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HPV vaccination hesitancy among adolescent girls and caregivers in Rwanda

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Abstract

Background

Vaccination against human papillomavirus (HPV) is a highly effective way to prevent cervical cancer. Rwanda has achieved high HPV vaccination coverage through a school-based program, but vaccine hesitancy may threaten sustained uptake. This study aimed to estimate the prevalence of HPV vaccine hesitancy among adolescent girls aged 13–15 years and their caregivers, and to identify factors associated with hesitancy, to inform service delivery.

Methods

We conducted a nationally representative cross-sectional household survey in all 30 districts of Rwanda between July and October 2025. Adolescent girls aged 13–15 years and their caregivers were selected through multistage cluster sampling and interviewed separately using standardized questionnaires. Informed by the WHO SAGE framework, respondents were classified as hesitant if the girl was unvaccinated or if they reported unwillingness or uncertainty about vaccination, unwillingness to recommend the vaccine, or perceiving it as less than very important; caregivers were also asked about vaccine safety and family and friends' support. Survey-weighted multivariable logistic regression identified associated factors.

Results

A total of 2,651 adolescent girls and 2,744 caregivers were included (household response rate 94.1%; 89% among girls and 94% among caregivers); 2,241 caregivers had complete hesitancy data. HPV vaccine hesitancy was 15.9% (95% CI: 14.0–17.9) among adolescent girls and 29.1% (95% CI: 26.7–31.7) among caregivers. Among girls, being aged 14 years (adjusted odds ratio [aOR] 0.66, 95% CI 0.50–0.87) or 15 years (aOR 0.58, 0.40–0.82) rather than 13 years, attending school (aOR 0.16, 0.11–0.23), and living in the Northern (aOR 0.57, 0.34–0.97) or Southern Province (aOR 0.52, 0.34–0.80) were associated with lower odds of hesitancy, whereas Protestant affiliation was associated with higher odds (aOR 1.64, 1.24–2.19). Among caregivers, rural residence (aOR 0.63, 0.45–0.89), a male household head (aOR 0.61, 0.39–0.95) and a previously married household head (aOR 0.60, 0.41–0.87) were associated with lower odds of hesitancy.

Conclusions

HPV vaccine hesitancy persists in Rwanda among both girls and caregivers despite high coverage. Outreach to out-of-school girls, engagement of faith leaders, and caregiver-focused communication,

particularly in higher-hesitancy provinces and urban areas, could help sustain progress towards cervical cancer elimination.

Introduction

Although cervical cancer can largely be prevented through vaccination and screening, it remains a major public health problem worldwide. In 2022, it was the fourth most frequently diagnosed cancer in women, with an estimated 662,000 new cases and about 350,000 deaths globally [1]. Low- and middle-income countries (LMICs), particularly sub-Saharan Africa, carry a disproportionate share of this burden, largely because preventive services remain difficult to access [2]. Almost all cervical cancers are caused by persistent infection with high-risk HPV types, with HPV16 and HPV18 responsible for the majority [2]. As part of its strategy to eliminate cervical cancer, the World Health Organization (WHO) aims for 90% of girls to be fully vaccinated against HPV by the age of 15 years by 2030 [3]. More than 140 countries now include the HPV vaccine in their national immunization programs, yet coverage varies widely between settings [4].

Vaccine hesitancy, the delay in acceptance or refusal of vaccines despite the availability of vaccination services, is increasingly recognized as a barrier to reaching and maintaining high HPV vaccination coverage. For the HPV vaccine specifically, hesitancy has been linked to concerns about safety and side effects, misconceptions that the vaccine causes infertility, religious beliefs, lack of information, misinformation, and limited trust in vaccines and health systems [5–7]. Because the vaccine is given in adolescence, the decision to vaccinate usually involves both the girl and her caregiver, so understanding the factors associated with hesitancy among adolescents and their caregivers is central to designing interventions that build confidence and uptake. Studies from sub-Saharan Africa show that uptake depends on a mix of individual, community, and health-system factors, including knowledge, access to services, and social norms [8], although the weight of each factor differs between countries and programs.

Rwanda was one of the first African countries to introduce HPV vaccination nationally, starting with a pilot in 2011 and scaling up nationwide in 2013 [9, 10]. Schools deliver the vaccine, while community health workers mobilize out-of-school girls and refer them to nearby health facilities. Following the 2022 WHO recommendation that a single dose may be used [11], Rwanda's National Immunization Technical Advisory Group (NITAG) recommended in 2024 a switch from two doses to a single dose for girls aged about 12 years [12]. Strong political commitment, multisectoral collaboration and extensive community mobilization have helped the program sustain high coverage [9, 13]. In the 2025 Rwanda Demographic and Health Survey, 87% of women aged 15–17 years reported receiving at least one dose of the HPV vaccine; the remaining 13% were unvaccinated, suggesting that barriers to vaccine access and acceptance persist [14]. Repeated surveys have documented substantial declines in vaccine-targeted HPV infections in Rwanda since the vaccine was introduced, gains that vaccine hesitancy could undermine [15].

