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Knowledge–Practice Gaps and Territorial Vulnerability in HPV Vaccine Uptake among Caregivers in Barranquilla, Colombia: A Cross-sectional KAP and Spatial Public Health Study

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Abstract

Background

Human papillomavirus (HPV) vaccination is a central strategy for preventing cervical cancer and other HPV-related diseases. However, vaccine uptake remains uneven in many Latin American settings, where caregiver decision-making may be shaped by misinformation, safety concerns, limited trusted counselling, and territorial barriers to preventive services.

Objective

To examine knowledge, attitudes, and practices (KAP) regarding HPV vaccination among caregivers of children and adolescents in Barranquilla, Colombia, and to identify educational, behavioural, and territorial gaps that may inform community-based public health strategies.

Methods

A cross-sectional analytical study was conducted among 345 caregivers of children and adolescents attending four public educational institutions in Barranquilla, Colombia, during 2025. A structured KAP questionnaire assessed sociodemographic characteristics, sources of information, vaccine-related knowledge, perceived myths and safety concerns, vaccination intention, and reported vaccination status. Descriptive statistics, chi-square tests, Student's t-tests, one-way ANOVA, Spearman correlations, linear/logistic regression models, Cramer's V effect sizes, and exploratory spatial/cluster analyses were used. The instrument showed acceptable internal consistency in the final analytical sample (Cronbach's alpha = 0.83).

Results

Most participants were women (67.83%) and belonged to socioeconomic strata 1 or 2 (70.00%). Although 68.70% correctly identified HPV vaccine-preventable conditions and 61.74% reported willingness to authorize vaccination, 69.57% stated that the minor under their care had not been vaccinated. Relevant misconceptions persisted: 19.71% believed that the vaccine could cause infertility, 33.91% perceived vaccination as experimentation, and 40.29% feared future complications. Educational level was associated with uncertainty about vaccine effectiveness (chi-square = 27.756, $p = 0.002$; Cramer's V = 0.201), and sex was associated with discussing vaccine benefits with relatives and friends (chi-square = 22.302, $p < 0.001$; Cramer's V = 0.254). Cluster analysis identified profiles characterized by low knowledge and scepticism, favourable behavioural disposition despite low knowledge, and high knowledge with positive attitudes.

Conclusions

This study identifies a relevant knowledge–intention–practice gap in HPV vaccination among caregivers in vulnerable urban communities of Barranquilla. Findings should be interpreted as associative and exploratory, not causal. Geographically targeted, caregiver-centred, professionally supported health education strategies may help address misinformation, clarify schedules, strengthen trust, and prioritize territories with greater informational vulnerability.

Introduction

Human papillomavirus (HPV) infection is one of the most common sexually transmitted infections worldwide and is causally linked to cervical cancer and other anogenital and oropharyngeal cancers. Cervical cancer is largely preventable, yet its burden remains concentrated in settings where vaccination, screening, diagnosis, and timely treatment are unevenly implemented. The World Health Organization (WHO) global elimination strategy places HPV vaccination at the centre of cervical cancer prevention and includes the 90-70-90 targets for 2030, including 90% of girls fully vaccinated with HPV vaccine by age 15 [1,2].

HPV vaccines have demonstrated strong protection against vaccine-type HPV infection and cervical precancer. Population-level evidence shows reductions in HPV infection, anogenital warts, and cervical intraepithelial neoplasia after the implementation of HPV vaccination programmes [3-5]. Nevertheless, availability of an effective vaccine does not automatically translate into high coverage. Uptake depends on trust in health institutions, caregiver knowledge, safety perceptions, provider recommendation, school-based delivery, and service accessibility [6-9].

In Latin America, HPV vaccination programmes operate in contexts marked by social inequality, heterogeneous health literacy, variable access to preventive services, and rapid circulation of misinformation. In Colombia, HPV vaccination has been affected by social controversy, safety concerns, and declining confidence after public concern related to reported adverse events in El Carmen de Bolívar. Subsequent evidence has not supported broad claims linking HPV vaccination to autoimmune, neurological, or haematological diseases, but public trust remains a key determinant of uptake [10-13].

