

Factors Associated with HPV Vaccine Uptake among Girls Aged 9 - 14 in the Langue de Barbarie Area of Saint-Louis, Senegal in 2024

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Abstract

Introduction: The HPV vaccine was included in the Expanded Programme on Immunisation in Senegal in 2018. However, vaccination coverage is still low among targeted girls. The aim of this research was to study the factors associated with vaccine uptake among girls aged 9 - 14 years in the Langue de Barbarie area of Saint-Louis, Senegal. **Methodology:** This was a descriptive and analytical cross-sectional study. The sample size was calculated using the Schwartz formula and distributed proportionally to the size of the population in the neighborhoods. Data were collected from 2nd to 19th January 2024 from mothers or guardians of girls aged 9 to 14 using anonymous questionnaires configured on tablets with Survey 123 software and analysed using R software. **Results:** A total of 799 people were interviewed. The average age of the respondents was 35.67 years, with a standard deviation of 7.08 and a range of 17 and 49 years. Reported vaccination coverage was 41.9%. Factors positively correlated with vaccination included: attendance at primary school or daara (OR = 2.50 [CI: 1.43 - 4.48] and OR = 2.05 [CI: 1.09 - 3.94]), information about vaccination (OR = 6.64 [CI: 4.59 - 9.72]), history of cervical cancer screening among mothers or guardians (OR = 6.64 [CI: 4.59 - 9.72]). **Conclusion:** Identifying the factors associated with HPV vaccination is necessary to assess and improve the vaccination strategy in order to improve vaccination coverage among targeted girls.

Keywords

Cervical Cancer, Vaccine, HPV, Girls, Risk, Senegal

1. Introduction

Cervical cancer is a public health issue. It is the most common cancer in 23 countries, and in more than 99% of cases, it is linked to a sexually transmitted genital infection caused by certain types of Human Papillomavirus (HPV) with oncogenic properties, especially genotypes 16 and 18 [1].

In Vietnam, it is the main cause of cancer in women, with a very high prevalence in Ho Chi Minh and in France in 2005, cervical cancer ranked tenth among cancers in women and second among women under 50 [2]. The introduction of cervical smear screening in the early 1970s has led to a sharp decline in the incidence of cervical cancer since the 1980s [3].

In the African Region, cervical cancer is the second most common type of cancer, with 110,755 new cases, and causes the highest number of cancer deaths, with 72,705 deaths in 2020. More than half of all cervical cancers occur in HIV-positive women in countries with high HIV prevalence [4]. According to the World Health Organisation, Africa is home to 19 of the 20 countries with the highest burden of cervical cancer in the world. Despite the heavy burden of the disease in Africa, it is worrying to note that very few public health measures have been put in place to combat the disease in a resolute and action-oriented manner [5].

In Senegal, cancer continues to spread and affect more and more people, particularly women. Cervical cancer is the first cause of cancer-related death in women aged between 15 and 49 [6]. However, many cases of cervical cancer are preventable with vaccination or can be effectively treated if diagnosed early [1].

As part of its strategy to combat cervical cancer, Senegal's Ministry of Health introduced the HPV vaccine into its Expanded Programme on Immunisation (EPI) in October 2018. This makes it the first country in West Africa to offer the HPV vaccine to 9-year-old girls, with an ambitious target of vaccinating at least 95,000 girls a year [7]. The programme is supported by the World Health Organisation, the Global Alliance for Vaccines and Immunization (GAVI), Bill and Melinda Gates Foundation, UNICEF and the vaccine industry.

The implementation of this programme has encountered difficulties in the acceptance and use of the vaccine by the population. According to the August 2021 information bulletin from the immunisation division of the Ministry of Health and Social Action of Senegal (MSAS), vaccination coverage is still very low at national level, at around 32% for HPV1 and 22% for HPV2 [8]. Furthermore, data from the Saint-Louis medical directory extracted from the DHIS 2 in 2020 show vaccination coverage among 9-year-old girls to be around 35% for HPV1 and 23% for HPV2. For the same period and according to the DHIS2 data, the HPV1 vaccination coverage rate for 9-year-old girls was 35% in the Langue de Barbarie area of Saint-Louis.

