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Factors associated with human papillomavirus vaccination uptake in Central Uganda

[1,3*] ISABIRYE A., [2] ASIIMWE JB., [1]MBONYE KM

[1]Department of Population Studies, School of Statistics and Planning, Makerere University, Kampala, Uganda
[2]Department of Planning and Applied Statistics, School of Statistics and Planning, College of Business and Management Sciences, Makerere University, Kampala, Uganda
[3]Department of Sociology and Social Administration, Faculty of Arts and Social Sciences, Kyambogo University, Kampala, Uganda
***Corresponding author**: aloneisab@gmail.com

Abstract

The burden of cervical cancer in Uganda is high yet uptake of HPV vaccination is low. Identification of child and mother factors associated with HPV vaccination are important for targeted interventions however, this problem has not been well investigated. The aim of the study was to determine the prevalence of HPV vaccine uptake and associated factors among the10 to 17-year-old girls in Central Uganda four years after rolling out the vaccine in the country. The cross-sectional survey was done in Wakiso and Nakasongola districts in Central Uganda. A total of 503 girls participated in the study. Logistic regression analyses were done to establish the relationship between vaccination status and socio-demographic characteristics of the girls and their mothers. HPV vaccination uptake was generally low (39.4%) in central Uganda and significantly associated with; mothers' education attainment, HPV knowledge, mothers' age, religion, wealth index, type of residence, birth order and schooling status. There were reduced odds of HPV vaccination among Pentecostal girls [OR=0.44; (95% CI: 0.21-0.90), p=0.025)] and rural dwelling girls [OR=0.24 (95% CI: 0.16-0.37), P=0.016)]. The likelihood of vaccination was higher among girls; of birth order three [OR=2.45 (95% CI: 1.25-4.82), P=0.029)], who were schooling [OR=2.73 (95% CI: 1.12-6.63), P=0.027)], with high wealth index [OR= 2.31 (95% CI: 1.12-4.76), P=0.024)], living with mothers with high HPV knowledge [OR= 2.26 (95% CI: 1.41-3.61), P=0.001)], and whose mothers were aged 30-39 years [OR= 2.44 (95% CI: 1.07-5.59), P=0.034)]. Both child and mother characteristics showed a marked impact on HPV vaccination. Strategies like creation of awareness should target girls: in rural areas, not schooling, with lower social economic status, living with women below 29 years, of lower birth orders, and living with less knowledgeable women; and involving religious leaders in programs should be embraced in order to achieve high vaccination uptake.

Keywords: *Central Uganda; HPV; Human papillomavirus; vaccine uptake*

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Introduction

Background

Globally, cervical cancer ranks fourth amongst most common types of cancer with 569 847 new cases per year. It accounts for 311 365 annual deaths amongst women worldwide. The global estimated age-standardized incidence rate per 100, 000 is 13.1 (Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, 2018). Cervical cancer disproportionately affects women in resource-limited settings, almost 70 percent of the cases occur in countries with low or medium levels of income (Torre, Bray, Siegel, & Ferlay, 2015). Sub-Saharan Africa has the second largest prevalence (21.6%) of global cervical cancer deaths after India (25.4 %). It is the only region where cervical cancer is almost equivalent to breast cancer with each accounting for a quarter of the global cancer burden (Bruni, L., Albero, G., Serrano, B., Mena, M., Gómez, D., Muñoz, J.,

Bosch, FX., & de Sanjosé , S., 2019). Despite the overwhelming evidence of efficacy and impact of Human Papillomavirus (HPV) vaccination (Finocchario-Kessler S, Wexler C, Maloba M, Mabachi N, Ndikum-Moffor F, 2016; Kumakech et al., 2016; Woestenberg et al., 2018; World Health Organization, 2013), integration of HPV vaccination in primary health care in Africa is still low (Bruni, L., Albero, G., Serrano, B., Mena, M., Gómez, D., Muñoz, J., Bosch, FX., & de Sanjosé , S., 2019). Human Papillomavirus and related diseases report for Africa in 2019 indicated that only 16.7% of the countries in Africa had rolled out HPV vaccination by 2016 (Bruni, L., Albero, G., Serrano, B., Mena, M., Gómez, D., Muñoz, J., Bosch, FX., & de Sanjosé , S., 2019). Globally, Eastern Africa is ranked first and second in terms of age standardized mortality (30) and age standardized incidence (40.1) rates per 100 000 respectively (Bruni, L., Albero, G., Serrano, B., Mena, M., Gómez, D., Muñoz, J., Bosch, FX., & de Sanjosé , S., 2019).

