

RESEARCH ARTICLE



Human papillomavirus vaccination in rural Malawi: Identifying factors associated with vaccine uptake using a community-based household survey

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ABSTRACT

Uptake of the human papillomavirus (HPV) vaccine is suboptimal globally. Effective interventions are needed to meet the global goal of vaccinating 90% of girls against HPV, and this requires a robust understanding of barriers to vaccine uptake. Using a household survey in three communities of Malawi with parents/guardians of girls aged 9–13 years, we collected and analyzed data about intervention-amenable factors hypothesized to be associated with girls' HPV vaccination status. The 299 parent/guardian respondents provided information on 382 girls aged 9–13 years, of whom 39.0% ($n = 149$) had received ≥ 1 dose of the HPV vaccine. More than half of parents/guardians were concerned about the HPV vaccine's safety. Greater HPV vaccine hesitancy was associated with having an unvaccinated daughter in adjusted multilevel models (aOR 0.69 [95% CI 0.50–0.93]). Higher odds of being vaccinated were found among daughters of respondents with greater knowledge about the HPV vaccine and who knew someone who had cervical cancer. Speaking with more people about cervical cancer/HPV vaccination, and perceiving that other parents are vaccinating their daughters against HPV, were strongly associated with daughters' HPV vaccination status (aOR 2.03 [95% CI 1.59–2.62] and 3.68 [95% CI 1.97–7.18, respectively]). Most parents/guardians had not experienced, or did not anticipate experiencing, challenges accessing HPV vaccination services, but those who did also had daughters with lower odds of vaccination. Interventions that leverage social networks and norms, increase confidence in the vaccine's safety, and work to improve access to HPV vaccination services, may increase coverage of the HPV vaccine in Malawi.

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Introduction


Although over 90% of the global cervical cancer burden occurs in low- and middle-income countries (LMICs),¹ there is very low uptake of the highly effective human papillomavirus (HPV) vaccine in LMICs.² The HPV vaccine is an extremely important tool in the global effort to eliminate cervical cancer³; it is also highly effective at preventing other types of cancer (including oropharyngeal and other anogenital cancers).⁴ Malawi has the second-highest cervical cancer incidence and attributable mortality in the world,¹ yet in 2022, only an estimated 13% of eligible Malawian girls received any HPV vaccine dose(s).⁵ This number increased in the 2023 data, with 68% of Malawian girls having received any dose(s) of the HPV vaccine.⁶

Interventions will be needed to achieve the global goal of vaccinating at least 90% of eligible girls in all countries by the year 2030.³ To design effective interventions, we need to understand the factors associated with receiving the vaccine in diverse settings. There is a rich literature from high-income countries that has informed a number of highly effective behavioral interventions⁷—but we lack similar information from the high-burden LMICs where HPV vaccination is urgently

needed.⁸ Since Malawi introduced its national HPV vaccination program for preadolescent girls in 2019, the published literature has included qualitative insights^{9,10} and has explored attitudes toward the HPV vaccine and intention to vaccinate,^{11,12} but there have been no empirical studies to identify factors associated with HPV vaccination in the Malawian context.

Malawi is a southern-eastern African country of approximately 20 million people.¹³ There are an estimated 70.9 cases of cervical cancer, and 54.1 deaths attributable to cervical cancer, per 100,000 Malawian women.¹ Cervical cancer incidence is increasing in Malawi,¹⁴ and the HPV vaccine is urgently needed, particularly because many women are not reached by secondary prevention (screening) services.^{15,16} There was a very successful HPV vaccination demonstration project in Malawi from 2013–2016 in which over 80% of eligible girls in targeted areas received the HPV vaccine.¹⁷ However, since formal vaccine rollout in 2019, uptake has been much lower.⁵ Under the national program, HPV vaccination is offered for free to eligible girls (primarily 9 year-old girls at the time of this study), and delivered via school- and community-based campaigns

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as well as routinely at health facilities (two doses were recommended at the time of this study).

We aimed to identify individual-level factors associated with HPV vaccination through a community-based survey in three districts of Malawi. The overall goal of this research was to identify potential targets for interventions that would aim to increase uptake of the HPV vaccine in the Malawi context.

Methods

HPV is an extremely common sexually transmitted infection; it is estimated that approximately 11.7% of adults globally are infected with HPV, and Africa has the highest regional prevalence (24.0%).¹⁸ Although many HPV infections are asymptomatic and do not require treatment, certain high-risk types of HPV are carcinogenic. HPV causes approximately new 690,000 cases of cancer each year, most of these in the cervix.⁴ Vaccines to prevent infection with high-risk HPV types were introduced in the United States in 2006 and in other high-income countries shortly thereafter. These vaccines have been shown to reduce infections with these high-risk types by over 80% in girls^{19,20} as well as decreased incidence of cervical pre-cancers and cervical cancer.^{20–25} Numerous low- and middle-income countries have now also introduced the HPV vaccine.^{26–29}

We conducted a cross-sectional household survey of parents/guardians of girls currently or recently age-eligible for HPV vaccination per Malawi guidelines.^{30,31} Malawi is a country in southeastern Africa. This study was conducted in collaboration with a Malawian non-governmental organization (Children in the Wilderness) that provides education programming for young people in three districts of Malawi: two in the Southern region (Balaka and Machinga) and one in the Northern region (Nkhata-Bay). Surveys were conducted between December 2022 and January 2023.