The aim of this study was to analyse the factors associated with HPV vaccine uptake among girls aged 9 to 14 in the Langue de Barbarie area of Saint-Louis in 2024.

2. Methodology

2.1. Study Framework

The Langue de Barbarie is in the Saint-Louis region on Senegal's north coast, approximately 250 km from Dakar. The city of Saint-Louis is located in the estuary of the Senegal River. It extends over an area comprising three entities: the Langue de Barbarie, the island of Saint-Louis and the large suburb of Sor. The Langue de Barbarie is where the Senegal River meets the Atlantic Ocean. It is a very narrow strip of land bounded by the Atlantic Ocean on the west coast and by the Senegal River on the east coast. The northern limit of the Langue de Barbarie is the border with Mauritania, less than 3 km from Goxu-Mbacc, while in the south, the strip of land ends at the mouth of the Senegal River.

The population of the Langue de Barbarie is divided between the 3 main neighbourhoods: Guet-Ndar/Hydrobase, Santhiaba and Goxu-Mbacc. It is subdivided into 12 sub-neighbourhoods (**Table 1**).

The population of the Langue de Barbarie was estimated at more than 60,549 in 2013, according to figures from the general census of population and housing, agriculture, and livestock (RGPHAE 2013). It represented almost a quarter of the population of the commune of Saint-Louis, which stood at 253,392.

The Langue de Barbarie is part of the Saint-Louis health district. In terms of health infrastructure, the Langue de Barbarie currently has:

- 3 functional public health posts (Guet-Ndar, Santhiaba and Goxu Mbaac).
- 1 “community health” post in the process of being turned into a health post at Hydrobase.
- 1 private health facility in Santhiaba, which focuses on nutritional monitoring and child growth, as well as primary curative consultations.

On the other side of the river, on the island, the Guet-Ndar neighborhood faces the Saint-Louis regional hospital.

In terms of education infrastructures, according to data for 2022 from the education and training inspectorate of Saint-Louis (IEF), the Langue de Barbarie has 11 elementary schools, 2 secondary schools, 3 pre-schools and several daaras (koranic school).

Regarding socio economic aspects, the three neighborhoods of the Langue de Barbarie have the highest concentration of fishermen in Senegal. Most of their inhabitants depend on sea fishing for their livelihood [9].

Table 1. Subdivision of Langue de Barbarie.

Guet-Ndar/Hydrobase	Santhiaba	Goxu-Mbacc
Lodo	Bas Ndartoute	Premier Bayal
Pond Khollé	Haut Ndartoute	Deuxième Bayal
Dack	Camp Gazell	Troisième Bayal
Bas Hydrobase		
Haut Hydrobase		
Keur Ibra Dièye		

Indeed, the male population is almost exclusively made up of fishermen, with more than 86% of male heads of household engaged in fishing [10].

Artisanal processing of fish products is mainly carried out by women and is a source of income. It is an old tradition among the women of the Langue de barbarie, particularly in Guet-Ndar, who are known for their long experience and know-how in this profession [11].

2.2. Study Design

This is a descriptive and analytical cross-sectional study in the Langue de Barbarie, Saint-Louis.

2.3. Study Population

The study population consisted of Women in Reproductive Age (WRA), mothers or guardians of daughters aged between 9 and 14.

2.4. Selection Criteria

Inclusion criteria: All mothers or guardians of girls aged between 9 and 14 who have lived in the Langue de Barbarie for more than 6 months at the time of the study and who have given their consent to take part in the research.

Non-inclusion criteria: Any mother or guardian absent or unavailable at the time of the survey.

2.5. Sampling

The minimum sample size was calculated using the Schwartz formula:

$$n = t^2 \times p \times (1 - p) / m^2$$

- n = minimum sample size;
- t = confidence level (1.96);
- p = probability of the event occurring (0.5);
- m = margin of error (5%).

The minimum sample size calculated was 768, rounded to 800 to take into account of possible non-responses. The sample was distributed proportionally to the population size by neighborhood in the Langue de Barbarie.

A cluster survey was used with:

- A first stage consisting of concessions in the neighborhoods.
- A second stage by households in the concessions.
- A third stage by mothers or guardians in the households.