High coverage, however, does not necessarily reflect high confidence. Vaccine uptake is the proportion of the target population that has received a vaccine, whereas vaccine confidence is trust in the vaccine's safety and effectiveness and in the health system that delivers it [16]. A population can therefore be well vaccinated while still holding doubts that may erode future uptake. Despite Rwanda's success in delivering the HPV vaccine, nationally representative evidence on HPV vaccine hesitancy is scarce. Most African studies have examined uptake, awareness or acceptability rather than hesitancy itself [5–7, 17–21], and little is known about how sociodemographic, educational, religious and geographic factors relate to hesitancy among adolescent girls and their caregivers in Rwanda. This study therefore aimed to estimate the prevalence of HPV vaccine hesitancy, and to identify the factors associated with it, among adolescent girls aged 13–15 years and their caregivers in Rwanda.

Methods

Study design and setting

We conducted this survey in Rwanda as part of the HPV IMPACT project, a multi-country partnership to improve measurement of HPV vaccination coverage and equity in Gavi priority countries (Rwanda, Senegal, and Liberia), in which the University of Rwanda is a consortium partner [22]. We conducted a nationally representative, cross-sectional household survey of HPV vaccination coverage in all 30 districts of Rwanda between July and October 2025. Rwanda is a low-income country in East-Central Africa with a population of about 14.4 million, organized into four provinces and the City of Kigali, and 30 districts. Health services are provided through a decentralized system that links community health workers, health centers, and district, provincial and national referral hospitals, and that benefits from strong government commitment and a well-organized primary health care network.

Study population and sampling

The study population comprised adolescent girls aged 13–15 years and their caregivers living in Rwanda. We chose this age group because the national program targets girls at about 12 years of age, so girls aged 13–15 years should already have had the opportunity to be vaccinated, and because WHO monitors coverage as the proportion of girls vaccinated by age 15 [3]. We interviewed both girls and caregivers because the broader project also examined which of the two is the more reliable respondent for reporting HPV vaccination status. Eligible households were those with at least one girl aged 13 to under 16 years at the time of data collection and a resident caregiver; households without a caregiver were not visited. A multistage cluster sampling design produced estimates representative at the national and provincial levels. Enumeration areas from the National Institute of Statistics of Rwanda (NISR) national sampling frame served as primary sampling units. In the first stage, enumeration areas were selected with probability proportional to size; in the second stage, 15 eligible households were randomly selected in each enumeration area. We invited all eligible girls and caregivers in the selected households to take part.

Measures

Data were collected with structured electronic questionnaires in Kinyarwanda, Rwanda's national language, administered on tablets using SurveyCTO. The questionnaires were developed for this study by the HPV IMPACT consortium as a common English master version for Rwanda, Liberia and Senegal, then adapted to the Rwandan context and translated into Kinyarwanda; items on vaccine confidence, intention and social norms were adapted from the WHO Behavioural and Social Drivers of Vaccination (BeSD) survey tools [23]. The English versions of the caregiver and adolescent girl questionnaires are provided in Additional files 2 and 3. Trained data collectors, including nurses and experienced social science fieldworkers, conducted face-to-face interviews. Before the main survey, the team pretested the questionnaires in enumeration areas not selected for the survey and revised them accordingly. The questionnaires covered sociodemographic characteristics, HPV vaccination status, awareness and perceptions of HPV vaccination, behavioral and social drivers of vaccination, and reasons for hesitancy or non-vaccination. HPV vaccination status was based mainly on the girl's self-report and the caregiver's recall; documentary evidence (a vaccination card or an SMS confirmation received by the caregiver) was requested but was available for only 11.5% of vaccinated girls (269 of 2,349).

The primary outcome was HPV vaccine hesitancy, a binary variable constructed from vaccination status and attitude items (Additional file 1: Table S1). Adolescent girls were classified as hesitant if they had never received the HPV vaccine, if (when unvaccinated) they did not want or were unsure about receiving it, if they would not recommend it to others, or if they rated it as less than very important; they were classified as not hesitant if they were vaccinated, would recommend the vaccine, and rated it as very important. Caregivers were classified as hesitant if their daughter had never received the vaccine, or if they perceived the vaccine as less than very safe or less than very important, did not want or were unsure about their daughter receiving it, or believed that most of their close family and friends did not want their child to receive it; they were classified as not hesitant if their daughter was vaccinated and they gave non-hesitant responses to all four items. Because non-vaccination was part of the definition, all unvaccinated girls and all caregivers of unvaccinated girls were classified as hesitant; among vaccinated girls and caregivers of vaccinated girls, the outcome reflects attitudes only. Respondents who gave no hesitant response but had a missing value on any item were treated as missing for the outcome.

We chose this definition for three reasons. First, it reflects the WHO SAGE Working Group's view of hesitancy as a continuum between full acceptance and outright refusal, encompassing confidence (perceived safety), complacency (perceived importance) and intention [16, 24]. Second, including attitude items for vaccinated respondents captures residual doubts among those who have already accepted the vaccine, which may affect their future willingness to recommend it. Third, in a high-coverage setting such as Rwanda, a definition limited to refusal would identify very few respondents and would underestimate the burden. However, including non-vaccination means hesitancy among unvaccinated respondents cannot be separated from access-related reasons for not being vaccinated; therefore, we also report hesitancy separately by vaccination status.