Data collection and analysis were informed by the World Health Organization Behavioral and Social Drivers of Vaccination (BeSD) framework.^{32,33} Figure 1 shows the study's conceptual model, i.e., the constructs examined in this study aligned with the BeSD domains. We aimed to identify which constructs were associated with a respondent's daughter's or daughters' HPV vaccination status.

Survey instrument

The survey instrument included questions reflecting the constructs in Figure 1 (see Appendix 1). HPV vaccination was measured by asking the parent/guardian if their age-eligible daughter(s) (i.e., between the ages of 9–13 years) had received any doses of the HPV vaccine and if so, the date and place of each dose received. Factors hypothesized to be associated with this, included HPV vaccine hesitancy (negative attitudes about importance, effectiveness, and/or safety), HPV vaccine knowledge, perceived disease risk, social processes about HPV vaccine (conversations about the HPV vaccine, health worker recommendation of HPV vaccination, vaccination social norms), and access to HPV vaccination services. To measure these factors, we adapted questions from existing instruments as shown in Table 1.^{33–38} The survey instrument also included questions about characteristics of the parent/guardian (e.g., demographics and educational attainment), the household (e.g., location and socioeconomic status), and the age-eligible girls in the household (e.g., their ages and birth order). The survey instrument was developed in English, and translated to Chichewa by experienced and fully bilingual study team members and research assistants, who also pilot tested the survey instrument with other study team members.

Sample selection

In order to select a sample with the target population of age-eligible girls, in each of the three study districts (Balaka and Machinga in Southern Malawi, and Nkhata-Bay in Northern Malawi), with support from local primary schools and health surveillance assistants (a community health worker), we developed a list of girl(s) aged 9–13 years, and purposively selected 40 villages with the most girls on this list. Ultimately, approximately 100 households were recruited in each district. We aimed for a total sample size of 300 households based on a power calculation using an assumed actual coverage of HPV vaccination of 70% (per 2023 administrative data⁶) with 5% error and 95% level of confidence.

A research assistant visited each selected household, accompanied by a community health worker, to describe the study to adults in the household. An eligible respondent self-identified as being a parent or guardian to a girl aged 9–13 years. If a household was not eligible, not interested in participating, or was not available within two days of attempts, another household was selected from the sampling frame.

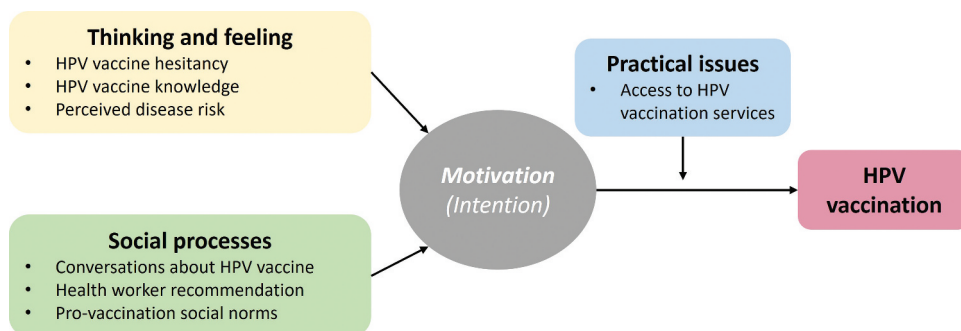


Figure 1. Study conceptual model. Motivation was not measured in this study

Table 1. All study constructs and variable construction.