Numerous international policy frameworks underscored the importance of HPV vaccination. A decade of vaccines vision was declared by 2011-2020 Global Vaccine Action Plan where the international community was tasked to ensure 90% and 80% national and district HPV vaccine coverage respectively by 2020 (WHO, 2020). Second, the 2013 World Cancer Declaration encouraged governments to ensure universal HPV vaccination (UICC, 2013). Item number three of the Sustainable Development Agenda echoed countries to reduce premature mortality by one third through prevention (United Nations General Assembly, 2015). Uganda, has cervical cancer age-standardized incidence and mortality rates of 47.5 and 25 per 100,000 population, respectively (Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, 2018), indicating that nearly half of the Ugandan women diagnosed with cervical cancer will die of their disease. Evidence suggest that almost every case of cervical cancer is highly preventable. World Health Organization (WHO) and Uganda's Ministry of Health (MOH) underscored the importance of cervical cancer primary prevention i.e. Vaccination of girls aged 9-14 years before exposure to HPV/ sex as an important step in cervical cancer prevention (Finocchario-Kessler S, Wexler C, Maloba M, Mabachi N, Ndikum-Moffor F, 2016; MOH, 2010; World Health Organization, 2013). In 2006, a vaccine that provides immunity against infection with the two high-risk types of HPV (HPV 16 and 18) was approved by United States Food and Drug Administration (FDA). This was a great breakthrough because those HPV types are responsible for causing approximately 70 percent of cervical cancers (World Health Organization, 2013). Evidence has proved the cost-effectiveness (Hidle et al., 2018; Ladner et al., 2012; Path, 2009) and efficacy (Kim, Sweet, Chang, & Goldie, 2011; Kumakech et al., 2016; Woestenberg et al., 2018) of the HPV vaccine. Research conducted on 22.2 million girls in 72 countries proved that implementing an HPV vaccine intervention has the potential of averting 1.30 million disability –adjusted life years due to cervical cancer and saving 12.6 lives per 1000 girls vaccinated (Kim et al., 2011).

In 2006, HPV vaccines for HPV 16 and 18 types were availed commercially in Uganda (Muñoz N Sanjosé S, et al, 2003). In 2008, Program for Appropriate Technology in Health (PATH) implemented the first pilot HPV vaccination in Uganda; in the districts of Nakasongola and Ibanda, to assess the feasibility of the program. In 2012, the second pilot was conducted in 12 other districts (PATH, 2009). These two pilot projects proved the efficacy of the school HPV vaccine delivery strategy paving way for a nationwide rollout in November 2015 (WHO, 2015). The strategic plan for cervical cancer prevention drafted by MOH set an eighty percent HPV vaccine coverage target among eligible girls by 2015 (MOH, 2010). However, in 2016 the uptake of HPV vaccine in Uganda was low (20%) (Isabirye, Mbonye, Asiimwe, & Kwagala, 2020). Another study done in Northern Uganda after nationwide rollout of the HPV vaccine also indicated low (17%) vaccine uptake (Kisaakye E, Namakula J, Kihembo C, Kisakye A, Nsubuga P, 2018). HPV vaccination coverage in Uganda is lower than that of other countries in the East African region. For example the HPV vaccination in Rwanda stands at 93.2% (Binagwaho et al., 2012). The low HPV vaccine uptake in Uganda is coupled with the imbalanced distribution of social amenities (Nakisige, Schwartz, & Ndira, 2017). For instance, central Uganda is the most developed region of the country that hosts the capital city (UBOS and IFC, 2018). Additionally, Health facilities and cervical cancer interventions in the region are relatively available and accessible (MOH, 2010; Nakisige et al., 2017). Surprisingly, the region registered the lowest (18.2%) uptake of HPV vaccine (Isabirye et al., 2020).

A number of studies have underscored the role of girl and mother related factors in influencing HPV vaccine uptake (Spencer, Roberts, Brabin, Patnick, & Verma, 2014). Girl related factors may have a bearing on health services uptake. Such factors include age, schooling status, girl's living arrangements, birth order and type of residence (Gallagher et al., 2016; Kulkarni & Nimbalkar, 2008; Lefevere, Hens, Smet, & Damme, 2011; Rossi, 2015). In Zimbabwe, children living away from their mothers were less likely to be vaccinated compared to children living with their mothers (Rossi, 2015); schooling girls were most likely to complete HPV vaccination compared to non-schooling girls in Rwanda (Binagwaho et al., 2012) and high-income countries (Gallagher et al., 2016); in Belgium, the province of residence was significantly associated with HPV vaccination; girls from Limburg province were most likely to have ever been vaccinated compared to girls from Antwerp province (Lefevere et al., 2011); In India, women with high birth orders were likely to utilize health services quite often compared to women with lower birth orders (Kulkarni & Nimbalkar, 2008); and older girls were most likely to be vaccinated compared to their younger counterparts in Southeast Michigan (Dempsey A, Cohn L, Dalton V, 2010), Belgium (Lefevere et al., 2011), and Germany (Schülein et al., 2016).