For adolescent girls, the independent variables were age in completed years at the time of the survey, province of residence, place of residence (rural or urban), religion (recorded as Catholic, Anglican, Traditional, Adventist, Islam or other, and analyzed as Catholic, Protestant or other), current school attendance, and perceived family economic status (not enough money earned, just enough money earned, need extra money for fun, never worry about money earned). For caregivers, the independent variables were the sex, current marital status (married or living together, previously married, never married) and religion of the household head, household wealth quintile, the caregiver's own educational level (none, primary, secondary or higher), province of residence and place of residence (rural or urban).

Statistical analysis

All analyses accounted for the complex survey design and used post-stratification sampling weights, and were performed in StataNow version 19.5 (StataCorp LLC, College Station, TX, USA). Weighted proportions with 95% confidence intervals (CIs) were estimated for categorical variables. Unadjusted associations between HPV vaccine hesitancy and each independent variable were assessed using the Rao–Scott design-adjusted F test and survey-weighted bivariable logistic regression. Separate multivariable logistic regression models were then fitted for adolescent girls and for caregivers. Variables were selected a priori on the basis of the literature and their epidemiological relevance, and all were retained in the final models irrespective of their bivariable p-values: for girls, age, province, place of residence, perceived family economic status, religion and school attendance; for caregivers, sex, marital status and religion of the household head, wealth quintile, caregiver education, province and place of residence. We report results as crude odds ratios (ORs) and adjusted odds ratios (aORs) with 95% CIs, and we considered $p < 0.05$ statistically significant. Reasons for non-vaccination (asked of unvaccinated girls who had heard of the vaccine), concerns about the vaccine (asked of girls who reported any concern), and negative information about the vaccine heard by caregivers were summarized as survey-weighted proportions; more than one response was allowed (Additional file 1: Table S5). Because school attendance and vaccination status are closely linked in a school-based program, we conducted sensitivity analyses that estimated hesitancy separately among vaccinated and unvaccinated girls and among caregivers of vaccinated and unvaccinated girls, and refitted the girls' model restricted to vaccinated girls (Additional file 1: Tables S2-S4). The hesitancy outcome was missing for 12 adolescent girls (0.5%) and for 503 caregivers (18.3%); among caregivers, item missingness was highest for the social-norms question (505 caregivers, including responses other than yes or no). Analyses were restricted to respondents with complete data (complete-case analysis).

Ethical considerations

The Institutional Review Board of the University of Rwanda College of Medicine and Health Sciences approved the study, and the National Institute of Statistics of Rwanda authorized the survey (No. 0284/202510/NISR). Caregivers provided written informed consent, and adolescent girls provided

assent before participating. We protected confidentiality by using anonymized identifiers and restricting access to the data.

Results

Adolescent girls

Of the 2,651 adolescent girls aged 13–15 years interviewed, vaccination status was missing for six, and hesitancy could be determined for 2,639 (99.5%). The household response rate was 94.1%, and the individual response rate was 89% among adolescent girls and 94% among caregivers. HPV vaccine uptake was high (88.6%, 95% CI 86.6–90.4). Overall, 15.9% (95% CI 14.0–17.9) of girls were hesitant about the HPV vaccine (Table 1). Hesitancy varied by province ($p = 0.001$), being highest in the Eastern Province (21.3%) and the City of Kigali (18.6%) and lowest in the Northern (12.0%) and Southern (11.2%) provinces. It was lower among Catholic girls (11.8%) than among Protestant girls (18.8%) and girls of other religions (18.7%) ($p < 0.001$), and much higher among girls not attending school (44.8%) than among those in school (13.4%) ($p < 0.001$). Hesitancy did not differ significantly by age, place of residence or perceived family economic status.

Table 1
Sample distribution and weighted population characteristics of adolescent girls participating in the study, Rwanda, 2025 (N = 2,651)

Characteristics	Count (N)	Sample %	Weighted sample %	Hesitant (%)	95%CI	F Test, P-value
Age in years						2.583
13	933	35.2	33.5	18.5	[15.7,21.6]	0.080
14	931	35.1	33.3	15.0	[12.5,17.7]	
15	787	29.7	33.2	14.2	[11.2,18.0]	
Province						4.882
Eastern	680	25.7	28.3	21.3	[17.1,26.2]	**0.001**
Kigali City	397	15.0	9.8	18.6	[14.7,23.3]	
Northern	441	16.6	14.8	12.0	[8.3,17.1]	
Southern	580	21.9	23.6	11.2	[8.5,14.7]	
Western	553	20.9	23.5	15.4	[11.8,19.9]	
Place of residence						1.563
Rural	2,014	76.0	76.7	15.3	[13.1,17.7]	0.213
Urban	637	24.0	23.3	18.0	[14.6,21.9]	
Religion						8.690
Catholic	1,123	42.4	42.2	11.8	[10.0,14.0]	**< 0.0001**
Protestant	1,200	45.3	45.4	18.8	[15.8,22.3]	
Others	325	12.3	12.5	18.7	[14.2,24.1]	
Currently in school						116.858
No	199	7.5	8.1	44.8	[37.0,52.9]	**< 0.0001**
Yes	2,451	92.5	91.9	13.4	[11.7,15.2]	
Perceived family economic status						1.437
Not enough money earned	1,462	55.1	56.6	16.7	[14.2,19.5]	0.224
Just enough money earned	1,013	38.2	37.0	14.0	[11.6,16.9]	
Need extra money for fun	70	2.6	2.6	15.1	[7.8,27.1]	