Caregivers are central actors because they often authorize vaccination for children and adolescents. Their decisions are shaped by knowledge, perceived benefits, myths about infertility or sexual behaviour, fear of adverse events, social norms, and the credibility of health professionals. KAP studies can identify modifiable barriers, but their contribution is stronger when they move beyond simple description and show how educational and territorial vulnerabilities overlap.

Barranquilla, an urban centre in the Colombian Caribbean, includes communities with different socioeconomic, educational, and service-access profiles. Understanding how caregiver knowledge, attitudes, myths, intention, and reported vaccination vary across these contexts can support targeted public health action. Therefore, this study aimed to analyse the association between sociodemographic

factors and KAP regarding HPV vaccination among caregivers of children and adolescents in Barranquilla, Colombia, and to explore spatial and psychosocial segmentation patterns that may guide community-based health education strategies.

Research questions and exploratory hypotheses

Primary research question: What educational, behavioural, and territorial gaps characterize HPV vaccination knowledge, attitudes, practices, and reported uptake among caregivers of children and adolescents in vulnerable communities of Barranquilla, Colombia?

Secondary question: How are sociodemographic factors, including sex, educational level, marital status, occupation, and socioeconomic stratum, associated with KAP indicators?

Secondary question: Is there a measurable gap between recognition of HPV vaccine importance or intention to vaccinate and reported vaccination of minors?

Secondary question: Do spatial or cluster patterns identify caregiver groups or territories requiring differentiated public health education strategies?

Exploratory hypotheses: Higher educational level is expected to be associated with lower uncertainty about vaccine effectiveness and lower endorsement of myths; caregiver sex is expected to be associated with promotion of vaccination in family and social networks; lower socioeconomic vulnerability may be associated with more favourable KAP indicators; favourable knowledge and attitudes may not fully translate into reported vaccination practice; and spatial clustering may reveal territories where low knowledge, scepticism, or favourable intention with low knowledge are concentrated.

Methods

Study design and reporting guideline

This was an observational, cross-sectional, analytical study with a quantitative KAP approach. The manuscript was prepared according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for cross-sectional observational studies [14]. A completed STROBE checklist with page and line references is provided as supplementary material. Because of the design, the study estimates associations and spatial patterns but cannot establish causality.

Setting and study period

The study was conducted in Barranquilla, Atlántico, Colombia, among caregivers linked to public educational institutions. Data collection was conducted during 2025. The public health relevance of this

setting relates to urban social vulnerability, heterogeneous educational profiles, and the need to improve HPV vaccine uptake among school-age populations.

Participants, eligibility criteria, and recruitment

The target population consisted of parents or legal guardians of children and adolescents aged 9 to 17 years who were eligible for HPV vaccination or school-based health education activities. Inclusion criteria were: being a parent or legal guardian of a child/adolescent enrolled in a participating public educational institution; being able to complete the questionnaire; and providing informed consent. Exclusion criteria were: refusal to participate, withdrawal during survey completion, or questionnaires with substantial missing information in core KAP or vaccination-status variables. Four public educational institutions agreed to participate. The number of schools initially invited, eligible caregivers invited, questionnaires distributed, questionnaires returned, and questionnaires excluded were not fully documented in the available study records; therefore, the final response rate could not be calculated. This limitation was considered when interpreting representativeness and external validity.

Sampling and sample size

The final analytical sample included 345 caregivers. A school-based non-probabilistic sampling strategy was used. Caregivers were recruited through four selected public educational institutions in Barranquilla. Participation was voluntary and subject to informed consent. The sampling frame consisted of caregivers linked to the participating schools during the study period. A conservative sample size approach for estimating proportions was considered using $p = 0.50$, 95% confidence, and 5% precision. Because complete denominator information for all eligible caregivers was not available in the working study records, finite population correction and response-rate adjustment could not be applied.