Construct	Source & adaptations	Operationalization for analysis
HPV vaccine hesitancy	Adapted the Vaccine Hesitancy Scale-HPV ³⁴ ; chose items that could be well-translated; added detail on severity and duration of side effects per our team's formative work ⁹	Seven items, each scored on a 4-point Likert per VHS guidance ³⁴ ; averaged items for respondents who answered > 3 of the questions to generate a mean hesitancy score
HPV vaccine knowledge	Adapted from previous studies ^{35,36} ; chose items that could be well-translated	Seven items, each scored dichotomously (correct, versus incorrect or don't know); summed correct items to generate a total knowledge score
Perceived disease risk	Question used previously by our team ³⁷ about whether the respondent knew someone who had cervical cancer	One item, treated dichotomously (yes, versus no)
Social processes about HPV vaccine	Adapted the Human Papillomavirus Attitudes and Beliefs Scale ³⁸ subscales on "communication" and "influence;" chose items that could be well-translated, and added types of discussions	Two items about discussions, each treated dichotomously (yes, versus no) Two items about comfort in discussing, each treated dichotomously (very comfortable, versus somewhat comfortable, not comfortable, or don't know) Two items about social norms, each treated dichotomously (strongly agree, somewhat agree or don't know, versus strongly disagree or somewhat disagree)
Access to HPV vaccination services	Adapted the World Health Organization BeSD question on ease of access ³³	One question about ease of access experienced or anticipated, treated categorically (not at all difficult, a little or somewhat difficult, or very difficult)

Data collection

After assessing eligibility and confirming interest in participation, the research assistant obtained the parent/guardian's oral informed consent to participate in the survey. The survey was administered immediately thereafter: the research assistant read each question aloud in local language (Chichewa) and recorded each response in an electronic data collection form using SurveyCTO software. The parent/guardian provided information about all girls aged 9–13 in the household. The surveys lasted on average 44.5 minutes. Each parent/guardian respondent received the equivalent of US\$ 5 for their participation.

Data analysis

We described characteristics of parents/guardians, households, and girls, and stratified these by daughter's HPV vaccination status: any doses received, no doses received, or do not know. The only variable with substantial missingness was age of the child, and we used single imputation within groups defined by birth order to replace these ($n = 45$). Relationships between all hypothesized associated factors (see Table 1) and a dichotomous vaccination status variable (any doses versus no doses, excluding those with unknown status) were assessed using generalized linear mixed effects models. These included covariates representing parent/guardian and household characteristics (age, gender, educational attainment, employment status, and marital status; household income and location) as well as girl characteristics (age, birth order), and had a random intercept for parents/guardians to account for clustering at the family level. Adjusted odds ratios of vaccination status including these covariates were reported with 95% confidence intervals. We also conducted a set of analyses that treated "access to HPV vaccination services" as a moderator, per the BeSD conceptual framework (Figure 1), i.e., each variable was interacted with the "access" variable in turn.

Ethical review

The study was reviewed and approved by the Malawi National Health Sciences Research Committee (protocol #21/04/2685). The study was reviewed by the University of California Los Angeles Institutional Review Board (protocol #21-001174) and determined to be exempt from review as no identifiable data were collected. All respondents gave oral informed consent to participate.

Results

In total, we visited 330 eligible households; five were not interested in participating and 26 were not available. This led to the ultimate survey sample: a total of 299 parents/guardians

Table 2. Characteristics of the parent/guardian sample ($n = 299$).

Parent/guardian age ^a	
Mean (SD)	40.38 (11.03)
Parent/guardian gender, n (%)	
Male	38 (12.67)
Female	262 (87.33)
Parent/guardian level of educational attainment, n (%)	
No school or did not complete primary	199 (66.33)
Primary	70 (23.33)
Secondary	18 (6.00)
Higher	13 (4.33)
Parent/guardian employment, n (%)	
Employed	90 (30.00)
Self-employed	156 (52.00)
Not employed	54 (18.00)
Parent/guardian marital status, n (%)	
Single	4 (1.33)
Married/Cohabiting/Partnered	230 (76.67)
Widowed	20 (6.67)
Divorced	46 (15.33)
Household income sufficiency over prior year, n (%)	
More than sufficient	56 (18.67)
Sufficient (just met expenses)	166 (55.33)
Insufficient	78 (26.00)
Household location^b, n (%)	
Trading center (town)	52 (17.33)
Village (rural)	248 (82.67)

^a4 parents/guardians had a missing age value.

^bNo households were located in urban/city areas.

were surveyed, and reported on HPV vaccination status for 382 girls between the ages of 9 and 13.

Characteristics of the 299 respondents included in this analysis are shown in Table 2. Parents/guardians were on average 40.4 years old; most respondents ($n = 262$, 87.3%) were female. Two-thirds of respondents had no formal schooling or had not completed primary level ($n = 199$, 66.3%). Approximately 80% were working ($n = 90$, 30.0%) or self-employed ($n = 156$, 52.0%), and approximately half were just meeting their household's financial needs ($n = 166$, 55.3%) while 26.0% said their household's income was not sufficient to meet their needs ($n = 78$) and 18.7% said the household had more than enough income to meet their needs ($n = 56$).

Of the 382 girls with a reported vaccination status, 216 had not received any doses of the HPV vaccine (56.5%), and 149 had received at least one dose (39.0%). The 17 girls (4% of the sample) with unknown HPV vaccination status were excluded from all subsequent analyses.