Characteristics	Count (N)	Sample %	Weighted sample %	Hesitant (%)	95%CI	F Test, P-value
Never worry about money earned	63	2.4	2.3	21.3	[12.4,34.2]	
Ever received HPV vaccine						
No	297	11.2	11.4	100.0		
Yes	2,348	88.8	88.6	5.0		
Total	**2**,651	**100.0**	**100.0**	**15.9**	**[14.0,17.9]**	

Counts are unweighted and include all 2,651 girls interviewed; vaccination status was missing for six girls. Percentages hesitant and 95% CIs are survey-weighted and calculated among the 2,639 girls with a non-missing hesitancy outcome; p-values are from Rao–Scott design-adjusted F tests. CI: confidence interval.

In the adjusted survey-weighted multivariable analysis (Table 2), girls aged 14 and 15 years had significantly lower odds of hesitancy than those aged 13 years (aOR 0.66, 95% CI 0.50–0.87 and aOR 0.58, 95% CI 0.40–0.82, respectively). Girls from the Northern and Southern provinces had significantly lower odds of hesitancy than those from the Eastern Province (aOR 0.57, 95% CI 0.34–0.97 and aOR 0.52, 95% CI 0.34–0.80, respectively). School attendance was strongly associated with lower odds of hesitancy (aOR 0.16, 95% CI 0.11–0.23). Protestant girls and girls of other religions had significantly higher odds of hesitancy than Catholic girls (aOR 1.64, 95% CI 1.24–2.19 and aOR 1.52, 95% CI 1.09–2.13, respectively). Place of residence and perceived family economic status were not significantly associated with hesitancy after adjustment.

Table 2
Survey-weighted multivariable analysis of factors associated with HPV vaccine hesitancy among adolescent girls, Rwanda, 2025 (N = 2,592)

Variables	Crude			Adjusted		
	OR	95% CI	p-value	aOR	95% CI	p-value
Age in years						
13	Ref			Ref		
14	0.77	0.59–1.01	0.059	0.66	0.50–0.87	**0.003**
15	0.73	0.53–1.01	0.057	0.58	0.40–0.82	**0.003**
Province						
Eastern	Ref			Ref		
Kigali City	0.84	0.57–1.25	0.394	0.80	0.49–1.29	0.353
Northern	0.50	0.31–0.82	0.007	0.57	0.34–0.97	**0.038**
Southern	0.47	0.31–0.71	< 0.001	0.52	0.34–0.80	**0.003**
Western	0.67	0.45–1.02	0.061	0.71	0.47–1.08	0.108
Place of residence						
Rural	Ref			Ref		
Urban	1.22	0.89–1.66	0.214	1.16	0.80–1.68	0.422
Religion						
Catholic	Ref			Ref		
Protestant	1.72	1.32–2.25	< 0.001	1.64	1.24–2.19	**< 0.001**
Others	1.71	1.18–2.47	0.004	1.52	1.09–2.13	**0.015**
Currently in school						
No	Ref			Ref		
Yes	0.19	0.14–0.26	< 0.001	0.16	0.11–0.23	**< 0.001**
Perceived family economic status						
Not enough money earned	Ref			Ref		
Just enough money earned	0.82	0.62–1.07	0.147	0.94	0.70–1.25	0.652
Need extra money for fun	0.89	0.42–1.86	0.751	1.07	0.54–2.11	0.852
Never worry about money earned	1.35	0.69–2.66	0.379	1.65	0.81–3.35	0.167

Survey-weighted logistic regression accounting for stratification by district and clustering by enumeration area. Crude ORs are from bivariable models; adjusted ORs are from a model including all variables shown. p-values < 0.05 for adjusted ORs are shown in bold. OR: odds ratio; aOR: adjusted odds ratio; CI: confidence interval.

Reasons for non-vaccination and vaccine concerns. Among unvaccinated girls, 23.8% (95% CI 18.9–29.6) had never heard of the HPV vaccine. Among the 231 unvaccinated girls who had heard of it, the most frequently reported reasons for not being vaccinated were practical rather than attitudinal: being absent when the vaccine was given (21.0%), not knowing where to get it (19.3%), being too ill at the time (17.9%), and believing they were not of eligible age (13.8%). Few reported refusal by a parent or caregiver (3.3%), fear of side effects (1.9%), or religious objections (0.1%) (Additional file 1: Table S5). Overall, 4.5% (95% CI 3.7–5.5) of girls reported a concern about the vaccine, most commonly pain from the injection (25.6%), effects on fertility (21.9%), and safety (17.6%).

Sensitivity analysis. Hesitancy was 5.0% (95% CI 4.2–6.0) among girls who had received the HPV vaccine, whereas all 297 unvaccinated girls were, by definition, classified as hesitant (Table 1; Additional file 1: Table S2). Few unvaccinated girls reported hesitant attitudes: 3.7% did not want the vaccine or were unsure, 1.1% would not recommend it, and 5.8% rated it as less than very important, proportions like those among vaccinated girls (Additional file 1: Table S2). When the survey-weighted model was restricted to vaccinated girls (n = 2,299), school attendance was no longer significantly associated with hesitancy (aOR 0.51, 95% CI 0.24–1.09; p = 0.081), nor were age or religion; only residence in the Southern Province remained associated with lower odds of hesitancy (aOR 0.45, 95% CI 0.24–0.85; p = 0.014) (Additional file 1: Table S4).