To choose the starting point, the sub-neighborhoods were divided into sectors with an average of thirty concessions in each sector. The first concession was chosen at random by elementary sampling in the sector, which was also identified at random by drawing lots.

At the concession level, households are numbered, and one household drawn at random. All the women that met the selection criteria at the level of the household selected at random were surveyed. A mother or guardian who met the inclu-

sion criteria would only be surveyed once. If she had several daughters/wards in the 9 to 14 age group, a draw was made to choose the girl around whom the interview would revolve.

2.6. Data Collection

Data collection was carried out from 2 to 19 January 2024 based on anonymous questionnaires administered by interviewers to women in the targeted households. This questionnaire was structured in 4 parts: identification of the questionnaire, the respondent's profile including her socio-demographic characteristics and those of the girl about whom the interview focused, knowledge of the HPV vaccine and Senegal's vaccination strategy, the respondent's relationship to cervical cancer and HPV vaccination including the girl's vaccination status reported and the number of doses received.

The questionnaire was configured on tablets using Survey 123 software to allow direct entry of information into the database.

The team of interviewers was made up of 3 men and 7 women who were trained in the use of the tablets for data collection and in the questionnaire so that the questions could be better formulated in the local language. The questionnaire was pre-tested after the training in the Khor area, another locality in Saint-Louis, with around twenty women, which enabled adjustments to be made to the wording of some of the questions and the answers given by the women during the pre-test. The interviewers were distributed throughout the different zones and local resource persons were identified to facilitate their introduction to the local population. The data collected was protected and stored on the password-protected platform, with the possibility of monitoring the progress of the survey in real time.

2.7. Data Analysis

The data collected were exported in Excel format and then in csv and the analysis were carried out with the R software version 4, which is free and open source [12].

A descriptive analysis was carried out using frequencies with their standard deviation for the qualitative variables. For quantitative variables, basic parameters such as mean, minima, maxima, median and standard deviation were presented [13].

A bivariate analysis between the use of the HPV vaccine in girls aged 9 to 14 as the dependent variable and the other factors studied was performed in R. The usual chi-square, t-test or ANOVA statistics were used, depending on the situation, to determine whether the variables studied influenced HPV vaccine use among 9- to 14-year-old girls in Langue de Barbarie. These tests were used to prepare the multivariate analysis by specifying the p-values of the different variables involved.

A top-down logistic regression strategy was used for the multivariate analysis.

All variables with p-values less than 0.25 [14] [15] were retained in the initial model developed. A likelihood ratio test was performed manually to study the model parameters before selecting a final model. This process highlighted the factors associated with vaccination and the different degrees of association for each factor through the adjusted ORs.

The performance of the model was evaluated by calculating the Area under Curve (AUC) which is a good indicator of the quality of the final model.

2.8. Ethical Considerations

Participation in the survey was free and voluntary for all respondents. Comprehensive information on the study was shared in advance of the questionnaire being administered and the interviews proceeded only once informed consent was obtained.

The research protocol was submitted to and approved by Senegal's National Health Research Ethics Committee (CNERS) under number SEN23/84 on 25 October 2023.

3. Results

3.1. Socio-Economic Characteristics of Respondents

A total of 799 people were interviewed in the various districts of the Langue de Barbarie. No cases of refusal were documented. The average age of the respondents was 35.67, with a standard deviation of 7.08 and range of 17 and 49. The median age was 36. Respondents were most often aged 30 - 40 (47.6%). Biological mothers were the main interviewees (82.7%). Educated participants accounted for just over half of the respondents (56.7%) and were mainly at primary school level (40.9%) (Table 2).

More than half of the respondents (63.7%) had their daughters educated in French and 23.3% in Arabic; 6.6% had not attended school and 6.4% had dropped out.

The mean age of girls was 11.4 ± 1.7 years, with a range of 9 to 14. The median age was 11 (Table 3).

HPV vaccination coverage of the girls was 41.9%, of which 24.3% had received one dose (HPV1), 17.3% two doses (HPV2) and 0.3% three doses (HPV3).

3.2. Bivariate Analysis

A bivariate analysis between HPV vaccination status and the other factors studied was performed in R.

The analysis of socio-economic factors in relation to vaccination revealed a link between vaccination and factors such as place of residence, girls schooling, and the occupation of mothers or guardians (Table 4).

