

RESEARCH

Open Access



The barriers to cervical cancer screening for urban and rural populations in Rwanda

Hallie Dau^{1,2}, Marianne Vidler³, Maryam AboMoslim^{1,2}, Barbra Mutamba⁴, Zoey Nesbitt¹, John Deodatha⁴, Schadrack Danson Byiringiro⁴, Charles Niyotwiringiye⁴, Nadia Mithani^{1,2}, Varun Nair^{2,5}, Laurie Smith^{2,6}, Stephen Rulisa⁷ and Gina Ogilvie^{1,2,8,9*}

Abstract

Background Cervical cancer is the leading cause of cancer mortality in Rwandan women. There is a limited understanding of the barriers that women face to obtain cervical cancer screening in Rwanda. It is important to understand the barriers in order to implement effective screening programs. The goal of this study is to describe the barriers to cervical cancer screening among women in Rwanda and how they differ among women in rural and urban areas.

Methods This cross-sectional study recruited women from June 1 to 9, 2022, at Muhima and Nyamata District Hospitals in Rwanda. Women were eligible for the study if they were ≥ 18 years and spoke Kinyarwanda or English. Women completed a 15-min survey which included questions on the participants' demographics, knowledge of cervical cancer, cervical cancer screening history, and barriers to healthcare. Women were stratified by survey location (urban vs rural). Descriptive statistics were reported.

Results A total of 374 women completed the survey with 169 participants from Muhima and 205 from Nyamata. Most women were in a relationship and had a primary school or less education. The most common barriers to accessing general healthcare services were long wait times at the facility (Muhima 26%; Nyamata 30%), low quality of care (Muhima 15%; Nyamata 12%), and transportation costs (Muhima 13%; Nyamata 9.3%). However, women from Nyamata were significantly more likely to report distance to the health center as a barrier (p -value < 0.001), and women from Muhima were significantly more likely to report transportation method as a barrier (p -value = 0.004). The primary reason reported for not obtaining cervical cancer screening was that women did not know how or where to get tested (Muhima 57%; Nyamata 51%).

Conclusions The most common barriers to cervical cancer screening in Rwanda were the quality of clinical care and issues with traveling to the clinic. Implementing a cervical cancer self-collection program could help eliminate many barriers that women face to obtain health services in Rwanda. More research is needed to better understand the acceptability of cervical cancer screening in Rwanda and how it could be integrated into the healthcare system.

Keywords Rwanda, Cervical cancer, Screening, Barriers

*Correspondence:

Gina Ogilvie

Gina.Ogilvie@bccdc.ca

Full list of author information is available at the end of the article



© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

Background

Cervical cancer is one of the most preventable types of cancer because of vaccination and effective widespread screening methods. However, globally it remains the fourth most common type of cancer among women [1]. In low- and middle-income countries (LMIC), it has one of the highest incidence and mortality rates among female cancers [2] with sub-Saharan Africa (SSA) carrying the highest burden due to poor infrastructure and financial constraints [1, 3]. The World Health Organization has called for the elimination of cervical cancer, with the ambitious goal of achieving 90–70–90, where 90% of girls are fully vaccinated with the HPV vaccine by 15 years of age, 70% of women are screened at least twice by age 45, and 90% of women with pre-cancer or cancer receive the appropriate care and treatment [4]. While the HPV vaccine is highly effective in reducing the risk of cervical cancer, its affordability and unequal distribution have led to less than 25% of low-income countries administering it as part of their immunization programs [4]. Therefore, screening and treatment of cervical cancer and pre-cancer must be of top priority if cervical cancer is to be eliminated.

The cervical cancer vaccination program in Rwanda has been widely successful. Rwanda was the first African country to implement a national vaccination program against HPV in 2011 [5]. In 2012, the program reached 96.6% coverage of the target population after the catch-up period. As a result, Rwanda has one of the highest HPV vaccination rates in the world [6]. However, while the vaccination program achieved widespread coverage among young girls, challenges remain with cervical cancer screening. Cervical cancer is the leading cause of cancer deaths in Rwandan women [1]. As the vaccine program has only been implemented for approximately 10 years and is offered to girls in grade six [5], many women in Rwanda never received the vaccine as they were too old when the program was initiated [7]. This, in turn, puts them at a higher risk for developing cervical cancer. There is a need to better understand the barriers that women face in Rwanda to access cervical cancer screening in order to implement an efficient program.