Caregivers

We interviewed 2,744 caregivers, of whom 2,241 (81.7%) had complete data on the hesitancy outcome (Table 3). Most lived in male-headed households (75.4%), in households whose head was married or living with a partner (74.4%), and in rural areas (76.4%). Overall, 29.1% (95% CI 26.7–31.7) of caregivers were hesitant about the HPV vaccine.

Hesitancy was significantly higher among urban caregivers (35.0%) than among rural caregivers (27.3%) (p = 0.028). It was lower in households with a Catholic head (26.0%) than in those with a Protestant head (30.8%) or a head of another religion (32.4%) (p = 0.05). Hesitancy did not differ significantly by caregiver education (32.0% with no formal education, 27.9% with primary and 31.3% with secondary or higher education; p = 0.340), wealth quintile, or sex or marital status of the household head (Table 3).

Table 3
Sample distribution and weighted population characteristics of caregivers participating in the study, Rwanda, 2025 (N = 2,744)

Characteristics	Count (N)	Sample %	Weighted sample %	Hesitant (%)	95% CI	F Test, P-value
Sex of the household head						0.222
Female	676	24.6	24.6	30.3	[24.8,36.4]	0.638
Male	2,068	75.4	75.4	28.8	[26.1,31.6]	
Marital status of household head						0.685
Married/ Living Together	2,038	74.4	74.4	29.8	[27.1,32.5]	0.497
Previously Married	659	24.1	24.2	26.7	[21.8,32.2]	
Never Married	42	1.5	1.3	30.1	[16.2,48.9]	
Religion of household head						3.030
Catholic	1,212	44.5	43.4	26.0	[22.8,29.4]	**0.050**
Protestant	1,054	38.7	39.5	30.8	[27.0,34.8]	
Others	456	16.8	17.1	32.4	[27.1,38.1]	
Wealth quintiles						0.516
Poorest	549	20.0	20.8	28.7	[23.4,34.5]	0.718
Poorer	549	20.0	19.0	26.3	[21.7,31.5]	
Middle	549	20.0	19.9	31.6	[26.7,37.1]	
Richer	549	20.0	21.0	28.8	[23.5,34.8]	
Richest	548	20.0	19.4	29.9	[25.3,35.0]	
Caregiver education						1.082
None	506	18.5	19.1	32.0	[26.4,38.1]	0.340
Primary	1,908	69.7	69.8	27.9	[25.3,30.7]	
Secondary+	325	11.9	11.0	31.3	[24.5,39.0]	
Province						1.226
Kigali City	418	15.2	9.8	30.8	[21.7,41.6]	0.299
Eastern	699	25.5	28.3	29.1	[24.6,34.1]	
Northern	448	16.3	14.8	33.7	[28.3,39.6]	

Characteristics	Count (N)	Sample %	Weighted sample %	Hesitant (%)	95% CI	F Test, P-value
Southern	611	22.3	23.7	24.7	[20.0,30.0]	
Western	568	20.7	23.4	30.1	[25.1,35.8]	
Place of residence						4.900
Urban	665	24.2	23.6	35.0	[28.8,41.7]	**0.028**
Rural	2,079	75.8	76.4	27.3	[24.7,30.0]	
Total	**2,744**	**100.0**	**100.0**	**29.1**	[**26.7**,**31.7**]	

Counts are unweighted and include all 2,744 caregivers interviewed. Percentages hesitant and 95% CIs are survey-weighted and calculated among the 2,241 caregivers with a non-missing hesitancy outcome; p-values are from Rao–Scott design-adjusted F tests. Marital status and religion are for the household head; education is for the caregiver. CI: confidence interval.

In the adjusted survey-weighted multivariable analysis (Table 4), rural caregivers had significantly lower odds of hesitancy than urban caregivers (aOR 0.63, 95% CI 0.45–0.89). Caregivers in male-headed households had lower odds of hesitancy than those in female-headed households (aOR 0.61, 95% CI 0.39–0.95), as did caregivers whose household head was previously married rather than married or cohabiting (aOR 0.60, 95% CI 0.41–0.87). In bivariable analysis, a Protestant household head or a head of another religion was associated with higher odds of hesitancy (OR 1.27, 95% CI 1.01–1.60 and OR 1.36, 95% CI 1.00–1.85, respectively). These associations were attenuated and not statistically significant after adjustment (aOR 1.25, 95% CI 0.99–1.58 and aOR 1.32, 95% CI 0.98–1.79). Caregiver education, wealth quintile and province were not significantly associated with hesitancy after adjustment.