There were few differences in girls' HPV vaccination status by parents'/guardians' characteristics, although more daughters of unemployed (not working or retired) respondents were vaccinated compared to their peers with employed or self-employed parents/guardians ($p = .055$) (Appendix 2).

"Thinking and feeling" correlates of HPV vaccine uptake

Nearly all respondents strongly agreed that the HPV vaccine is important for their daughter(s) (90.1%) and is effective (92.5%) (Table 3), but many expressed concerns about the vaccine's safety. Nearly 60% of parents/

guardians strongly agreed that the HPV vaccine was riskier than other vaccines ($n = 125$, 59.2%). Half of respondents were worried about long-term side effects of HPV vaccination ($n = 128$), 55.2% of respondents ($n = 143$) were worried about severe short-term side effects from the HPV vaccine, and 61.3% ($n = 155$) were worried about mild to moderate short-term side effects from the HPV vaccine. (The frequencies of all response options to these questions can be found in Appendix 3).

Daughters of respondents who were concerned about long-term side effects had much lower odds of HPV vaccination than girls whose parents/guardians did not have these safety concerns (aOR 0.79 [0.69–0.92]) (Table 3). Daughters of respondents with concerns about short-term side effects, either mild/moderate or severe, had approximately 15% lower odds of HPV vaccination than those who were not concerned. Overall, expressing more HPV vaccine hesitancy was significantly associated with lower odds of having a vaccinated daughter (aOR 0.69 [0.50–0.93]).

Most parents/guardians exhibited a high level of knowledge about HPV and the HPV vaccine (Table 4). Approximately 90% knew that the HPV vaccine protects against cervical cancer (91.6%, $n = 274$) and that someone could have HPV for many years without knowing it (90.6%, $n = 271$). Over three-quarters knew that HPV can cause cervical cancer (81.6%, $n = 244$) and that the vaccine is effective if given to girls before they become sexually active (76.1%, $n = 226$). (The frequencies of all response options to these questions can be found in Appendix 4).

Table 3. Parental attitudes about the HPV vaccine and HPV vaccine hesitancy, and associations with girls' HPV vaccination.

	n (%) of parents/guardians strongly agree ^a	aOR girls' receiving any HPV vaccine dose(s) (95% CI) ^b
The HPV vaccine is important for my daughter's health ^c	256 (90.14)	1.18 (0.84–1.72)
Getting the HPV vaccine is a good way to protect my daughter from disease ^c	260 (92.53)	1.44 (0.90–2.64)
The HPV vaccine carries more risks than older vaccines ^{c,d}	125 (59.24)	0.91 (0.78–1.07)
I am concerned about mild to moderate short-term effects of HPV vaccine ^{c,d}	155 (61.26)	0.84* (0.72–0.98)
I am concerned about serious short-term effects of HPV vaccine ^{c,d}	143 (55.21)	0.85* (0.73–0.98)
I am concerned about long-term mild, moderate or severe effects of HPV vaccine ^{c,d}	128 (50.00)	0.79** (0.69–0.92)
I do what the health care provider recommends about HPV vaccine ^{c,e}	213 (88.38)	1.51* (1.05–2.29)
	Mean (SD)	aOR any HPV vaccine dose(s) (95% CI) ^c
Mean HPV vaccine hesitancy score (higher score indicates more hesitancy) ^f	3.56 (0.84)	0.69* (0.50–0.93)

^aStrongly agree versus Somewhat agree, Strongly disagree or Somewhat disagree (Don't know is excluded).

^bAdjusted odds ratios were adjusted for: Parent's/guardian's age (continuous), parent's/guardian's gender (male/female), parent's/guardian's educational level (no school or incomplete primary/primary/secondary/higher), parent's/guardian's employment status (employed/self-employed/unemployed), parent's/guardian's marital status (single/married or cohabitating/widowed/divorced), household income (more than sufficient/sufficient/insufficient), household location (town/rural); and daughter's birth order (continuous) and age (continuous).

^cFrequency of "don't know" for these items: "The HPV vaccine is important for my daughter's health" $n = 15$, "Getting the HPV vaccine is a good way to protect my daughter from disease" $n = 18$, "The HPV vaccine carries more risks than older vaccines" $n = 88$, "I am concerned about mild to moderate short-term effects of HPV vaccine" $n = 46$, "I am concerned about serious short-term effects of HPV vaccine" $n = 40$, "I am concerned about long-term mild, moderate or severe effects of HPV vaccine" $n = 43$, "I do what the health care provider recommends about HPV vaccine" $n = 10$.

^dIndicates this variable was reverse-coded to calculate the hesitancy score.

^eExcludes people without a health care provider ($n = 64$).

^fMean score for observations with 4 or more questions ($n = 333$).