Research has indicated that mothers' factors significantly influence daughters' uptake of HPV vaccination (Vincente et al., 2015; Watson-jones et al., 2012) since parents provide consent on behalf of their daughters before vaccination (Vincente et al., 2015; Watson-jones et al., 2012). A number of studies have found significant association between parent refusal of daughters' vaccination with fears associated with the quality of delivery, safety, and advance effects, especially on future fertility of their daughters (Alberts CJ, Der-Loeff MF, Hazeveld Y, De-Melker HE, Der-Wal MF, Nielen A, Fakiri FE, Prins M, 2017; Bingham, Drake, & Lamontagne, 2019; Suppli, Hansen, Rasmussen, Valentiner-branth, & Krause, 2018; Watson-jones et al., 2012). Mothers with secondary education were most likely to vaccinate their children compared to mothers with primary education in Zimbabwe (Rossi, 2015). Other mother factors that were significant predictors of HPV vaccination were parental knowledge related to HPV vaccine; In Fiji, mothers who had high knowledge about HPV were most likely to vaccinate their daughters compared to their counterparts (Vincente et al., 2015). Studies in the developed economies found higher likelihood of HPV vaccination among girls with high Social Economic Status (SES) compared to girls with low SES, especially in Germany (Schülein et al., 2016), England (Kumar & Whynes, 2011), Belgium (Lefevere et al., 2011), and the Netherlands (Marc, Alies, Jan, Laura, & Hester, 2019). There is paucity of evidence regarding HPV vaccination and SES in the Low- and Middle-Income Countries (LMICs). Additionally, research assessing the performance of HPV vaccination programs with regard to type of residence, mother factors and child factors is scarce. To improve uptake of HPV vaccination in Central Uganda and similar areas, there is need to understand the mother and child factors associated with HPV vaccination uptake with regard to type of residence. This study sought to establish the predictors of HPV vaccine uptake with regard to the type of residence, child characteristics and mother characteristics in Central Uganda with the aim of guiding interventions aimed at creating awareness in Uganda.

Materials and Methods

Study design and setting

Our cross-sectional population-based survey was done in two of the 27 districts in Central Uganda for the duration of two months (June to July 2019). The two districts consisted of Wakiso; a district at the outskirts of Kampala city and Nakasongola rural district. According to the 2014 Uganda National Population and Housing Census, Wakiso and Nakasongola districts had a total population of 1 997 418 and 181 795 people respectively. Approximately 12.6% of the population in these districts are girls aged 10-19 years (UBOS, 2017a, 2017b). Wakiso district is a suburb of Kampala city, the capital of Uganda and its people are heavily influenced by the city while Nakasongola District is mainly a rural district where almost all people are predominantly farmers (UBOS, 2017b).

Sample size and sampling procedure

The current study was nested in a primary study that examined cervical cancer screening uptake among 845 randomly selected women aged 25-49 years from Nakasongola and Wakiso

districts. Out of the 845 women considered in the primary study, 437 women were mothers/ caregivers of girls aged 10-17 years who were eligible for the HPV vaccination module. Of the 437 women, 384 had one girl, 42 had two girls, 9 had 3 girls and 2 women had 4 girls; yielding a sub-sample size of 503 girls considered in the current study. The women provided information regarding HPV vaccination and background characteristics of 297 girls from Wakiso and 206 girls from Nakasongola. Specifically, women answered the question "was (name) vaccinated against HPV?".

The primary sample size of 850 women was estimated with Kish Leslie formula (Rao & Kish, 1969). We calculated our sample size of 850 women by assuming 50% prevalence and a significance level of 5% with statistical power of 95%. Being a cluster survey, we incorporated a design effect of two and a 90% response rate. Of the 850 respondents, 600 (70%) participants were recruited from Wakiso; an urban setting and 250 (30%) from Nakasongola rural district. Since a large proportion of eligible respondents were mainly from Wakiso district, 40% more women were interviewed from the district. We randomly selected one district from each of the semi-urban/ urban and rural clusters of central Uganda. The rural cluster comprised of 25 districts while the urban cluster comprised of 2 districts. Thirty-four villages out of the 1916 villages were selected from the two study districts; 10 out of 334 wards/ villages and 24 out of 1582 villages were selected from Nakasongola and Wakiso districts respectively by simple random approach. Every village/ ward selected was designated as a cluster and from each cluster, 25 households were selected by systematic random sampling. One eligible woman was selected from each selected household by prioritizing spouses of household heads. Each interviewed woman was asked whether she was living with girl(s) aged 10-17 years either as a mother or guardian. Information concerning HPV vaccination and other background characteristics of the girls was obtained from the women who were living with girls eligible for the HPV vaccination module.

Data collection procedure

The questionnaire that was used for data collection contained items (questions) adapted from tools and findings used in studies elsewhere (Ali-risasi, Mulumba, Verdonck, Broeck, & Praet, 2014; Mupepi, Sampselle, & Johnson, 2011; Ndejjo R, Mukama T, Musabyimana A, 2016; UBOS and IFC, 2018) and was pretested in the nearby communities for validation purposes. The survey tool comprised of seven sections. Section one comprised of items on the participants' demographic characteristics including age, marital status, the highest level of education attained, type of residence, and health seeking behaviors. Section two had questions on household factors including household assets and type of house. Section three comprised of questions on reproduction including use of contraception and number of children. Section four comprised of questions on cervical cancer awareness and knowledge, section five contained questions about cervical cancer screening, section six contained questions about HPV vaccination and section seven contained questions on husband's characteristics.