Generally, the barriers to cervical cancer screening in LMICs are well known. Commonly reported barriers include knowledge of screening methods [8–10], cost [8, 11], shame [8], awareness of the importance of screening [11], and access to health facilities [9, 10]. While understanding barriers in LMICs as a whole is important, it is also important to consider the country-specific barriers. To date, only one peer-reviewed quantitative study has examined barriers in Rwanda. Niyonsenga et al. published a cross-sectional study in 2021 and reported that the most common barriers were knowledge of availability,

lack of awareness, and living in rural areas [12]. However, this study only sampled women from three district hospitals in urban Kigali.

The overall goal of understanding the barriers to cervical cancer screening is part of a larger aim of this study to determine if self-collection would be an acceptable method for cervical cancer screening in Rwanda. Self-collection for cervical cancer screening has proven to be an accurate low-cost method of HPV testing when compared to other methods such as visual inspection with acetic acid (VIA) [13–15]. Importantly, it has also shown to be highly acceptable among women [16]. A 2010 study by Mitchell et al. in Uganda found that over 80% of women indicated that they were willing to self-collect cervical samples [16]. While the willingness to self-collect has been studied in multiple countries [16–19], there is no knowledge if self-collection would eliminate the barriers to cervical cancer screening in Rwanda. As such, this study aims to describe the perceived barriers to cervical cancer screening among women in Rwanda and how they differ among women in rural and urban areas.

Methods

Data collection

This cross-sectional study surveyed women waiting for health services at Muhima and Nyamata District Hospitals in Rwanda. Muhima and Nyamata districts were chosen as they represent both urban and rural districts in Rwanda. Muhima is an urban hospital located in Kigali and Nyamata is a rural hospital located in the Bugesera district. Each hospital was provided with 150,000 Rwanda Franc (\$140 USD) by the study team as a token of appreciation for their participation in the study. Women were eligible for the study if they (i) were over the age of 18 years, (ii) spoke Kinyarwanda or English, and (iii) were able to provide informed consent. Women were recruited from June 1 to 9, 2022. Participants were recruited from the waiting room by four Rwandan data collectors fluent in both Kinyarwanda and English using convenience sampling. The survey was administered on tablets using REDCap software [20]. All self-reported questions were read aloud to participants and entered into REDCap by the data collectors in real time. Participants were compensated 1050 Rwanda Franc (\$1 USD) for participating in the study.

Measures and analysis

The survey tool consisted of 51 closed-ended questions which took participants approximately 15 min to complete. The survey included questions on the participants' demographics, knowledge of cervical cancer, cervical cancer screening history, barriers to screening, integration of cervical cancer screening services, and

willingness to self-collect for cervical cancer screening. The survey tool is a combination of two survey instruments: (i) the core plus module of the Improving Data for Decision Making in Global Cervical Cancer Programs Toolkit-Part 2 (IDCCP) [21] and (ii) a survey conducted in Kisenyi, Uganda, by Mitchell et al. [16] which is informed by the Theory of Planned Behaviour [22], comprehensive literature reviews, and expert interviews. Module 1 of the IDCCP toolkit includes core questions on screening prevalence, interval, results, and treatment and 14 optional questions.

Perceived barriers to cervical cancer screening were measured using the following survey items. The first item asked women what their biggest challenge was accessing women's health services. Response options included long wait times at the facility, low quality of care, transportation cost, distance to health center, health care workers not receptive, transportation method, lack of awareness of where to get services, no time, partner not supportive, lack of awareness on what services I need, other, not important, or none. The second item asked women what the primary reason was as to why they have never received a cervical cancer screening test. Response options included poor service quality, clinic too far away, family member would not allow it, embarrassment, afraid of the procedure, did not have time, did not know how/where to get the test, other, and do not know.

Participants' demographics were also included in the analysis; this included survey location, marital status, education, religion, age at the first time they had sexual intercourse, number of sexual partners in the last week, comorbidities, number of visits to a health facility in the past 12 months for a reason other than pregnancy, if they had ever been screened for cervical cancer, the most commonly accessed services at a health facility, and willingness to self-collect at their home for cervical cancer screening. Before answering questions about self-collection, data collectors were instructed to read a script on self-collection procedures that included a demonstration. Willingness to self-collect included five response options which were dichotomized into yes–no. The yes category included somewhat likely and very likely. The no category included not sure, somewhat likely, and very unlikely.