Data collection instrument

Data were collected using a structured KAP questionnaire culturally adapted from a previous instrument assessing knowledge and attitudes of parents toward HPV vaccination. The adaptation process included review of language, cultural equivalence, and contextual suitability for caregivers in Barranquilla, Colombia. The questionnaire included sociodemographic items and KAP-related items assessing knowledge, attitudes, and practices toward HPV vaccination. Knowledge items were scored as correct = 1 and incorrect = 0, with final categorization into knowledge and lack-of-knowledge indicators. Attitudes and perceived beliefs were assessed using Likert-type response options. The instrument explored previous orientation about HPV vaccination, sources of information, knowledge of vaccine-preventable diseases, ideal timing of vaccination, dose schedule, perceived safety, myths about infertility, fear of future complications, intention to authorize vaccination, and reported vaccination status of the child/adolescent under care. A pilot test was conducted with 30 caregivers from a public educational institution in Barranquilla to assess clarity, comprehension, cultural adequacy, and operational feasibility. Internal consistency of the final questionnaire was acceptable, with Cronbach's alpha = 0.83. Previous reliability estimates reported during the adaptation or pilot phase, including Cronbach's alpha = 0.91 and

Kuder-Richardson = 0.899, were considered preliminary and were not used as the definitive reliability estimate for the final analytical sample.

Variables

Sociodemographic variables included caregiver age, sex, number of children, child/adolescent age, school grade, educational level, marital status, socioeconomic stratum, and occupation. KAP variables included previous vaccine orientation, source of orientation, reported vaccination status of the minor, perceived vaccine-preventable diseases, perceived ideal timing, knowledge of dose schedule, perceived safety, myths about infertility, fear of future complications, confidence in effectiveness, intention to authorize vaccination, and communication about HPV vaccination with relatives and friends.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics version 21, R, and Python. Descriptive analyses summarized continuous variables as means, standard deviations, medians, and ranges, and categorical variables as frequencies and percentages. Bivariate analyses included chi-square tests for categorical variables, Student's t-test for mean comparisons by sex, one-way ANOVA for comparisons across educational level, marital status, and socioeconomic stratum, and Spearman correlation for ordinal associations. Effect sizes for categorical associations were reported using Cramer's V. Linear regression models explored associations between sociodemographic variables and cognitive, affective, and behavioural KAP scores. The available logistic-regression output was reported as coefficients and p values. Adjusted odds ratios and 95% confidence intervals were not available in the working dataset and should be recalculated from the final clean database if required for journal submission. Statistical significance was set at alpha = 0.05. Questionnaires with incomplete core information on KAP variables or reported vaccination status were excluded from the final analytical dataset; therefore, a complete-case analysis was performed for the main KAP and vaccination-status analyses.

Spatial and cluster analysis

An exploratory georeferenced analysis visualized neighbourhood-level patterns in knowledge, attitudes, and behavioural disposition toward HPV vaccination using aggregated neighbourhood information. No exact household coordinates or identifiable residential locations were displayed. The geocoding unit was the neighbourhood of residence reported by participants. Variables included in cluster assignment were KAP-related indicators and selected sociodemographic variables. Before clustering, variables were standardized to ensure comparability. Ward's hierarchical clustering method was applied using an appropriate distance metric, and the number of clusters was selected based on interpretability and separation of profiles. The resulting map should be interpreted as an exploratory territorial visualization rather than a precise geospatial risk model, given the use of aggregated self-reported neighbourhood data and the absence of household-level geocoding.

Ethical considerations

The study followed the principles of the Declaration of Helsinki and Colombian ethical standards for health research involving human participants. Participation was voluntary and based on informed consent. Data were anonymized and reported only in aggregate form. The study protocol was reviewed and approved by the Comité de Ética de Investigación en Seres Humanos de la Universidad Simón Bolívar, Barranquilla, Colombia. The project was registered under code PRO-CEI-USB-CE-0552-00 / CEI-USB-CE-0552-00. Ethical approval was issued after review in the committee session held on 26 July 2024, recorded in Act No. 161, and legalized through Project Approval Act No. 489 dated 30 July 2024. The project also received scientific approval from the Faculty of Health Sciences Scientific Committee through Act 640-031-2024, dated 8 July 2024.

Results

Participant characteristics

The study included 345 caregivers. As shown in Table 1, the mean caregiver age was 40.83 years (SD = 8.68; range 17–73), and the mean number of children was 2.46 (SD = 0.94). The mean age of the child/adolescent under care was 12.99 years (SD = 2.50; range 7–26). The recorded maximum value of 26 years is outside the defined eligibility range of 9 to 17 years and was treated as a data-quality issue requiring source-document verification. Women represented 67.83% of the sample. Most participants belonged to socioeconomic strata 1 or 2 (70.00%), and the most frequent educational levels were technical education (35.90%) and secondary education (32.50%) (Table 1).