Women were interviewed in Luganda, the main spoken local language in Central Uganda. The tool was drafted in English and translated into Luganda language by two natives conversant in both English and the local language. The tool was back translated into English by a pair of translators not familiar with the original version; the two versions were compared for conceptual equivalence and harmonized. A final translation into Luganda was then performed and checked for accuracy and preservation of meanings. Research assistants (RAs) included five women with bachelor degrees in social sciences and education. The RAs were trained for two days on principles of quantitative and survey research including data collection, on the objectives of this research, sampling procedures, interview techniques, and consent procedures. Pretesting of tools was performed with 10 women in the nearby community. The questionnaires were administered by five research assistants. Data from 6 to 8 participants was collected by each RA per day for a period of 28 days. Review of collected data was done by the principal investigator on daily basis to ensure comparability and quality of data among research assistants.

The outcome variable of the study was HPV vaccination. HPV vaccination was measured in terms of whether girls had ever been vaccinated; respondents were specifically asked "was (name) vaccinated against HPV?"(No/Yes). Explanatory variables included; mother's age

(≤29, 30-39, and 40–49 years), child's age (10, 11, 12, 13, 14, 15, 16 and 17), religion (Roman Catholicism, Anglican, Islam, Pentecostals and others), study site/ type of residence (Wakiso/ urban and Nakasongola/ rural), education level (some primary, some secondary, and above secondary), occupation (housewife, farmer, professional, business and others), ethnicity (Baganda, Banankole, Basoga, Baluri, and others), and age at first marriage (≤18, 19-34, and singles). Responses to schooling status were got by asking respondents questions that required No/ Yes responses. Household assets such as bicycles, televisions, materials used for housing construction and other characteristics related to wealth were used to generate a composed score which was used to generate the wealth index. We generated factor scores of household assets which was recoded into three categories; poor, middle and high wealth indices.

Data management and analysis

Two independent clerks entered data using Epidata 3.1 (EpiData Software, Odense, Denmark). Synchronized and cleaned data was exported to STATA I/C version 16 for analysis (StataCorp, 2019). Descriptive statistics in the form of frequencies were generated. We performed Chi-square tests to determine associations between independent variables and dependent variable; HPV vaccination. Variables that were significant at p values less than 0.05% were put into multivariable logistic regression models to examine association of girls' and mothers' characteristics with the outcome (being ever vaccinated) adjusting to limit bias from confounding. However, Schooling status and age of girls were not statistically significant at bi-variate analysis, but they were included in the multi-variate model because of their significance according to literature (LaMontagne et al., 2011; Vincente et al., 2015). Odds ratios were reported with accompanying 95% confidence intervals. We tested for multicollinearity among predictor variables and no multicollinearity problems were observed in our multivariate logistic regression models.

Ethical considerations

This study was approved by Makerere University School of Social Sciences Research and Ethics Committee (MAHSSREC) and the Uganda National Council of Science and Technology (UNCST); UNCST registration number SS4848. Entry into the communities was sought from the district and local leaders. We sought voluntary written informed consent from all participants prior to interviews, and they were assured of confidentiality. Women were also informed of their liberty to decline participation if they decided to and or join the interview and pull out at any point without fear of blame from the RAs. About 5–10 minutes were granted to participants to enquire about the study after the interviews.

Results

Descriptive characteristics

The general characteristics of the study population are shown in Table 1. Majority (61%) of the girls had not received the HPV vaccine. About 15 % of the girls were 14 years, over half (59%) were from Wakiso; an urban area and most of the girls (92%) were attending school. Close to three quarters (72%) of the girls were living with their mothers, over two-thirds (78%) of the girls were living in male headed households, and 1 in 5 (21%) were in the first birth order. Girls were also distributed by background characteristics of their mothers. Over half of the girls their mothers were aged 30-39 years (52%), had high knowledge about HPV (54%) and had attained primary education (58%). Approximately three-quarters (78%) their mothers/ caregivers were married. One third (37%) of the mothers were engaged in business. Approximately a quarter (26%) were Protestants, 35 % were Baganda and 61 % were in the middle wealth category.

Our Chi-square test results indicate that HPV vaccination was statistically associated with type of residence ($p<0.001$), birth order ($p<0.001$), girl's living arrangements ($p<0.001$), mother/ care taker's age ($p<0.001$), mother's education level ($p<0.001$), religion ($p=0.040$), occupation ($p<0.001$), wealth index ($p=0.008$), number of living children ($p=p<0.001$), knowledge about HPV vaccination ($p<0.001$), source of information about vaccination ($p=0.030$) and ethnicity ($p<0.001$). HPV vaccination was higher among girls who were living in urban areas (61%), Anglican (45.4%), birth order 4 (56%) and living with their mothers in the household (45%). HPV vaccination was also higher among girls whose mothers were age 40+ years (47%), having primary education (47%), other religion (57%), farmers (61%), high

wealth index (52%), Baluri tribe (58%), had high knowledge about HPV vaccination (49 %) and reported other source of information (54%). Girls' age, girls' school attendance status, mothers' marital status and sex of the household head were not significantly associated with HPV vaccination (Table 1).