All descriptive statistics were calculated using counts and frequencies. Chi-square and Fisher's exact tests with complete cases were used to compare barriers to self-collection between women who completed the survey in Muhima and Nyamata. *P*-values were used to report all significant levels with <0.05 indicating a significant difference between the two groups. Missing values were provided for all variables that contained missing data. All analyses were conducted using R 4.2.3 [23].

Results

The survey was completed by 374 participants in Kinyarwanda (Table 1). No participant completed the survey in English. In all, 169 (44.2%) participants completed the survey in Muhima and 205 (54.8%) in Nyamata. Most women were in a relationship (Muhima $n=123$, 73%; Nyamata $n=164$, 80%; p -value 0.082) and had a primary school or less education (Muhima $n=84$, 51%; Nyamata $n=132$, 65%; p -value 0.009). The majority of women in both groups had made three or more visits to a health facility in the past 12 months for reasons other than antenatal care (ANC) (Muhima $n=82$, 51%; Nyamata $n=121$ 60%; p -value 0.001). Child health (Muhima $n=55$, 33%; Nyamata $n=101$ 50%; p -value <0.001) and acute care (Muhima $n=55$, 33%; Nyamata $n=97$ 47%; p -value 0.004) were the most common reasons for seeking healthcare. When asked about their willingness to self-collect, 80% ($n=135$) of women in Muhima and 96% ($n=196$) of women in Nyamata said yes (p -value = <0.001).

Table 2 shows the most common barriers to accessing women's health services as reported by our surveyed population. Only 9 (5.3%) women in Muhima and 12 (5.9%) in Nyamata indicated no barriers to care (p -value 0.8). The majority of women from both Muhima (60.9%) and Nyamata (65.9%) indicated other for their biggest barrier. However, among the listed options, both women in Muhima and Nyamata indicated that long wait times at the facility were the biggest barrier (Muhima $n=44$, 26%; Nyamata $n=55$, 27%; p -value 0.90). Low quality of care was the second most common barrier (Muhima $n=29$, 17%; Nyamata $n=25$, 12%; p -value 0.20) followed by transportation costs (Muhima $n=22$, 13%; Nyamata $n=25$, 12%; p -value 0.80). Women from Nyamata were significantly more likely to report distance to health center as a barrier (Muhima $n=7$, 4.1%; Nyamata $n=32$, 16%; p -value <0.001) and women from Muhima were significantly more likely to report the transportation method as a barrier to screening (Muhima $n=15$, 8.3%; Nyamata $n=4$, 2.0%; p -value = 0.004). Notably, no women reported that "lack of awareness on what services I need" to be a barrier to accessing women's health services and only one woman from Muhima (0.6%) and three women from Nyamata (1.5%) reported that they had a lack of awareness of where to obtain services (p -value = 0.60).

In all, 76% of women from Muhima ($n=129$) and 78% of women from Nyamata ($n=159$) had never been screened for cervical cancer ($p=0.30$). Among these participants, the primary reason for not obtaining screening was that they did not know how or where to get tested (Muhima $n=76$, 56%; Nyamata $n=88$, 57%). The least common reasons for not being screened were that the clinic was too far away (Muhima $n=1$, 0.7%; Nyamata $n=2$, 1.3%), a family member would not allow