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4. Parental knowledge about HPV and the HPV vaccine, and associations with girls' HPV vaccination.

	n (%) of parents/guardians who responded correctly ^a	aOR girls' receiving any HPV vaccine dose(s) (95% CI) ^b
HPV can cause cervical cancer, true (vs. false or don't know)	244 (81.61)	5.36*** (2.55–12.2)
HPV can be passed on during sexual intercourse, true (vs. false or don't know)	210 (70.23)	2.41** (1.38–4.32)
Men can get HPV, true (vs. false or don't know)	180 (60.20)	1.67 (0.99–2.83)
A person could have HPV for many years without knowing it, true (vs. false or don't know)	271 (90.64)	1.73 (0.75–4.21)
The HPV vaccine is most effective if given to girls who have never had sex, true (vs. false or don't know) ^c	226 (76.09)	3.47*** (1.87–6.69)
The HPV vaccine offers protection against cervical cancer, true (vs. false or don't know)	274 (91.64)	2.67 (1.04–7.89)
Girls who have had the HPV vaccine do not need cervical cancer screening/test when they are older, false (vs. true or don't know) ^c	95 (31.88)	0.77 (0.44–1.33)
	Mean (SD)	aOR any HPV vaccine dose(s) (95% CI) ^c
HPV knowledge score (higher score indicates greater knowledge) ^d	5.01 (1.54)	1.44*** (1.21–1.75)

^aCorrect answer, versus incorrect answer or don't know ("prefer not to answer" is excluded).

^bAdjusted odds ratios were adjusted for: Parent's/guardian's age (continuous), parent's/guardian's gender (male/female), parent's/guardian's educational level (no school or incomplete primary/primary/secondary/higher), parent's/guardian's employment status (employed/self-employed/unemployed), parent's/guardian's marital status (single/married or cohabitating/widowed/divorced), household income (more than sufficient/sufficient/insufficient), household location (town/rural); and daughter's birth order (continuous) and age (continuous).

^cFrequency of "prefer not to answer" for these items: "The HPV vaccine is most effective if given to girls who have never had sex" $n = 2$, "Girls who have had the HPV vaccine do not need VIA when they are older" $n = 1$.

^dThere were 296 parents/guardians with valid knowledge scores (who reported on vaccination status of 362 girls) included in this analysis.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Many specific knowledge items were associated with vaccination status, as was increased parental knowledge about HPV and the HPV vaccine overall (aOR 1.44 [1.21–1.75]) (Table 4).

Half of parents/guardians knew someone who had cervical cancer: 104 parents/guardians (34.9%) knew someone who had died due to cervical cancer and 69 (23.2%) knew someone who had cervical cancer and survived (Appendix 5). Knowing someone who had cervical cancer was significantly associated with one's daughter being vaccinated (aOR 1.74 [1.08–2.83]) (Appendix 5).

"Social processes" correlates of HPV vaccine uptake

Fewer than half of respondents said they had ever spoken about cervical cancer or the HPV vaccine with their daughter(s) (30.4%, $n = 91$), with other parents (47.2%, $n = 151$), or with a health worker (43.5%, $n = 130$) (Table 5). Comfort in talking about the HPV vaccine was high: over 80% of parents said they were comfortable talking with their daughter, and with other parents, about cervical cancer or the HPV vaccine. Over three-quarters of parents/guardians felt that other parents in their community were vaccinating their own daughters against HPV (78.3%, $n = 234$). (The frequencies of all response options to these questions can be found in Appendix 6).

Girls with parents/guardians who have talked about the HPV vaccine with more parties had higher odds of being vaccinated than girls whose parents/guardians have had fewer of these conversations (aOR 2.03 [1.59–2.62]) (Table 5). Comfort in talking about the HPV vaccine was

not significantly associated with daughters' vaccination status. Feeling that other parents were vaccinating their own daughters against HPV was strongly associated with one's own daughter(s)' HPV vaccination (aOR 3.68 [1.97–7.18]) compared to those who did not perceive this, while feeling that other children receive routine childhood vaccines was not associated with one's daughter(s)' HPV vaccination status.

"Practical issues" correlates of HPV vaccine uptake

Approximately two-thirds of parents/guardians felt that accessing the HPV vaccine was or would be not at all difficult (66.9%, $n = 200$); among these 200 parents/guardians, 115 of them had a vaccinated daughter/s and 78 had an unvaccinated daughter/s (7 did not know their daughter (s) vaccination status) (Table 6). There were 40 parents/guardians who said that access was or would be a little or somewhat difficult (13.4%) (of whom 15 had a vaccinated daughter(s) and 23 had an unvaccinated daughter[s]), and 23 who said that access was or would be very difficult (7.7%) (of whom 4 had a vaccinated daughter(s) and 19 of whom had an unvaccinated daughter[s]).