Bivariate analysis performed with the variable related to knowledge of mothers and guardian revealed a link between vaccination and knowledge on cervical cancer, HPV and the strategy of vaccination (Table 5).

Table 2. Socio-demographic characteristics of respondents (n = 799).

Characteristics	n (%)
Neighbourhood	
Guet-Ndar/hydrobase	344 (43%)
Goxu Mbacc	304 (38%)
Santhiaba	151 (19%)
Age respondent	
<30 years	154 (19%)
30 - 40 years	388 (49%)
>40 years	257 (32%)
Type of household	
Married	714 (89%)
Non-married	85 (11%)
Relation between respondent and girl	
Other	138 (17%)
Biologic mother	661 (83%)
Has always lived in LDB	
No	83 (10%)
Yes	716 (90%)
Has an occupation	
No	334 (42%)
Yes	465 (58%)
Type residence	
Non-owner	188 (24%)
Owner	611 (76%)

Table 3. Socio-demographic characteristics of girls (n = 799).

Characteristics	n (%)
Neighbourhood	
Guet-Ndar/hydrobase	344 (43%)
Goxu Mbacc	304 (38%)
Santhiaba	151 (19%)
Age girl	
<11 years	277 (35%)
11 - 13 years	281 (35%)
>13 years	241 (30%)
Girls schooling	
No	104 (13%)
Yes	695 (87%)

Table 4. Bivariate analysis with socio-economic characteristics.

		Vaccinated		P-value
		Yes n (%)	Total	
Quartier	Goxu Mbacc	144 (47.4)	304	0.003*
	Santhiaba	70 (46.4)	151	
	Guet-Ndar	120 (34.9)	344	
Mother's/Guardian's age	<30 years	66 (42.9)	154	0.923
	30 - 39 years	158 (40.7)	388	
	40 years+	110 (42.8)	257	
Girls age rank	9 - 10 years	114 (41.2)	277	0.590
	11 - 12 years	124 (44.1)	281	
	13 - 14 years	96 (39.8)	241	
Marital status of mother	Single	14 (42.4)	33	0.776
	Divorced	13 (38.2)	34	
	Married	301 (42.2)	714	
	Separate	0 (0)	2	
	widowed	6 (37.5)	16	
Matrimonial regime	Monogame	210 (44.8)	469	0.122
	Polygamy	91 (37.1)	245	
	Unmarried	33 (38.8)	85	
Residence status	Hosted	23 (40.4)	57	0.838
	Tenant	27 (40.9)	66	
	Family home	24 (36.9)	65	
	Owner	260 (42.6)	611	
Relationship with the girl	Sister-in-law	1 (100)	1	0.031
	Entrusted daughter	11 (35.5)	31	
	Grandma	1 (33.3)	3	
	Biological mother	267 (40.4)	661	
	Niece	3 (100)	3	
	Sister	10 (35.7)	28	
	Aunt	41 (56.9)	72	
Residence	between 6 - 12 month	0 (0)	4	0.171
	Less 1 year	3 (50)	6	
	less 5 years	25 (34.2)	73	
	Always	306 (42.7)	716	

Continued

Girl's Schooling	French school	242 (47.5)	509	<0.001*
	Arabic	67 (36)	186	
	Abandon study	15 (29.4)	51	
	Not at school	10 (18.9)	53	
Mother's schooling	Not at school	131 (37.9)	346	0.280
	Elementary school	144 (44)	327	
	Middle	39 (45.3)	86	
	Secondary school	15 (46.9)	32	
	Hight school	5 (62.5)	8	
Profession	Employee	13 (72.2)	18	<0.001*
	Hairdresser/Dressmaker/Restorer	15 (62.5)	24	
	Female fish processor	21 (61.8)	34	
	Commerce	132 (44)	300	
	Student	2 (40)	5	
	housewife	126 (37.7)	334	
	Mareyeuse	25 (29.8)	84	
Monthly household income	100,000 FCFA	33 (34.4)	96	0.268
	100,000 - 300,000 FCFA	168 (44.9)	374	
	>300,000 FCFA	66 (40.7)	162	
	Don't know	67 (40.1)	167	

*Link with HPV vaccination.

