuscript: All authors
Accountable for all aspects of the work: All authors

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

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Open Payments is a public database containing information reported by companies about payments made to US-licensed physicians (Open Payments).

No potential conflicts of interest were reported.

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