Girls whose parents/guardians felt that access was or would be very difficult had approximately 84% lower odds of having received any doses of the HPV vaccine compared to those whose parents/guardians reported no actual or anticipated access difficulty (aOR 0.16 [0.04–0.47]) (Table 6). When asked about specific anticipated or experienced access challenges, less than 20% of parents/guardians felt that getting permission to vaccinate their daughter (e.g., from spouse or

Table 5. Social norms about HPV vaccine, and associations with girls' HPV vaccination.

Have you ever talked about cervical cancer or HPV vaccine with ...	n (%) of parents/guardians who said Yes	aOR girls' receiving any HPV vaccine dose(s) (95% CI) ^a
... your daughter?	91 (30.43)	5.97*** (3.39–10.8)
... other parents?	141 (47.16)	1.94** (1.20–3.18)
... a health care worker?	130 (43.48)	2.86*** (1.73–4.77)
Discussion score (n parties the parent/guardian has talked to about the HPV vaccine, can range 0–3)	1.21 (1.10)	2.03*** (1.59–2.62)
How comfortable do you feel talking about cervical cancer or HPV vaccine with ...	n (%) of parents/guardians who said they feel Comfortable ^b	aOR girls' receiving any vaccine dose(s) (95% CI) ^a
... your daughter? ^c	253 (84.62)	1.55 (0.75–3.33)
... other parents? ^c	247 (82.61)	1.21 (0.63–2.38)
Comfort score (n parties the parent/guardian is comfortable talking to about cervical cancer or HPV vaccine, can range 0–2)	1.67 (0.61)	1.27 (0.82–2.00)
I feel that other parents in my community are ...	n (%) of parents/guardians who said they Agree ^d	aOR girls' receiving any HPV vaccine dose(s) (95% CI) ^a
... vaccinating their daughters against HPV ^e	234 (78.26)	3.68*** (1.97–7.18)
... vaccinating their children with routine childhood vaccines	293 (97.99)	0.63 (0.13–3.54)

^aAdjusted odds ratios were adjusted for: Parent's/guardian's age (continuous), parent's/guardian's gender (male/female), parent's/guardian's educational level (no school or incomplete primary/primary/secondary/higher), parent's/guardian's employment status (employed/self-employed/unemployed), parent's/guardian's marital status (single/married or cohabitating/widowed/divorced), household income (more than sufficient/sufficient/insufficient), household location (town/rural); and daughter's birth order (continuous) and age (continuous).

^bVery comfortable versus Somewhat comfortable, Not comfortable or Don't know.

^cFrequency of "don't know" for these items: "How comfortable do you feel talking about cervical cancer or HPV vaccine with your daughter" n = 2, "How comfortable do you feel talking about cervical cancer or HPV vaccine with other parents" n = 1, "I feel that other parents in my community are vaccinating their daughters against HPV" n = 74, "I feel that other parents in my community are vaccinating their children with routine childhood vaccines" n = 6.

^dStrongly agree or Somewhat agree or Don't know, versus Strongly disagree or Somewhat disagree.

*p < .05, **p < .01, ***p < .001.

Table 6. Access to the HPV vaccine, and associations with girls' HPV vaccination.

Accessing the HPV vaccine is/would be...	n (%) of parents/guardians who reported each	aOR girls' receiving any HPV vaccine dose(s) (95% CI) ^a
... not at all difficult	200 (66.89)	(ref)
... a little or somewhat difficult	40 (13.38)	0.46* (0.21–0.97)
... very difficult	23 (7.69)	0.16** (0.04–0.47)
... don't know	36 (12.04)	0.06*** (0.01–0.19)

^aAdjusted odds ratios were adjusted for: Parent's/guardian's age (continuous), parent's/guardian's gender (male/female), parent's/guardian's educational level (no school or incomplete primary/primary/secondary/higher), parent's/guardian's employment status (employed/self-employed/unemployed), parent's/guardian's marital status (single/married or cohabitating/widowed/divorced), household income (more than sufficient/sufficient/insufficient), household location (town/rural); and daughter's birth order (continuous) and age (continuous).

*p < .05, **p < .01, ***p < .001.

other family member) or being too busy to get the vaccine would be a problem; in contrast, "getting money for/affording the vaccine visit" was or was anticipated to be a problem for approximately one-third of parents/guardians (data not shown).

Fully-adjusted multivariable models

In an analysis that included all hypothesized correlates—i.e., "thinking and feeling" and "social processes" plus "practical issues" as an effect modifier and covariates reflecting girl-, parent-/guardian-, and household-level characteristics – "social factors" remained significantly associated with girls' vaccination status, but "thinking and feeling" factors did not

(Table 7). In particular, daughters of parents/guardians who reported speaking with more people about the HPV vaccine and who perceived pro-HPV vaccination social norms, had significantly higher odds of having received any doses of the HPV vaccine than daughters of respondents who reported speaking with fewer people or did not perceive positive norms. When the models added an interaction term to reflect access to services as a potential effect modifier, this result remained unchanged, however the main effect of access to services was attenuated and became non-significant in most models that included interaction terms suggesting that access does not modify the relationship between intra- or inter-personal factors and HPV vaccine uptake (Table 7).