Table 5. Bivariate analyse with mothers' knowledge variables.

Knowlege		n (%)	P-value
Cervical cancer	Yes	309 (50)	<0.001*
	No	156 (86.2)	
HPV	Yes	152 (35.4)	
	No	301 (85.5)	<0.001*
	Other	12 (66.7)	
Strategy of vaccination	Yes	60 (29.4)	<0.001*
	No	377 (69.4)	
	Other	28 (53.8)	

The analysis with factors related to women's relationship to HPV and vaccine showed link between HPV vaccination and the mother or guardian knowing someone with gynaecological cancer, mother/guardian screened for cervical cancer, opinion on vaccination, acceptance of vaccination and willingness to recommend the vaccination to a third party (**Table 6**).

Overall, bivariate analysis showed that vaccine uptake was related to the following variables: area of residence, education of girls, occupation of women, knowledge of cervical cancer, knowledge of HPV, knowing someone with gynecological cancer, acceptance of the vaccine and recommendation. All these variables were included in the multivariate analysis to model women's use of the HPV vaccine as a function of the variables studied.

3.3. Multivariate Analysis

The logistic regression used for the multivariate analysis highlighted the factors associated with vaccination and the different degrees of association for each factor through the adjusted Odds Ratio (ORs). **Table 7** lists the factors associated with the use of the HPV vaccine in girls aged 9 to 14 in the LDB.

Table 6. Bivariate analysis with variables related to women's relationship to HPV and vaccine.

		vaccinated	
		Yes	P-value
Knowing someone with cancer	Yes	93 (66.4)	<0.001*
	No	237 (36.9)	
	Other	4 (25)	
Screened for cancer	Yes	93 (66.4)	<0.001*
	No	237 (36.9)	
	Other	4 (25)	
Vaccinated HPV	Yes	10 (58.8)	0.341
	No	323 (41.5)	
	Don't know	1 (33.3)	
Opinion on HPV vaccination	Good	298 (49.3)	<0.001*
	Not Good	5 (23.8)	
	Other	31 (17.8)	
Acceptation of HPV vaccine	Agree	305 (47.7)	<0.001*
	Do not agree	29 (18.1)	
Recommandation of HPV vaccine	Yes	302 (47.6)	<0.001*
	No	12 (20)	

Table 7. Multivariate analysis.

Characteristics	OR	95% C.I.	P-value
(Intercept)	0.08	0.05, 0.15	<0.001
Scholarising girl			
1-No school	-	-	
2-School	2.33	1.36, 4.10	0.003
Knowledge vaccination			
No	-	-	
Yes	6.78	4.72, 9.86	<0.001
Knowledge strategy			
No	-	-	
Yes	1.92	1.28, 2.88	0.002
Screening c. cancer			
No	-	-	
Yes	2.03	1.38, 2.97	<0.001
Accept HPV vaccination			
Agree	-	-	
Not agree	0.48	0.29, 0.77	0.003

AUC = 81.4%.

4. Discussion

The calculated vaccination coverage is consistent with data from the Senegalese Ministry of Health, which places the Saint-Louis health district among the districts with an HPV1 vaccination coverage rate of less than 50% [8]. Moreover, this rate has improved compared with estimates based on DHIS2 data for 2020, which put it at around 35% among 9-year-old girls in the Langue de Barbarie. This could be explained, on the one hand, by the change in strategy since the introduction of the vaccine, with the switch from a single cohort (aged 9) to a multi-cohort target (aged 9 to 14) at the time of the survey and, on the other hand, by a strong acceleration in awareness-raising and the increased involvement of *bajenu gox*¹ in awareness-campaigns and community mobilisation for the vaccination of girls.

Vaccination coverage was higher among girls attending French or koranic schools, who were more likely to be vaccinated than other girls, with (OR = 2.50 [CI: 1.43 - 4.48] and OR = 2.05 [CI: 1.09 - 3.94] respectively).

The association between girls' school attendance and HPV vaccination coverage was also found by Faye *et al.*, in Senegal [16] but also by Binagwaho *et al.* in

¹The neighborhood godmothers, commonly known as *Bajenu Gox*, are women who are close to the communities and who play a relay role in raising awareness of health issues.