Table 4
Survey-weighted multivariable analysis of factors associated with HPV vaccine hesitancy among caregivers, Rwanda, 2025 (N = 2,216)

Variables	Crude			Adjusted		
	OR	95% CI	p-value	aOR	95% CI	p-value
Sex of the household head						
Female	Ref			Ref		
Male	0.93	0.68–1.26	0.638	0.61	0.39–0.95	**0.030**
Marital status of household head						
Married/Living together	Ref			Ref		
Previously married	0.86	0.65–1.14	0.292	0.60	0.41–0.87	**0.008**
Never married	1.01	0.45–2.28	0.971	0.78	0.33–1.84	0.572
Religion of household head						
Catholic	Ref			Ref		
Protestant	1.27	1.01–1.60	0.045	1.25	0.99–1.58	0.065
Other religions	1.36	1.00-1.85	0.048	1.32	0.98–1.79	0.067
Household wealth quintile						
Poorest	Ref			Ref		
Poorer	0.89	0.62–1.27	0.519	0.97	0.65–1.43	0.868
Middle	1.15	0.80–1.65	0.439	1.29	0.88–1.89	0.199
Richer	1.01	0.69–1.47	0.970	1.10	0.71–1.70	0.662
Richest	1.06	0.74–1.53	0.736	1.22	0.79–1.88	0.362
Caregiver education						
None	Ref			Ref		
Primary	0.82	0.62–1.09	0.180	0.81	0.61–1.08	0.157
Secondary or higher	0.97	0.64–1.48	0.882	0.79	0.50–1.23	0.295
Province						
Kigali City	Ref			Ref		
Eastern	0.92	0.55–1.56	0.766	1.20	0.68–2.14	0.525
Northern	1.15	0.67–1.96	0.615	1.60	0.91–2.82	0.103

Variables	Crude			Adjusted		
	OR	95% CI	p-value	aOR	95% CI	p-value
Southern	0.74	0.43–1.27	0.267	1.03	0.57–1.85	0.931
Western	0.97	0.57–1.66	0.913	1.21	0.68–2.14	0.514
Place of residence						
Urban	Ref			Ref		
Rural	0.70	0.51–0.96	0.029	0.63	0.45–0.89	**0.009**

Survey-weighted logistic regression accounting for stratification by district and clustering by enumeration area. Crude ORs are from bivariable models; adjusted ORs are from a model including all variables shown. p-values < 0.05 for adjusted ORs are shown in bold. OR: odds ratio; aOR: adjusted odds ratio; CI: confidence interval. Marital status and religion are for the household head; education is for the caregiver.

Negative information heard about the vaccine. Overall, 7.2% (95% CI 6.0–8.6) of caregivers had heard something negative about the HPV vaccine in the previous 12 months. Among them, the most frequently reported content was that the vaccine affects fertility (82.2%), followed by concerns about its safety (12.7%), pain from the injection (4.0%), and the belief that it encourages sexual activity (1.8%); in free-text responses, caregivers also described effects on menstruation and the uterus (Additional file 1: Table S5).

Sensitivity analysis. By definition, all caregivers of unvaccinated girls were classified as hesitant. Among caregivers of vaccinated girls, 19.0% (95% CI 16.6–21.5) were hesitant, most often because they perceived the vaccine as less than very safe (12.8%) or less than very important (7.2%) (Additional file 1: Table S3).

Discussion

This nationally representative study estimated the prevalence of HPV vaccine hesitancy and the factors associated with it among adolescent girls aged 13–15 years and their caregivers in Rwanda. Although 88.6% of girls had received the vaccine, about one in six girls (15.9%) and nearly one in three caregivers (29.1%) were hesitant. Hesitancy was low among vaccinated girls (5.0%), and among girls overall it was associated with being out of school, being younger, Protestant or other non-Catholic affiliation, and living in the Eastern Province rather than in the Northern or Southern provinces. Among caregivers, hesitancy was associated with urban residence, a female household head and a married or cohabiting household head, whereas non-Catholic affiliation of the household head was associated with higher hesitancy only in bivariable analysis. We discuss these findings in turn below.

High coverage and residual hesitancy can coexist even in well-performing immunization programs. In our study, hesitancy among vaccinated girls was low (5.0%), indicating that most vaccinated girls had few reservations; the overall prevalence among girls was driven largely by the unvaccinated minority, who

were classified as hesitant by definition. Among caregivers, hesitancy was higher than among girls; although this difference partly reflects measurement (see below), it means that a substantial share of the adults who influence vaccination decisions hold reservations even in a program achieving close to 90% coverage. Rwanda's program may sustain high coverage despite these reservations because school-based delivery brings the vaccine to girls with little effort required from families, and because community mobilization and trust in the public health system create a strong norm of vaccination [9, 10, 13]. Coverage that rests on delivery rather than on confidence may, however, be fragile. A global review by Larson and colleagues showed that hesitancy determinants are context-specific and that concerns about vaccine risks are among the most frequently reported [5], and Dubé and colleagues described how media-amplified reports of adverse events and anti-vaccine messages can rapidly reduce acceptance [25]. In Japan, HPV vaccine coverage fell from more than 70% to below 1% after the government suspended its proactive recommendation in 2013 following media reports of adverse events [26], and in Denmark, uptake fell from about 90% to 54% in later birth cohorts during a period of increasingly negative media coverage [27]. Monitoring vaccine confidence alongside coverage would help Rwanda detect and address emerging concerns before they translate into lower uptake.