Table 1
Sociodemographic characteristics of caregivers and children/adolescents (n = 345).

Variable	Category/statistic	Value
Caregiver age, years	Mean (SD); range	40.83 (8.68); 17–73
Number of children	Mean (SD)	2.46 (0.94)
Child/adolescent age, years	Mean (SD); range	12.99 (2.50); 7–26*
Child/adolescent school grade	Median	8th grade
Sex	Female	234 (67.83%)
Sex	Male	111 (32.17%)
Marital status	Common-law union	123 (35.70%)
Marital status	Married	102 (29.60%)
Marital status	Separated	71 (20.60%)
Marital status	Single	44 (12.80%)
Marital status	Widowed	5 (1.40%)
Education	Technical	124 (35.90%)
Education	Secondary	112 (32.50%)
Education	Professional	70 (20.30%)
Education	Primary	30 (8.70%)
Education	Specialization or master's	9 (2.60%)
Socioeconomic stratum	Strata 1–2	241 (70.00%)
Occupation	Employed	135 (39.10%)
Occupation	Unemployed	107 (31.00%)
Occupation	Independent worker	103 (29.90%)

Note. The recorded maximum age of 26 years is outside the defined eligibility range and should be verified against the source questionnaire before final submission.

Knowledge about HPV vaccination

Key knowledge indicators are summarized in Table 2. Overall, 59.71% of caregivers reported having received orientation about the HPV vaccine. Health professionals were the most frequent source of orientation (35.94%), followed by family members (12.75%), mass media (9.86%), and the internet (6.09%). Although 68.70% correctly identified HPV vaccine-preventable conditions, important knowledge

gaps persisted: 51.59% did not know the recommended number of doses, and 47.54% did not know the site of vaccine administration (Table 2). These knowledge gaps are visually highlighted in Fig. 2.

Table 2
Key knowledge, attitude, and practice indicators regarding HPV vaccination.

Indicator	Category	n (%)
Received orientation about HPV vaccine	Yes	206 (59.71%)
Main source of orientation	Health professional	124 (35.94%)
Child/adolescent vaccinated against HPV	Yes	105 (30.43%)
Child/adolescent vaccinated against HPV	No	240 (69.57%)
Correctly identified vaccine-preventable diseases	Yes	237 (68.70%)
Does not know recommended number of doses	Yes	178 (51.59%)
Recognizes greater efficacy before sexual debut	Yes	227 (65.80%)
Believes vaccine causes infertility	Agree	68 (19.71%)
Perceives vaccination as experimentation	Agree	117 (33.91%)
Fears future complications	Agree	139 (40.29%)
Trusts vaccine effectiveness	Agree	234 (67.83%)
Would authorize HPV vaccination	Yes	213 (61.74%)

Attitudes, myths, and perceived safety

Attitudinal and safety-related indicators are presented in Table 2 and Fig. 2. Most respondents expressed confidence in vaccine effectiveness (67.83%), but uncertainty remained. A total of 40.29% feared that the vaccine could cause complications over time, 33.91% perceived vaccination as experimentation with the population, and 19.71% agreed with the false belief that HPV vaccination could sterilize children (Table 2; Fig. 2).

Practices and reported vaccination status

Reported vaccination practice was low. As shown in Table 2, 69.57% of caregivers stated that the child/adolescent under their responsibility had not been vaccinated against HPV, whereas only 30.43% reported that the child/adolescent had been vaccinated. This contrasted with favourable intention: 61.74% reported that they would authorize vaccination, and 61.74% reported that they would take the child/adolescent to be vaccinated (Table 2). Figure 1 illustrates this central knowledge–intention–practice gap, showing a 31.31 percentage-point difference between willingness to authorize HPV vaccination and reported vaccination of the child/adolescent.