Table 7. Multivariable model with all hypothesized constructs and covariates, associations with girls' HPV vaccination.

	Model 1, aOR ^a (95% CI)	Model 2, aOR ^a (95% CI)	Model 3, aOR ^a (95% CI)	Model 4, aOR ^a (95% CI)	Model 5, aOR ^a (95% CI)	Model 6, aOR ^a (95% CI)
HPV vaccine hesitancy score ^b	0.87 (0.61–1.23)	0.92 (0.44–1.93)	0.86 (0.61–1.23)	0.87 (0.61–1.23)	0.87 (0.61–1.23)	0.87 (0.62–1.24)
HPV vaccine knowledge ^c	1.16 (0.9–1.5)	1.16 (0.9–1.5)	1.35 (0.8–2.26)	1.16 (0.9–1.51)	1.16 (0.9–1.5)	1.16 (0.9–1.51)
Discussions about HPV vaccination ^d	1.8*** (1.32–2.44)	1.79*** (1.32–2.44)	1.79*** (1.32–2.43)	2.0* (1.07–3.73)	1.8*** (1.32–2.44)	1.79*** (1.32–2.43)
Comfort discussing HPV vaccination ^e	0.69 (0.38–1.25)	0.69 (0.38–1.25)	0.7 (0.38–1.28)	0.69 (0.38–1.26)	0.61 (0.14–2.59)	0.67 (0.36–1.23)
Perceiving pro- HPV vaccination norms	2.76* (1.26–6.06)	2.77* (1.26–6.09)	2.79* (1.27–6.16)	2.73* (1.24–6.01)	2.79* (1.26–6.17)	7.12 (0.76–66.77)
Access to HPV vaccination services ^f	2.26* (1.07–4.73)	3.0 (0.13–70.31)	6.66 (0.24–185.89)	2.7 (0.82–8.91)	1.73 (0.09–31.9)	6.03 (0.62–58.6)
Hesitancy score * Access to services		0.92 (0.4–2.15)				
Knowledge score * Access to services			0.82 (0.45–1.48)			
Discussions * Access to services				0.88 (0.45–1.72)		
Comfort discussing * Access to services					1.16 (0.24–5.65)	
Pro-vaccination norm * Access to services						0.33 (0.03–3.53)

^aAdjusted odds ratios were adjusted for: Parent's/guardian's age (continuous), parent's/guardian's gender (male/female), parent's/guardian's educational level (no school or incomplete primary/primary/secondary/higher), parent's/guardian's employment status (employed/self-employed/unemployed), parent's/guardian's marital status (single/married or cohabitating/widowed/divorced), household income (more than sufficient/sufficient/insufficient), household location (town/rural); and daughter's birth order (continuous) and age (continuous).

^bPer notes in Table 3.

^cPer notes in Table 4.

^dSums how many types of people the parent/guardian talks about HPV vaccine with (see Table 5; can range 0–3)

^eSums how many types of people the parent/guardian is comfortable talking about HPV vaccine with (see Table 5; can range 0–2)

^fDifficult (Very, a little, or somewhat) versus Not at all difficult.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

This paper presents information from one of the first community-based surveys about HPV vaccination in Africa. We found numerous potentially intervenable factors that were associated with HPV vaccine uptake for preadolescent girls in this setting, including parents'/guardians' attitudes, knowledge, and perceived social norms.

We found that 57% of girls had not yet received any doses of the HPV vaccine, while 39% had received at least one dose. The official estimates of Malawian girls having received a first dose of HPV vaccine were 13% in 2022⁵ and 68% in 2023.⁶ It is possible that the higher coverage found in our study sample reflects this estimate of increasing HPV vaccine uptake in Malawi, and confirms the need for further work in this area to achieve the 90% HPV vaccine coverage needed to substantially reduce cervical cancer incidence in Malawi.³

Parents'/guardians' attitudes about the HPV vaccine (vaccine hesitancy) and knowledge about HPV and the HPV vaccine – “thinking and feeling” factors per this study's conceptual model based on the WHO BeSD framework – were associated with girls' vaccine uptake. Most parents/guardians felt positively about the importance and efficacy of the HPV vaccine, but over half expressed concerns about safety; common safety concerns about the HPV vaccine have been found in other studies from Africa.^{39–43} In our survey, daughters of parents/guardians with safety concerns were less likely to be vaccinated than their peers with parents/guardians who were not concerned about safety. This bolsters the literature about parental vaccine attitudes and child vaccination: other studies

from Africa have found significant associations between parental hesitancy toward routine childhood vaccines and children's under-vaccination,⁴⁴ and specifically between parental concerns about HPV vaccine safety and stated intention to vaccinate one's daughter.¹² Similarly, surveys from the United States have found that parental concerns about the HPV vaccine's safety are associated with children's receipt of the vaccine,^{45–47} but to our knowledge, our data represent the first from Africa that explore this association with HPV vaccination behavior. The results suggest that HPV vaccine messaging interventions in Malawi should focus on improving attitudes about safety. “Best practices” suggest that policy-makers, clinicians, and others can most effectively address misinformation and hesitancy (including regarding vaccine safety) by directly messaging about it, i.e., by providing clear, factual, and relevant information.^{48,49}