Table 1: Socio-demographic factors, economic factors and HPV vaccination (N=503)

Characteristic	Ever vaccinated n(%)	Never vaccinated n (%)	Subtotal n(%)	Chi-square P-value
Total	**198 (39.4)**	**305 (60.6)**		
Residence				**<0.001**
Wakiso (Urban)	125 (60.7)	81(39.3)	206 (41.0)	
Nakasongola (Rural)	73 (24.6)	224 (75.4)	297 (59.1)	
Age (years)				**0.257**
10	23 (31.5)	50 (68.5)	73 (14.5)	
11	26 (44.1)	33 (55.9)	59 (11.7)	
12	29 (53.7)	25 (46.3)	54 (10.7)	
13	26 (40.3)	42.9 (59.7)	72 (14.3)	
14	26 (34.7)	49 (65.3)	75 (14.9)	
15	20 (36.4)	35 (53.6)	55 (10.9)	
16	19 (34.6)	36 (65.4)	55 (10.9)	
17	26 (43.3)	34 (56.7)	60 (11.9)	
Currently attending school				**0.253**
No	12 (30.8)	27 (69.2)	39 (7.8)	
Yes	186 (40.1)	178 (59.9)	464 (92.2)	
Birth order				**<0.001**
One	27 (26.0)	77 (74.0)	104 (20.7)	
Two	40 (39.2)	62 (60.8)	102 (20.3)	
Three	39 (54.7)	36 (61.0)	75 (14.9)	
Four	34 (55.7)	26 (44.3)	61 (12.1)	
Five and above	28 (51.9)	26 (48.1)	54 (10.7)	
Not living with mother	28 (26.2)	79 (73.8)	107 (26.2)	
Living arrangements				**<0.001**
Living with biological mother	161 (44.5)	203 (54.5)	362 (72.0)	
Not living with biological mother	37 (26.2)	104 (73.8)	141 (28.0)	
Mother's age (years)				**<0.001**
25-29	13 (17.8)	60 (82.2)	73 (14.5)	
30-39	103 (39.5)	156 (60.5)	259(51.5)	
40+	82 (47.0)	164 (54.3)	171(34.0)	
Mother's education level				**<0.001**
Primary	137 (47.4)	152 (52.6)	289 (57.5)	
O/A level	47 (26.3)	132 (73.7)	179 (35.6)	
Tertiary/university	14 (40.0)	21 (60.0)	35 (7.0)	
Religion				**0.040**
Catholic	34 (30.1)	79 (69.9)	113 (22.5)	
Anglican	59 (45.4)	71 (54.6)	130 (25.9)	
Muslim	33 (34.7)	62 (65.3)	95 (18.9)	
Pentecostal	60 (41.7)	84 (58.3)	144 (28.6)	
Others	11 (57.1)	10 (42.9)	21 (4.2)	
Tribe				**<0.001**
Baganda	46 (26.3)	129 (74.7)	175 (34.8)	
Banyankole	13 (29.6)	31 (70.4)	44 (8.8)	
Basoga	4 (17.4)	19 (82.6)	23 (4.6)	

Baluri	100 (58.1)	72 (41.9)	172 (34.2)	
Others	35 (39.3)	54 (60.7)	89 (17.7)	
Marital Status				**0.675**
Married	156 (40.0)	234 (60.0)	390 (77.5)	
Widowed	10 (40.0)	15 (60)	25 (5.0)	
Separated	29 (38.7)	46 (61.3)	75 (14.9)	
Single	3 (23.1)	10 (76.9)	13 (2.6)	
Occupation				**<0.001**
Housewife	29 (33.7)	57 (66.3)	86 (17.1)	
Farmer	105 (60.7)	68 (39.3)	173 (34.4)	
Professionals	10 (40.0)	15 (60.0)	25 (5.0)	
Business	48 (26.0)	143 (74.0)	185 (36.8)	
Others	6 (17.6)	28 (82.4)	34 (6.8)	
Wealth index				**0.008**
Poor	32 (30.8)	72 (69.2)	104 (20.7)	
Middle	119 (38.5)	190 (61.5)	309 (61.4)	
High	47 (52.2)	43 (47.8)	90 (17.9)	
Knowledge about HPV vaccination				**<0.001**
Low	65 (28.3)	165 (71.7)	230 (45.7)	
High	133 (48.7)	140 (51.3)	273 (48.7)	
Source of information				**0.030**
Radio	65 (36.4)	133 (63.6)	198 (39.4)	
Health worker	61 (43.3)	80 (56.7)	141 (28.0)	
Television	11 (23.4)	36 (76.6)	47 (9.3)	
Others	54 (46.1)	63 (53.9)	117 (23.3)	
Sex of head of household				**0.811**
Male	150 (38.4)	241 (61.6)	391 (77.7)	
Female	44 (39.4)	68 (60.6)	112 (22.3)	