Rwanda and Watson-Jones *et al.* in Tanzania [17] [18]. As a reminder, in Senegal, as in countries that have integrated HPV vaccination into their vaccination programmes, the vaccination strategy is based in part on schools to reach the maximum number of girls in the target age group. This collaboration with ministries of education is helping to raise awareness of cervical cancer among parents and girls and to strengthen prevention through vaccination against HPV. Meanwhile, girls' school attendance is a real challenge in the area. At a very early age, girls are made responsible for domestic chores and sometimes even for managing the children, while their mothers are busy with socio-economic activities such as selling fish or processing fish products.

Information about the vaccine and knowledge of the strategy play an important role in people's acceptance of the vaccine. The non-use of the vaccine among respondents was mainly linked to ignorance of vaccination. Mothers or guardians who were informed about vaccination were more likely to have vaccinated daughters (OR = 6.64 [CI: 4.59 - 9.72]). Similar results were found by de Baddouh *et al.*, in Morocco, in a study conducted in Marrakech among the parents of girls aged between 8 and 15 years who were seen in the pediatric department of Mohammed VI hospital between September 2014 and January 2015 [19]. This study showed an increase from 63% to 82% in the vaccine acceptability rate after parents were given knowledge about cervical cancer and the HPV vaccine. Similarly, the study conducted in Senegal by Faye *et al.* on the determinants of HPV vaccination coverage in 10-year-old girls supports this finding, showing that girls whose mothers had been informed about the vaccination campaign were 10 times more likely to be fully vaccinated (OR = 10.92 [CI: 2.93 - 40.64]) [16].

The strong relationship between acceptance of the HPV vaccine and its use by mothers or guardians is apparent in the analysis carried out. In the study on the progress of HPV vaccination in low- and middle-income countries conducted by LaMontagne *et al.*, three main reasons for parental acceptability of the HPV vaccine were cited: belief in the value of vaccination (68.7%), belief in preventing the disease (66.2%) and the desire to protect against cervical cancer (59.1%) [20].

The link between HPV vaccine use in girls and history of cervical cancer screening in mothers or guardians also emerged from the research. This confirms a study conducted by Lefevre in Belgium in 2011, which showed that HPV vaccination of young girls was strongly correlated with their mother's behaviour (the performance of FCV screening) [21]. It was also shown in a study in Malaysia where a survey of 449 ethnically diverse women showed that intention to receive the vaccine was significantly associated with knowledge of cervical screening and cervical cancer risk factors (OR = 1.17; 95% CI 1.03 - 1.33; P = 0.013) [22].

No association was found between vaccine use and household income level or accessibility. The fact that the vaccine is free of charge and that health facilities are well distributed in the area could explain this situation.

The final logistic model used revealed the factors associated with HPV vaccine use in Langue de Barbarie, with adjusted odds ratios for each factor and an AUC of 0.8145, guaranteeing good reliability.

One of the limitations of our research is the interpretation of the results on the association between the use of the HPV vaccine and women's knowledge of the cervical cancer, the vaccine and the vaccination strategy. It is difficult to say whether women were aware of this information before or after vaccinating their daughters. It is very likely that this information was acquired at the time of vaccination or after the girls had been vaccinated, hence the need to take this aspect into account when interpreting the results of the study.

In addition, the influence of male heads of household has not been specifically studied and could also play a major role in the decision-making process for vaccinating girls.

5. Conclusions

It is clear from the results of the research that non-use of the vaccine is not a matter of availability but much more of a lack of information about the vaccine and the vaccination strategy. This raises the issue of awareness to ensure that people have access to the right information about cervical cancer and vaccination, and consequently how to manage false information and rumours about the side effects that vaccination could cause. It is therefore important to review and improve the vaccination strategy against HPV, which various aspects remain relatively unknown by mothers and guardians. Hence, the need to consider the context and specific needs of population groups to better respond in a differentiated way to their requirements and facilitate access and use of the vaccine for girls targeted by the HPV vaccination programme.

It is therefore important in addition to this research, to study the socio-anthropological aspects linked to acceptance of HPV vaccination to have additional information that will enable communication strategies to be better adapted and ensure that HPV vaccination and cervical cancer are properly understood by the population.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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