Table 1 Demographics by site

Variable	Overall, N = 374 [†]	Muhima, N = 169 [†]	Nyamata, N = 205 [†]	p-value [‡]
Age	33 (26, 39)	33 (27, 39)	32 (25, 40)	0.8
(Missing)	6	6	0	
Relationship status				0.082
Not in a relationship	86 (23.1)	46 (27.2)	40 (19.6)	
In a relationship	287 (76.9)	123 (72.8)	164 (80.4)	
(Missing)	1	0	1	
Education				0.009
≤ Primary school	216 (58.7)	84 (51.2)	132 (64.7)	
> Primary school	152 (41.3)	80 (48.8)	72 (35.3)	
(Missing)	6	5	1	
Religion				0.10
Christian	288 (77.2)	123 (73.2)	165 (80.5)	
Other	85 (22.8)	45 (26.8)	40 (19.5)	
(Missing)	1	1	0	
Age at first intercourse				>0.9
< 18 years	78 (21.1)	35 (21.3)	43 (21.0)	
≥ 18 years	291 (78.9)	129 (78.7)	162 (79.0)	
(Missing)	5	5	0	
Number of partners in last week				0.004
None	80 (21.7)	35 (21.2)	45 (22.2)	
1	258 (70.1)	108 (65.5)	150 (73.9)	
2+	30 (8.2)	22 (13.3)	8 (3.9)	
(Missing)	6	4	2	
Ever been screened for cervical cancer (yes)	72 (20.0)	36 (21.8)	36 (18.5)	0.4
(Missing)	14	4	10	
Willing to self collect (yes)	331 (88.5)	135 (79.9)	196 (95.6)	<0.001
HIV positive (yes)	23 (6.1)	15 (8.9)	8 (3.9)	0.046
Number of visit to a health facility in the last year for a reason other than antenatal care				0.001
None	27 (7.4)	21 (13.0)	6 (3.0)	
1-2	133 (36.6)	58 (36.0)	75 (37.1)	
3+	203 (55.9)	82 (50.9)	121 (59.9)	
(Missing)	11	8	3	
Whats services do you most commonly access at a health facility? [‡]				
Child health	158 (42.2)	55 (32.5)	103 (50.2)	<0.001
Acute care (flu, fever)	152 (40.6)	55 (32.5)	97 (47.3)	0.004
Sexual/reproductive health	118 (31.6)	39 (23.1)	79 (38.5)	0.001
Antenatal care	130 (34.8)	43 (25.4)	87 (42.4)	<0.001
Malaria	80 (21.4)	34 (20.1)	46 (22.4)	0.6
HIV/ARV [‡]	26 (7.0)	18 (10.7)	8 (3.9)	0.011
Chronic condition (diabetes, hypertension)	20 (5.3)	12 (7.1)	8 (3.9)	0.2
Tuberculosis	0 (0.0)	0 (0.0)	0 (0.0)	>0.9

Table 1 (continued)¹ Median (IQR); *n* (%)² Wilcoxon rank sum test; Pearson's chi-squared test; Fisher's exact test³ Multiple response⁴ Antiretroviral therapy**Table 2** Most common barriers for accessing women's health services by site

Variable	Overall, N = 374 ¹	Muhima, N = 169 ¹	Nyamata, N = 205 ¹	p-value ²
None	21 (5.6)	9 (5.3)	12 (5.9)	0.8
Long wait times at facility	99 (26.5)	48 (28.4)	51 (24.9)	0.4
Low quality of care	54 (14.4)	25 (14.8)	29 (14.1)	0.9
Transportation cost	47 (12.6)	16 (9.5)	31 (15.1)	0.10
Distance to health center	39 (10.4)	7 (4.1)	32 (15.6)	<0.001
Health care workers not receptive	39 (10.4)	19 (11.2)	20 (9.8)	0.6
Transportation method	18 (4.8)	14 (8.3)	4 (2.0)	0.004
Lack of awareness of where to get services	4 (1.1)	3 (1.8)	1 (0.5)	0.3
No time	2 (0.5)	1 (0.6)	1 (0.5)	>0.9
Partner not supportive	1 (0.3)	0 (0.0)	1 (0.5)	>0.9
Not important	0 (0.0)	0 (0.0)	0 (0.0)	>0.9
Lack of awareness on what services I need	0 (0.0)	0 (0.0)	0 (0.0)	>0.9
Other	238 (63.6)	103 (60.9)	135 (65.9)	0.3

¹ *n* (%)² Pearson's chi-squared test; Fisher's exact test

it (Muhima *n* = 2, 1.5%; Nyamata *n* = 1, 0.6%), and embarrassment (Muhima *n* = 2, 1.5%; Nyamata *n* = 1, 1.3%).

Discussion

Participants in this cross-sectional study were recruited from an urban district hospital in Kigali (Muhima, 169, 44.2%), and a rural district hospital in Bugesera (Nyamata, 205, 54.8%). The participants were largely comparable between the two sites. Among both sites, the most common barriers to accessing healthcare services were the quality of clinical care (long wait times at facility, low quality of care, health care workers attitudes) and issues with traveling to the clinic (transportation cost, transportation method, distance to health center). However, women from Nyamata were significantly more likely to report distance to the health center as a barrier and women from Muhima were significantly more likely to report transportation method as a barrier.