Multivariable logistic regression was done to examine the relationship between HPV vaccination and girls' background characteristics, controlling for mothers' background characteristics. Model 1 consisted of girls' age, place of residence, girls' living arrangements, schooling status, and birth order. In model 2, we added mothers' characteristics namely; age, ethnicity, religion, education attainment, wealth index, knowledge about HPV vaccination, source of information, and occupation (Table2). Type of residence and birth order consistently retained its significance after controlling for mothers' characteristics. In Model 1, girls from Nakasongola (a rural setting) had reduced odds of having already vaccinated compared with girls from Wakiso (an urban setting) [OR=0.24 (95% CI: 0.16-0.37), P=0.016)]. Girls who were birth order 3 had increased odds of having already vaccinated compared with first birth order girls [OR=2.45 (95% CI: 1.25-4.82), P=0.029)]. In model 2, schooling status gained significance after controlling for mother's characteristics. Girls who were schooling had increased odds of having already vaccinated compared with non-schooling girls [OR=2.73 (95% CI: 1.12-6.63), P=0.027)]. Women with high wealth index had increased odds of their girls having already vaccinated compared to the poor women [OR= 2.31 (95% CI: 1.12-4.76), P=0.024)]. Women of Pentecostal religion had reduced odds of their girls having already been vaccinated compared to the catholic women [OR= 0.44 (95% CI: 0.21-0.09), P=0.025)]. Girls whose mothers were aged 30-39 years were most likely to be vaccinated compared to girls whose mothers were aged 25-29 years [OR= 2.44 (95% CI: 1.07-5.59), P=0.034)]. Girls whose mothers had high knowledge about HPV vaccination were most likely to have ever been vaccinated compared to girls whose mothers had low knowledge about HPV vaccination [OR= 2.26 (95% CI: 1.41-3.61), P=0.001)]. Girls' age, living with mother, women's age, occupation, ethnicity, and source of information were not significantly associated with HPV vaccination in any of the two models.

Table 2 Associations between socio-demographic and economic factors with HPV vaccination

Variables	Model (1)			Model (2)		
	OR	P-value	95% CI	OR	P-value	95% CI
Residence						
Wakiso (Urban) (Ref)						
Nakasongola (Rural)	0.24	<0.001	0.16-0.37	0.34	0.016	0.14-0.81
Age (years)						
10-11 (Ref)						
12-13	1.55	0.118	0.90-2.68	1.73	0.071	0.95-3.15
14-15	0.91	0.750	0.52-1.60	1.01	0.984	0.55-1.85
16-17	1.15	0.642	0.64-2.07	1.20	0.582	0.63-2.27
Currently attending school						
No (Ref)						
Yes	1.92	0.121	0.84-4.36	2.73	0.027	1.12-6.63
Birth order						
One (Ref)						
Two	1.67	0.110	0.89-3.12	1.54	0.213	0.78-3.03
Three	2.45	0.009	1.25-4.82	2.28	0.029	1.09-4.79
Four	1.79	0.124	0.85-3.77	1.68	0.231	0.72-3.93
Five and above	1.44	0.353	0.67-3.10	1.56	0.323	0.65-3.74
Not living with mother	1.04	0.930	0.44-1.47	1.01	0.984	0.43-2.40
Living with mother						
Yes (Ref)						
No	0.80	0.478	0.44-1.47	0.78	0.491	0.39-1.58
Mother's Characteristics						
Mother's age (years)						
25-29 (Ref)						
30-39				2.44	0.034	1.07-5.59
40+				2.33	0.063	0.96-5.66
Mother's education level						
Primary (Ref)						
O/A level				0.75	0.301	0.44-1.29
Tertiary/university				2.02	0.193	0.70-5.85
Religion						
Catholic (Ref)						
Anglican				0.77	0.465	0.38-1.55
Muslim				1.34	0.423	0.66-2.72
Pentecostal				0.44	0.025	0.21-0.90
Others				1.54	0.496	0.44-5.36
Ethnicity						
Baganda (Ref)						
Banyankole				1.53	0.347	0.63-3.70
Basoga				0.49	0.286	0.13-1.81
Baluri				1.14	0.785	0.45-2.90
Others				1.47	0.246	0.77-2.83
Occupation						
Housewife (Ref)						
Farmer				1.50	0.361	0.63-3.56
Professionals				1.25	0.716	0.37-4.22
Business				0.66	0.222	0.39-1.29

Others	0.35	0.083	0.11-1.15
Wealth index			
Poor (Ref)			
Middle	0.86	0.638	0.46-1.62
High	2.31	0.024	1.12-4.76
Knowledge about HPV vaccination			
Low (Ref)			
High	2.26	0.001	1.41-3.61
Source of information			
Radio (Ref)			
Health worker	1.25	0.432	0.72-2.17
Television	0.97	0.939	0.39-2.37
Others	1.74	0.062	0.97-3.13