The prevalence of hesitancy among girls in our study (15.9%) was lower than that reported among adolescent girls and young women in other settings. Hesitancy was 39.0% among female school students in Jimma, Ethiopia [17], 27.9% among female university students in Gondar, Ethiopia [19], and 44.8% among female first-year college students in Henan Province, China [21]. Among caregivers, our estimate (29.1%) was lower than the 46.8% reported among parents in Buea, Cameroon [28], and in South African schools with low coverage, 49.2% of caregivers of unvaccinated daughters gave hesitancy-related reasons for not vaccinating [20]. These comparisons should be interpreted with caution, because the studies used different definitions and instruments and were conducted in populations of different ages and with different access to the vaccine. In those settings, hesitancy was mainly linked to concerns about safety, misinformation and limited knowledge of HPV and cervical cancer [5–7, 17]. Lower hesitancy in Rwanda may reflect the reach of its school-based program and strong immunization infrastructure, which have achieved high coverage and reduced HPV prevalence [9, 13, 15]. Nevertheless, persistent hesitancy in a country with a strong routine immunization program shows that its drivers still need to be addressed.

Among adolescent girls, school attendance was strongly associated with lower hesitancy. This association must be interpreted with caution. Because the HPV vaccine is delivered mainly in schools in Rwanda, out-of-school girls are less likely to have been vaccinated, and because unvaccinated girls were classified as hesitant by definition, much of this association reflects differences in vaccination status rather than in attitudes. Indeed, when the analysis was restricted to vaccinated girls, school attendance was no longer significantly associated with hesitancy (aOR 0.51, 95% CI 0.24–1.09), and unvaccinated girls rarely reported hesitant attitudes, suggesting that the school gradient mainly reflects access to vaccination rather than differences in confidence. Beyond access, school-based delivery, which is widely used to reach adolescent girls in LMICs [29], also exposes girls to information from teachers, peers and visiting health workers, whereas out-of-school girls may miss both the vaccine and reliable information

about it. A systematic review from sub-Saharan Africa similarly identified school absenteeism and dropout as barriers to HPV vaccination [7]. Community-based and outreach strategies, such as tracing girls who leave school as recommended by Rwanda's NITAG [12], are therefore needed so that out-of-school girls are not missed.

Hesitancy also varied by province, but the patterns differed between girls and caregivers. Among girls, hesitancy was highest in the Eastern Province and lowest in the Northern and Southern provinces, and these differences persisted after adjustment for school attendance, place of residence and economic status. By contrast, among caregivers, hesitancy was highest in the Northern Province (33.7%), although provincial differences were not statistically significant after adjustment. This divergence suggests that girls' attitudes may be shaped more by school-based information and vaccination than by their caregivers' views, and that caregiver reservations do not necessarily lead to non-vaccination where school delivery is strong. Structural factors that differ between provinces may also contribute, including distances to health facilities in sparsely populated areas, the intensity of community mobilization, the density of community health workers and health facilities, school enrollment and attendance, and socioeconomic conditions; subnational variation in HPV vaccine confidence and uptake has been linked to such contextual factors in other settings [7, 30, 31]. Notably, rural residence was associated with lower caregiver hesitancy, even though access barriers are generally greater in rural areas, suggesting that differences in information environments, rather than access alone, may underline part of the geographic variation. Because we did not measure these contextual factors, we cannot attribute the provincial differences to a specific mechanism. Multilevel studies that include district- and community-level variables, such as health facility density, community health worker coverage and socioeconomic indices, are needed to explain subnational variation in HPV vaccine hesitancy in Rwanda.

Girls' reported reasons point to access rather than reluctance. About one in four unvaccinated girls had never heard of the vaccine, and among those who had, absence on the vaccination day, not knowing where to get the vaccine, illness and perceived ineligibility were the main reasons for not being vaccinated, whereas refusal and fear of side effects were rare. This pattern differs from that reported in other African studies, in which safety concerns, infertility rumors and misinformation dominated [5, 7, 17, 19]. Concerns about fertility were nevertheless present: they were among the most common concerns of girls and dominated the negative information heard by caregivers (82.2% of those who had heard something negative), consistent with the infertility rumors documented across sub-Saharan Africa [7, 17]. These findings suggest two priorities for Rwanda: catch-up vaccination and clear information on eligibility and vaccination sites for girls who miss school-based sessions, and proactive communication that addresses fertility-related rumors among caregivers.

HPV vaccine hesitancy was higher among caregivers than among adolescent girls. Part of this difference reflects measurement: the caregiver definition included two items that girls were not asked, perceived safety and perceived social norms, and the safety item alone classified about one in ten responding caregivers as hesitant (261 of 2,550). Nevertheless, the finding matters because caregivers influence their daughters' vaccination decisions. Among caregivers of vaccinated girls, 19.0% were

hesitant, mainly because they did not consider the vaccine very safe (Additional file 1: Table S3), showing that reservations persist even among caregivers whose daughters have been vaccinated. Unlike in Cameroon, where lower parental education was associated with hesitancy [28], caregiver education was not associated with hesitancy in our study: hesitancy was similar among caregivers with no formal education (32.0%) and those with secondary or higher education (31.3%). More educated caregivers, who are more often urban, may be exposed to more diverse and sometimes conflicting information about vaccines, including online, which may offset the benefits of education [25]. Caregivers in male-headed households and those whose household head was previously married had lower odds of hesitancy. These household-level associations were not anticipated; they may reflect differences in who makes health decisions within the household or in exposure to vaccine information, and they should be confirmed in further studies.