The lack of differences in barriers to general health services between the two sites is largely unsurprising. Similar to our findings, long wait times and low quality of care have been reported in previous studies in both urban and rural health centers in Rwanda [12, 24–26]. As of 2019, Rwanda only has 0.1 physicians per 1000 people (in comparison, the United States has 2.6 per 1000 people) [27] and nurses make up the majority of healthcare providers in Rwanda [28, 29]. This human resource shortage may lead to longer wait times and access to limited health services care. It is not surprising that participants from rural regions more often reported distance to the health center as a barrier to screening, research has shown that women in rural areas often travel farther to access health services in LMICs [30, 31]. However, it is notable that women in urban areas were more likely to report mode of transport as an issue; future research should explore access to transport as a barrier to health services in urban Rwanda and how this obstacle could be addressed to

improve health outcomes. Additionally, more research is needed to better understand what other barriers women in Rwanda face to obtain cervical cancer screening as the majority of women in both groups indicated “other” as their response.

Among the two sites, the majority of women noted that self-collection would be acceptable for cervical cancer screening. This is important because many of the barriers that women face accessing health services such as low quality of care and long wait times could be eliminated by implementing cervical cancer self-collection screening program in Rwanda. Self-collection in Rwanda could be integrated into primary points of care, such as ANC clinics. Furthermore, self-collection does not require specialized training to perform and would eliminate the need for a pelvic exam. As such, this could lead to improved clinical care as it would allow for community healthcare workers to be trained in implementing the program and would allow women to avoid an unpleasant exam. More research is needed to understand if women would be willing to wait longer if they were to receive multiple services at once when visiting a health center.

The findings from our study largely align with Niyonsenga et al. study on barriers faced by women accessing cervical cancer screening in Rwanda. While our study findings are broader in that they ask women about accessing general health services, the findings from Niyonsenga et al. can be comparable as they reported the most common barriers to cervical cancer screening in Rwanda as lack of information about the importance of screening, availability of services, and wait times. Unlike our study, they did not ask specifically about transportation to clinics. However, they did ask if living in a rural area prevented them from obtaining screening (51.9% agreed) [12]. Similarly, our study findings align with previous research on the acceptability of self-collection for cervical cancer screening. Mitchell et al. conducted a cross-sectional study of 300 women in Kisenyi Uganda reported that 81% were willing to use self-sampling for cervical cancer testing [16]. Esber et al. reported similar results in Malawi [32] and Broquet et al. in Madagascar [33].

This study has several strengths and limitations. First, the study is strengthened by the study team’s knowledge of cervical cancer and past experience conducting a similar study in Uganda [16]. The study is further strengthened by the use of previously used survey instruments. In addition to the strengths, the study has several limitations. First, the study was only conducted at two clinics in Rwanda and thus cannot be considered generalizable to the overall population in Rwanda. Additionally, the study utilized convenience sampling which could lead to selection bias. As the participants were asked questions on

a sensitive topic, some women could have altered their responses due to embarrassment, fear, or stigmatization due to the subject matter.

Conclusions

Our study found that the most common barriers to cervical cancer screening in urban and rural Rwanda were the quality of clinical care and issues with traveling to the clinic. Implementing a cervical cancer self-collection program could help eliminate many barriers found in our study that women face to obtain health services in Rwanda. More research is needed to better understand the acceptability of cervical cancer screening in Rwanda and how it could be integrated into the healthcare system.

Acknowledgements

We would like to thank Muhima and Nyamata District Hospitals for their assistance in this study

Authors’ contributions

HD: statistical analysis, interpretation, writing original draft, review and editing. MV: conceptualization, interpretation, review and editing. MA: project administration, review and editing. BM: investigation, interpretation, review and editing. ZN: interpretation, review and editing. JD: investigation, review and editing. SDB: investigation, review and editing. CN: investigation, interpretation, review and editing. NM: project administration, review and editing. VN: statistical analysis, review and editing. LS: project administration, review and editing. SR: conceptualization, interpretation, review and editing. GO: conceptualization, interpretation, review and editing. The authors read and approved the final manuscript.

Funding

Study funding is provided by the Canadian Institutes of Health Research. Additionally, Hallie Dau is supported by a Canada Graduate Doctoral Award from the Canadian Institutes of Health Research.