Ref = Reference Category
OR =Odds Ratios
CI =Confidence Interval

Discussion

The present study examined girl factors, mothers'/ caregivers' factors and the prevalence of HPV vaccination in Central Uganda. The results provide support of the view that several girl factors (schooling status, religious affiliation, social economic status, birth order, and type of residence) and mother factors (wealth index), were significantly associated with HPV vaccination. The results of this study indicate that HPV vaccine uptake in central Uganda among girls age 10 to 17 years was low (39.4%) compared to the 2015 Uganda's MOH target (80 %) (MOH, 2010) and other vaccines in the country (UBOS and IFC, 2018). Our results are over two folds the findings of a survey conducted in Northern Uganda (17.4%) (Kisaakye E, Namakula J, Kihembo C, Kisakye A, Nsubuga P, 2018). In spite of that, Uganda's HPV vaccine coverage is lesser than that of Rwanda (93.2%) (Binagwaho et al., 2012). This can partially be explained by the negative attitudes concerning the vaccine (Kisaakye E, Namakula J, Kihembo C, Kisakye A, Nsubuga P, 2018; Nickel et al., 2017) and limitations associated with delivering HPV vaccines in schools (Bingham et al., 2019; Hidle et al., 2018; PATH, 2009; Watson-jones et al., 2012). Another plausible explanation for the low HPV vaccine uptake is concerns related to delivery to young adolescent girls only, the newness of the vaccine, and the unique age group targeted for vaccination, as they are outside the traditional under 5-year-olds usually stressed in the Expanded Programme on Immunization (Katahoire et al., 2008; WHO, 2008, 2020).

Our study found that affiliation to Pentecostal religion was significantly associated with reduced odds of having already been vaccinated compared to catholic believers. The possible explanation for the finding is the positive effect of information received from religious leaders on the uptake of positive health behaviors (Adedini et al., 2018). Findings from Nigeria demonstrated that involving religious leaders in health services promotion improved uptake (Adedini et al., 2018; Maiwada, Rahman, Abdurrahaman, Mamat, & Ann-walker, 2016). In reviewing the literature, religion was not significantly associated with HPV vaccination uptake (Mabeya et al., 2018; Vermandere et al., 2014). Our results suggest that religious leaders especially the Pentecostals and Anglican should be sensitized to encourage their followers to vaccinate against HPV. There is also scarcity of information regarding the influence of religious leaders on HPV vaccine uptake especially in Uganda, which calls for further research in this area.

Our findings indicate that the likelihood of vaccination was higher among girls whose mothers were having high knowledge about HPV vaccination compared to girls whose mothers had low knowledge, indicating a positive effect of high mothers' knowledge about HPV vaccination on HPV vaccination uptake. The study findings are consistent with results of a study that was done in three countries (UK, USA, and Australia) after HPV vaccine introduction, it indicated a high likelihood of HPV vaccination among girls whose parents had high knowledge about HPV vaccination (Nickel et al., 2017). Our study finding points to the need to create awareness among parents/ guardians about HPV vaccination to be able to scale up the uptake of HPV vaccination in Uganda.

The current study found that schooling girls were more likely to have been vaccinated than the non-schooling girls. The probable explanation for this relationship is the use of the school based HPV vaccine delivery scheme minus special effort to vaccinate girls who are not schooling (Binagwaho et al., 2012; Gallagher et al., 2016; PATH, 2009; Watson-jones et al., 2012). These findings are supported by studies elsewhere which indicated that schooling girls were most likely to be vaccinated compared to non-schooling girls (Gallagher et al., 2016; Isabirye et al., 2020; Kisaakye E, Namakula J, Kihembo C, Kisakye A, Nsubuga P, 2018). This suggests that the delivery of the vaccine through schools should be complemented with interventions to reach eligible girls who are not in schools.

Another unanticipated finding was that, girls' living arrangements were not significantly associated with HPV vaccination. However, the likelihood of having been vaccinated was higher among girls who were living with their biological mothers compared to girls who were not living with their mothers indicating a positive effect of

girls living with their mothers on HPV vaccination uptake. This may indicate that caregivers other than the parents may be reluctant to spare time or unwilling to vaccinate girls who are not their own. Our finding is supported by findings from Zimbabwe which found that girls who were living with their biological mothers were more likely to have been vaccinated compared to girls who were not living with their parents (Rossi, 2015). The results of the current study though not significant indicate that parents should be encouraged to stay with their children to enable them to benefit from parental support.

Rural dwelling girls had reduced odds of having already been vaccinated compared to their urban counterparts. This finding is surprising because the rural area (Nakasongola district) that was selected for the study benefited from the first vaccination project in the country (PATH, 2009). The possible explanation for our finding may be because the urban area (Wakiso district) characteristically have less cultural conservatism, easier access to health care, and higher socioeconomic status (UBOS, 2017a). However, our results are not supported by findings from Eldoret, Kenya as type of residence was not significantly associated with HPV vaccination (Vermandere et al., 2014). The difference in the effect of the type of residence may be because the study in Kenya was a longitudinal study that was done prior and post implementation of a pilot vaccination program yet the current study is cross-sectional and post pilot. The study finding suggest that increasing awareness related to HPV vaccine in rural areas is necessary to increase uptake.

In our study, girls of third birth order were more likely to have been vaccinated compared to first birth orders. This may be attributed to increased likelihood by women to utilize health services with increase in parity (Kulkarni & Nimbalkar, 2008). However, our findings are not supported by findings from Cameroon (Rodrigue ND, 2020) and Austria (Pruckner, Schneeweis, Schober, & Zweimüller, 2019) which indicated reduced odds of children's vaccination with higher birth orders. There is paucity of information that explains the low vaccination among first birth order girls especially in Uganda, which calls for further research.