Bivariate associations

Selected statistically significant bivariate associations are reported in Table 3. Sex was associated with several vaccine-related beliefs and behaviours, including the belief that HPV vaccination prevents sexually transmitted diseases (chi-square = 9.138, p = 0.010; Cramer's V = 0.163), the belief that the vaccine causes infertility (chi-square = 20.056, p < 0.001; V = 0.241), doubts about effectiveness (chi-square = 12.852, p = 0.002; V = 0.193), perception of experimentation (chi-square = 15.855, p < 0.001; V = 0.214), willingness to take the child/adolescent for vaccination (chi-square = 14.945, p = 0.001; V = 0.208), authorization of vaccination (chi-square = 11.750, p = 0.003; V = 0.185), talking about vaccine benefits with relatives and friends (chi-square = 22.302, p < 0.001; V = 0.254), and advising others to vaccinate girls (chi-square = 16.972, p < 0.001; V = 0.222) (Table 3). Educational level was also associated with relevant KAP indicators. These included the belief that the vaccine causes infertility (chi-square = 19.175, p = 0.038; V = 0.167), doubts about effectiveness (chi-square = 27.756, p = 0.002; V = 0.201), willingness to change opinion if better informed (chi-square = 31.024, p = 0.001; V = 0.212), fear of future complications (chi-square = 34.154, p < 0.001; V = 0.222), and authorization of vaccination (chi-square = 22.379, p = 0.013; V = 0.180) (Table 3).

Table 3
Selected statistically significant bivariate associations between sociodemographic variables and HPV vaccine KAP items.

Sociodemographic variable	KAP item	Chi-square	p value	Cramer's V
Sex	Vaccine prevents sexually transmitted diseases	9.138	0.010	0.163
Sex	Vaccine causes infertility	20.056	< 0.001	0.241
Sex	Doubts about vaccine effectiveness	12.852	0.002	0.193
Sex	New vaccine perceived as experimentation	15.855	< 0.001	0.214
Sex	Would take child/adolescent for HPV vaccination	14.945	0.001	0.208
Sex	Would authorize HPV vaccination	11.750	0.003	0.185
Sex	Talks about vaccine benefits with relatives/friends	22.302	< 0.001	0.254
Education	Doubts about vaccine effectiveness	27.756	0.002	0.201
Education	Fear of future complications	34.154	< 0.001	0.222
Education	Would authorize HPV vaccination	22.379	0.013	0.180

Regression models

The available regression summary is presented in Table 4. Educational level was associated with the behavioural/logistic outcome (coefficient = 0.1634, p = 0.0351), and marital status was inversely associated with the same outcome (coefficient = -0.1504, p = 0.0321). Socioeconomic stratum was not associated with the behavioural/logistic outcome (coefficient = -0.0002, p = 0.9990) (Table 4). These findings should be interpreted as exploratory because the available output did not include adjusted odds ratios or 95% confidence intervals.

Table 4
Exploratory regression summary for KAP dimensions.

Outcome/dimension	Predictor	Coefficient	p value	Interpretation
Cognitive	Educational level	0.0178	0.5179	No statistically significant association in the current model
Affective	Marital status	0.0432	0.0234	Exploratory positive association; interpret cautiously
Behavioural	Marital status	-0.0501	0.0590	Borderline exploratory association
Behavioural logistic model	Educational level	0.1634	0.0351	Exploratory association; aOR and 95% CI unavailable in working output
Behavioural logistic model	Marital status	-0.1504	0.0321	Borderline exploratory association
Behavioural logistic model	Socioeconomic stratum	-0.0002	0.9990	No association in current model

Spatial and cluster findings

Cluster segmentation identified three profiles: low knowledge and scepticism; favourable behavioural disposition but low knowledge; and high knowledge with positive attitude (Table 5). The preliminary cluster table reported 89, 145, and 115 participants in these groups, respectively. Because these counts sum to 349, whereas the final analytical sample is n = 345, the participant counts were treated as preliminary and the cluster profiles were interpreted primarily through their cognitive, affective, and behavioural mean scores. Figure 3 translates these cluster profiles into the cognitive, affective, and behavioural KAP dimensions, showing progressive increases in mean scores from the low-knowledge/scepticism group to the high-knowledge/positive-attitude group. At the neighbourhood level, the exploratory map suggested areas with favourable behavioural disposition but insufficient knowledge, low knowledge with scepticism, and high knowledge with positive attitudes (Fig. 4). These spatial profiles provide planning signals for territorially focused public health education. Figure 5 summarizes the conceptual pathway suggested by the findings: caregiver knowledge, myths, safety concerns, trust,

provider recommendation, and territorial barriers may shape intention to vaccinate and its translation into reported HPV vaccine uptake.