Availability of data and materials

The data used and analyzed during this study includes potentially identifiable personal data. As such, we are unable to make this dataset available in a public depository due to the possibility of identifying participants. Request for data access can be made to Gina Ogilvie at Gina.Ogilvie@bccdc.ca.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the University of British Columbia (H22-01335) and Rwanda National Ethics Committee (125/RNEC/2022). Written informed consent was obtained from all participants. Research conformed to the principles of the Helsinki Declaration. Additionally, each hospital was provided with 150,000 Rwanda Franc (\$140 USD) by the study team as a token of appreciation for their participation in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹School of Population and Public Health, University of British Columbia, Vancouver, BC, Canada. ²Women’s Health Research Institute, Vancouver, BC, Canada. ³Department of Obstetrics and Gynaecology, University of British Columbia, Vancouver, BC, Canada. ⁴Eagle Research Center, Kigali, Rwanda. ⁵Integrated Sciences, University of British Columbia Vancouver, British Columbia, Canada. ⁶BC Cancer, Vancouver, Canada. ⁷School of Medicine

and Pharmacy, University Teaching Hospital of Kigali, University of Rwanda, Kigali, Rwanda. ⁸BC Centre for Disease Control, Vancouver, Canada. ⁹BC Women's Hospital and Health Centre, Box 42, Room H203G - 4500 Oak Street, Vancouver, BC V6H 3N1, Canada.

Received: 17 February 2023 Accepted: 12 June 2023

Published online: 31 July 2023

References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2021;71(3):209–49.
2. Arbyn M, Weiderpass E, Bruni L, de Sanjosé S, Saraiya M, Ferlay J, et al. Estimates of incidence and mortality of cervical cancer in 2018: a worldwide analysis. *Lancet Glob Health*. 2020;8(2):e191–203.
3. Pierz AJ, Randall TC, Castle PE, Adedimeji A, Ingabire C, Kubwimana G, et al. A scoping review: Facilitators and barriers of cervical cancer screening and early diagnosis of breast cancer in Sub-Saharan African health settings. *Gynecol Oncol Rep*. 2020;33: 100605.
4. World Health Organization. Global strategy to accelerate the elimination of cervical cancer as a public health problem. Geneva: World Health Organization; 2020. Licence: CC BY-NC-SA 3.0 IGO.
5. Binagwaho A, Wagner CM, Gatera M, Karema C, Nutt CT, Ngabo F. Achieving high coverage in Rwanda's national human papillomavirus vaccination programme. *Bull World Health Organ*. 2012;90(8):623–8.
6. Bruni L, Saura-Lázaro A, Montoliu A, Brotons M, Alemany L, Diallo MS, et al. HPV vaccination introduction worldwide and WHO and UNICEF estimates of national HPV immunization coverage 2010–2019. *Prev Med*. 2021;144: 106399.
7. Sayinzoga F, Umulisa MC, Sibomana H, Tenet V, Baussano I, Clifford GM. Human papillomavirus vaccine coverage in Rwanda: a population-level analysis by birth cohort. *Vaccine*. 2020;38(24):4001–5.
8. Fort VK, Makin MS, Siegler AJ, Ault K, Rochat R. Barriers to cervical cancer screening in Mulanje, Malawi: a qualitative study. *Patient Prefer Adherence*. 2011;5:125–31.
9. Watkins MM, Gabali C, Winkleby M, Gaona E, Lebaron S. Barriers to cervical cancer screening in rural Mexico. *Int J Gynecol Cancer*. 2002;12(5):475.
10. Ebu NI, Mupepi SC, Siakwa MP, Sampelle CM. Knowledge, practice, and barriers toward cervical cancer screening in Elmina, Southern Ghana. *Int J Women's Health*. 2015;7:31.
11. Were E, Nyaberi Z, Buziba N. Perceptions of risk and barriers to cervical cancer screening at Moi Teaching and Referral Hospital (MTRH), Eldoret, Kenya. *Afr Health Sci*. 2011;11(1).
12. Niyonsenga G, Gishoma D, Sego R, Uwayezu MG, Nikuze B, Fitch M, et al. Knowledge, utilization and barriers of cervical cancer screening among women attending selected district hospitals in Kigali - Rwanda. *Can Oncol Nurs J*. 2021;31(3):266–74.
13. FokomDomgue J, Valea FA. Is it relevant to keep advocating visual inspection of the cervix with acetic acid for primary cervical cancer screening in limited-resource settings? *J Glob Oncol*. 2018;4:1–5.
14. Mezei AK, Pedersen HN, Sy S, Regan C, Mitchell-Foster SM, Byamugisha J, et al. Community-based HPV self-collection versus visual inspection with acetic acid in Uganda: a cost-effectiveness analysis of the ASPIRE trial. *BMJ Open*. 2018;8(6): e020484.
15. Longatto-Filho A, Naud P, Derchain SFM, Roteli-Martins C, Tatti S, Hammes LS, et al. Performance characteristics of Pap test, VIA, VILI, HR-HPV testing, cervicography, and colposcopy in diagnosis of significant cervical pathology. *Virchows Arch*. 2012;460(6):577–85.
16. Mitchell S, Ogilvie G, Steinberg M, Sekikubo M, Biryabarema C, Money D. Assessing women's willingness to collect their own cervical samples for HPV testing as part of the ASPIRE cervical cancer screening project in Uganda. *Int J Gynecol Obstet*. 2011;114(2):111–5.
17. Guan Y, Castle PE, Wang S, Li B, Feng C, Ci P, et al. A cross-sectional study on the acceptability of self-collection for HPV testing among women in rural China. *Sex Transm Infect*. 2012;88(7):490–4.
18. Murchland AR, Gottschlich A, Bevilacqua K, Pineda A, Sandoval-Ramírez BA, Alvarez CS, et al. HPV self-sampling acceptability in rural and