Religious affiliation was associated with hesitancy among girls, with higher odds among Protestants and other non-Catholic groups than among Catholics; among caregivers, a similar pattern emerged in bivariable analysis by the household head's religion but attenuated after adjustment. Studies from other settings point to several possible mechanisms. In Cameroon, parents whose religious leaders did not support HPV vaccination had more than three times the odds of hesitancy [28], highlighting the influence of faith leaders. A scoping review of Muslim-majority countries found that fears that the vaccine causes infertility or encourages sexual activity, perceived conflict with religious norms, and concerns about forbidden ingredients shaped acceptance [32]. In the United States, religious beliefs were associated with HPV vaccination attitudes among college students [33], stronger religious commitment was associated with lower HPV vaccine adherence and less knowledge about HPV [34], and religious affiliation was linked to moral and philosophical beliefs about vaccines [35]. In Rwanda, differences between denominations may reflect church leaders' stances on the vaccine, the extent to which congregations engage in health programs, and the messages that circulate within religious networks. Because religious beliefs and leaders' positions were not measured in this study, the association may also reflect broader social and community factors, such as trust in health services and exposure to vaccine-related information. Engaging leaders of Protestant and other faith communities as partners in HPV vaccine communication, and qualitative research on the reasons for denominational differences, are warranted.

Urban residence was associated with higher caregiver hesitancy. In some settings, urban populations are exposed to more diverse and conflicting sources of health information, including social media, which can undermine confidence [25], whereas rural communities may receive more consistent messages through community health workers. Ensuring that accurate information reaches urban caregivers through the channels they use, including digital and mass media, could therefore be an important action.

Study strengths and limitations

This study has several strengths. It used a nationally representative sample and a complex survey design, and it interviewed girls and caregivers separately, which supports the generalizability of the

findings to Rwanda and similar settings. It also has limitations. First, the hesitancy items were limited and differed between girls and caregivers: only caregivers were asked about vaccine safety and social norms, and neither group was asked about trust in the health system or exposure to misinformation, so comparisons between girls and caregivers should be interpreted with caution. Second, the cross-sectional design does not allow causal inference. Third, our definition of hesitancy was broader than the definitions used in some previous studies, which counted only refusal or delay; this may yield higher prevalence estimates and limits direct comparison across studies. Fourth, hesitancy was analyzed as a binary outcome; we did not examine its dimensions or degrees (for example, through factor analysis or an ordinal scale), nor did we test interactions between factors such as age and place of residence. Fifth, because non-vaccination was part of the definition, we classified all unvaccinated respondents as hesitant, although few reported hesitant attitudes, so hesitancy among unvaccinated respondents largely reflects non-vaccination, which may reflect access as much as attitudes. Sixth, the outcome could not be determined for 18.3% of caregivers, mostly because they answered "don’t know" to the social-norms question; if these caregivers differed systematically from those with complete data, the caregiver estimates may be biased. Finally, vaccination status relied mainly on self-report and caregiver recall because documentary evidence was rarely available, and may be subject to recall and social desirability bias.

Conclusions

HPV vaccine hesitancy affects about one in six adolescent girls and nearly one in three caregivers in Rwanda despite high vaccine uptake. Rwanda’s school-based program has achieved high coverage, but our findings identify groups that warrant targeted action: out-of-school girls, who need outreach that brings both the vaccine and accurate information to them; younger adolescents, who may benefit from age-appropriate information at the time of vaccination; Protestant and other non-Catholic communities, where faith leaders could be engaged as partners in vaccine communication; urban caregivers, who may be reached through digital and mass media channels; and girls in the Eastern Province, where hesitancy was highest. Monitoring vaccine confidence alongside coverage, and qualitative research on the reasons for hesitancy in these groups, would help sustain progress towards cervical cancer elimination.

Abbreviations

aOR
Adjusted odds ratio
BeSD
Behavioural and Social Drivers of Vaccination
CI
Confidence interval
HPV
Human papillomavirus
LMICs

Low- and middle-income countries
NISR
National Institute of Statistics of Rwanda
NITAG
National Immunization Technical Advisory Group
OR
Odds ratio
SAGE
Strategic Advisory Group of Experts on Immunization
WHO
World Health Organization.

Declarations

AI use disclosure

Claude (Anthropic) was used to assist with language editing and with revising the manuscript. The authors reviewed and verified all content and take full responsibility for the manuscript.

Ethics approval and consent to participate:

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the University of Rwanda College of Medicine and Health Sciences (Reference Number 212/CMHS/IRB/2025 of March 17, 2025). We obtained written informed consent from caregivers and assent from adolescent girls before participation.

Consent for publication:

Not applicable.

Competing interests:

The authors declare that they have no competing interests.

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Author Contribution

A.N. conceived the study protocol, developed the methodology, analyzed the data, and prepared the original draft; T.N., M.G., EK, AKZ, HS, and AM reviewed and edited the manuscript. All authors read and approved the final manuscript.

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Data Availability

All data supporting the findings of this study are available upon request to the corresponding author.

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2022;27:3059–81.

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- AlbertNdagijimanaHPVvaccinehesitancyAdditionalFile3AdolescentGirlQuestionnaire.docx