Our results highlight the importance of social norms in shaping vaccination behavior and suggest that leveraging “peer parents” as messengers about HPV vaccination might be very effective. In this sample, few parents/guardians had spoken to other people about the HPV vaccine, but those who had were more likely to have vaccinated daughters. Likewise, daughters of parents/guardians who perceived pro-HPV vaccination social norms (i.e., felt that other parents were vaccinating their own daughters against HPV) had much higher odds of being vaccinated; this was in fact one of the strongest associations with vaccination behavior among all constructs we evaluated. Studies from the United States about HPV vaccination^{50,51} and about COVID-19 vaccination,^{52–55} as well as studies about COVID-19

vaccination from Malawi⁵⁶ and HPV vaccination in Kenya,⁵⁷ have shown that social support and perceived norms are strongly associated with vaccination attitudes and behavior. Causal data about the effect of norm-based messaging show mixed results, however, with positive effects seen in studies about HPV vaccination in the United States⁵⁸ and polio vaccination in Ghana,⁵⁹ and no effect seen on COVID-19 vaccination in the United Kingdom.⁶⁰ Given the relatively scarce and conflicting literature, particularly for HPV vaccination in Africa, this is an area needing further study. Interestingly, parents/guardians in this sample overestimated how common HPV vaccination was among their peers: over three-quarters of parents/guardians said that they thought other parents in their communities were vaccinating against HPV, but only 39% of girls in this sample had received any doses of the vaccine. There may be a knowledge gap in our understanding of perceived community acceptance, including of the HPV vaccine, in diverse global contexts.

Two-thirds of respondents in this survey did not face or anticipate facing any challenges accessing HPV vaccination services, which is particularly high for a low-income country with a resource-constrained health system where access to health care is often challenging.^{61–63} Although few in number (only 7.7% of the sample), parents/guardians who had or anticipated “very difficult” access much less commonly had daughters who had received the HPV vaccine compared to parents/guardians who had not faced, or did not anticipate facing, access challenges which suggests that increasing access to the vaccine (and in particular removing financial barriers) may help increase HPV vaccine uptake.

This is, to our knowledge, one of the first household surveys to explore factors associated with uptake of the HPV vaccine in a low-income, high-cervical cancer burden setting. Although previous studies have examined intention or motivation to vaccinate or acceptability of vaccination, there have been few analyses that use actual vaccination (rather than attitude or motivation to vaccinate). However, there are some limitations of our study that should be noted. First, these surveys were conducted only in three communities of Malawi so results may not generalize to other contexts. Second, parents/guardians reported on their daughter’s HPV vaccination status, usually using recall; our team has found that this is a robust proxy measure for actual vaccine uptake, but future studies should look to measure this with greater rigor (e.g., asking the girl herself, or using vaccination record/card data). In addition, these surveys were interviewer-administered so there may have been some response bias, for example social desirability bias. Third, as the HPV vaccination program in Malawi currently only targets girls, we did not collect any information about HPV vaccination for boys, but future studies should seek to do so particularly as HPV vaccination programs in LMICs expand to be gender-neutral. Lastly, many of these questions were adapted from survey instruments that have been validated in high-income countries, and we do not know how well these perform in settings like Malawi. It will be important to study the psychometric properties of approaches to measuring constructs like HPV vaccine hesitancy in a variety of settings.

Conclusions

This study used data collected from households in three areas of Malawi to assess factors hypothesized to be associated with HPV vaccination per the WHO BeSD framework. We found that factors reflecting parents’/guardians’ attitudes and knowledge about the HPV vaccine, social interactions and norms surrounding HPV vaccination, and access to HPV vaccination services were all strongly associated with girls’ HPV vaccination status. These results highlight numerous targets for intervention, from policy-/system-, community-, intra-, and inter-personal levels; and suggest that interventions leveraging social norms and networks may be particularly impactful in this setting. These findings add to a relatively scarce evidence base on HPV vaccination determinants in low- and middle-income countries, and offer insights for reducing the very high cervical cancer burden in this setting.

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Data availability statement

The data used in this analysis are not available as respondents did not consent to data sharing.

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