- indigenous communities in Guatemala: a cross-sectional study. *BMJ Open*. 2019;9(10): e029158.
19. Rodrigues LL, Morgado MG, Sahasrabudhe VV, De Paula VS, Oliveira NS, Chavez-Juan E, et al. Cervico-vaginal self-collection in HIV-infected and uninfected women from Tapajós region, Amazon, Brazil: High acceptability, hrHPV diversity and risk factors. *Gynecol Oncol*. 2018;151(1):102–10.
20. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, et al. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform*. 2019;95: 103208.
21. World Health Organization. Improving data for decision-making: a toolkit for cervical cancer prevention and control programmes. 2018.
22. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991;50(2):179–211.
23. R Core Team. R: a language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2021.
24. Farmer DB, Berman L, Ryan G, Habumugisha L, Basinga P, Nutt C, et al. Motivations and constraints to family planning: a qualitative study in Rwanda's Southern Kayanza District. *Glob Health Sci Pract*. 2015;3(2):242–54.
25. Mazimpaka C, Uwitonze E, Cherian T, Hedt-Gauthier B, Kateera F, Riviello R, et al. Perioperative management and outcomes after cesarean section—a cross-sectional study from rural Rwanda. *J Surg Res*. 2020;245:390–5.
26. Kotagal M, Lee P, Habiyaqare C, Dusabe R, Kanama P, Epino HM, et al. Improving quality in resource poor settings: observational study from rural Rwanda. *BMJ*. 2009;339: b3488.
27. The World Bank. Physicians (per 1,000 people) [updated 2023. Available from: <https://data.worldbank.org/indicator/SH.MED.PHYS.ZS>.
28. Rwanda Ministry of Health. 10-year government program: national strategy for health professions development 2020 – 2030. 2020.
29. Rwanda Ministry of Health. Health Labour Market Analysis Report. 2019.
30. Carrasco-Escobar G, Manrique E, Tello-Lizarraga K, Miranda JJ. Travel time to health facilities as a marker of geographical accessibility across heterogeneous land coverage in Peru. *Front Public Health*. 2020;8:498.
31. Stewart K, Li M, Xia Z, Adewole SA, Adeyemo O, Adebamowo C. Modeling spatial access to cervical cancer screening services in Ondo State, Nigeria. *Int J Health Geogr*. 2020;19(1):28.
32. Esber A, J. NA, Enock J, Jonathan K, Nampandeni Patrick AL, Patricia CR, et al. Feasibility, validity and acceptability of self-collected samples for human papillomavirus (HPV) testing in rural Malawi. *Malawi Med J*. 2018;30(2):61–6.
33. Broquet C, Triboullier D, Untiet S, Schafer S, Petignat P, Vassilakos P. Acceptability of self-collected vaginal samples for HPV testing in an urban and rural population of Madagascar. *Afr Health Sci*. 2015;15(3):755–61.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