Next, we examined whether mother's characteristics influenced HPV vaccine uptake of their daughters. This is because the vaccine is administered to minors (10-14 years) (MOH, 2010), delivered outside the mainstream Expanded Program for Immunization (EPI) and parents may be involved in providing consent. Our findings indicate that some mother characteristics significantly influence the vaccination of girls. High wealth index was positively associated with HPV vaccination. The likelihood of having already been vaccinated was found among girls with high wealth backgrounds though vaccination was free of charge for all. The plausible explanation for this relationship is that countrywide HPV vaccination was implemented in 2015 (WHO, 2015) 4 years prior to the survey (UBOS and IFC, 2018) making it relatively new. Social Economic Status (SES) has been identified to predict adoption of new positive health behaviors (Rogers, Singhal, & Quinlan, 1983). Individuals who are socioeconomically vulnerable are likely to practice a new positive health behavior after some time as their decisions depend on their experiences, adjust behavior a long time prior to changes in their awareness and knowledge, skeptical of innovations, take additional time to persuade, and sometimes they are suspicious because of their poor economic situation (Rogers et al., 1983). It is also likely that girls from poor families have parents who are less educated and may have limitations in accessing information and even when they do, they rarely understand it (Armstrong & Murphy, 2008; Mwaka, Okello, Kiguli, & Rutebemberwa, 2014). Additionally, research has significantly associated poverty with poor health-seeking behaviors (Kuuire, Bisung, Rishworth, Dixon, & Luginaah, 2016). Our results differ from a review on completion of multi-dose vaccine schedules in adolescents which indicated a rare significant influence of SES on vaccination (Gallagher et al., 2016). However, our results are in agreement with prior studies which found lower odds of HPV vaccination among girls with lower social economic backgrounds compared to girls with higher socioeconomic backgrounds (Kumar & Whynes, 2011; Lefevere et al., 2011; Marc et al.,

2019). The results of the current study point to creation of awareness among women with low SES.

We found that girls whose mothers had tertiary education were more likely to be vaccinated compared to girls whose mothers had primary education though not statistically significant. This is because mother's education attainment is likely to trigger positive attitude and health seeking behavior. A study in Zimbabwe found a positive significant relationship of mothers' education level with vaccination; children whose mothers had secondary education or higher were most likely to have been vaccinated compared to children whose mothers were having at most primary education (Rossi, 2015). This finding calls for more investment in universal education at all levels to reap the health benefits that accrue from an educated population.

Our study found that girls whose mothers were aged 30-39 years were most likely to have been vaccinated compared to girls whose mothers were aged 25-29 years. This relationship may be attributed to positive attitude towards the vaccine by older women compared to their younger counterparts (Lee, Chang, Cho, Park, & Park, 2017). Our study findings are not supported by findings from Kenya which did not find a significant relationship between age of the mother and HPV vaccination uptake of daughters (Mabeya et al., 2018). Our study results suggest that awareness regarding HPV vaccine should be created among younger women (25-29 years).

This study is cross-sectional. Therefore, it is not possible to evaluate causality. The current study does not provide data on HPV dose completion to facilitate better assessment of HPV vaccination completion rates. Secondly, HPV vaccination status was reported by mothers or caregivers to girls and could have been affected by recall bias. However, potential bias was minimized by asking respondents to provide vaccination cards which ensured reliability and validity of the data. Finally, this study was carried out in mainly two districts (Urban and rural) in central Uganda and consequently, the study results may not be generalizable to other contextually different areas.

Conclusion

This study established low uptake of HPV vaccination (39.4%) in Central Uganda. HPV vaccination was significantly associated with girl and mother/ caregiver factors; mothers' age, religion, wealth index, type of residence, birth order, mothers' knowledge about HPV, and schooling status were significantly associated with HPV vaccination. If higher vaccination rates are to be achieved in Central Uganda, both girl and mother factors responsible for variation in HPV vaccination should be addressed. A comprehensive approach should be taken to increase vaccine coverage in Central Uganda including; provision of universal basic education, creation of job opportunities, poverty alleviation, and female empowerment programs. In addition, bridging the inequality gaps between rural and urban areas are important community-based interventions that will alleviate low and variation in HPV vaccine uptake. Variation in HPV vaccination among different religious sects indicate that communication on HPV vaccine should be tailored to perceptions associated with religious beliefs. Our finding also calls for more involvement of Anglican and Pentecostal religious leaders in promoting uptake of HPV vaccination among followers. Awareness should be created through educating the public about the importance of vaccinating girls against HPV. There is scarcity of information that explains the low vaccination among Pentecostal and Anglican girls especially in Uganda, which calls for further research.

Ethics approval and consent to participate

Written informed consent was obtained from all women and parents/ guardian for girls prior to data collection. The study was approved by the ethics committee of Makerere University School of Social Sciences Research and Ethics Committee (MAHSSREC) and the Uganda National Council of Science and Technology (UNCST); UNCST registration number SS4848.

Availability of data and materials

The datasets used and/or analyzed during the current study is available from the corresponding author on reasonable request.

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