Table 5
Cluster segmentation according to cognitive, affective, and behavioural KAP dimensions.

Cluster profile	Cognitive mean	Affective mean	Behavioural mean	Preliminary participants
Low knowledge and scepticism	1.3	1.5	1.5	89 (23.6%)*
Favourable behavioural disposition but low knowledge	1.9	2.1	2.6	145 (42.6%)*
High knowledge and positive attitude	2.7	2.8	2.8	115 (33.8%)*

Note. Cluster counts are preliminary because the reported counts sum to 349, whereas the final analytical sample is 345. Cluster profiles should be interpreted mainly through their cognitive, affective, and behavioural mean scores until final counts are recalculated from the clean database.

Discussion

This cross-sectional KAP and spatial public health study identified a marked gap between favourable caregiver attitudes toward HPV vaccination and reported vaccination of minors in vulnerable communities of Barranquilla. Although many caregivers recognized the preventive value of the vaccine and expressed willingness to authorize vaccination, nearly seven in ten reported that the minor under their responsibility had not been vaccinated. This mismatch suggests that vaccine hesitancy and under-vaccination should not be interpreted only as refusal; they may also reflect uncertainty, weak access pathways, insufficient counselling, and poor translation of intention into action.

The findings are consistent with international evidence showing that HPV vaccination reduces HPV infection and precancerous outcomes but that programme success depends on trust, access, and caregiver decision-making. Global and regional evidence shows that vaccine uptake varies considerably and that provider recommendation, health literacy, and confidence in institutions are central determinants of acceptance and completion [3–9].

The knowledge-practice gap is one of the strongest contributions of the manuscript. Caregivers may accept the idea of vaccination but fail to complete it because they do not know the schedule, do not receive reminders, are unsure where to vaccinate, or continue to worry about adverse effects. Therefore, public health action should combine education with navigation support and linkage to school or primary-care vaccination services.

Misinformation remains a critical barrier. The belief that HPV vaccination causes infertility and the perception of vaccination as experimentation are scientifically unsupported but socially powerful. In

Colombia, these fears must be interpreted within a broader history of public concern and declining trust after the El Carmen de Bolívar controversy. Communication should be transparent, culturally appropriate, and delivered by trusted professionals and community actors [10–13].

The territorial component strengthens the article by moving beyond a descriptive KAP study. Cluster profiles can help local health authorities distinguish communities requiring practical schedule information from those requiring trust-building, myth correction, and dialogue. This is especially important in vulnerable urban settings where educational gaps and service access barriers may concentrate geographically.

The results have implications for schools, caregivers, and health professionals. Schools can serve as trusted platforms for caregiver education and vaccination reminders. Health professionals should deliver clear, repeated, myth-sensitive recommendations. Community leaders can help adapt messages to local concerns, while health authorities can use spatial prioritization to allocate educational resources.

The study has several strengths: it addresses a preventable cancer-related public health priority; includes caregivers from socially vulnerable communities; evaluates knowledge, attitudes, myths, intention, and reported practice; reports effect sizes for key associations; and incorporates exploratory spatial and cluster analyses that can guide local interventions.

Limitations must be acknowledged. The cross-sectional design prevents causal inference. Vaccination status and KAP variables were self-reported, which may introduce recall and social desirability bias. The number of schools initially invited, eligible caregivers invited, questionnaires distributed, questionnaires returned, and questionnaires excluded were not fully documented in the available study records; therefore, the response rate could not be calculated. This limits the assessment of selection bias, representativeness, and external validity. The value of 26 years for the child/adolescent under care was outside the defined eligibility range and should be verified against the source questionnaire. The KAP instrument was culturally adapted and pilot-tested, but additional construct-validation evidence would strengthen future applications. Spatial results are exploratory and depend on neighbourhood-level aggregation and self-reported location data. Subgroup analyses may have limited power to detect small associations, particularly for sparse categories.

Future studies should validate the questionnaire in broader Colombian samples, verify vaccination status through records when feasible, evaluate access barriers, and test whether geotargeted, school-community educational interventions can increase vaccine initiation and completion. Longitudinal and implementation research would be necessary to determine whether intention can be converted into verified vaccination uptake.

Conclusions

Among caregivers of children and adolescents in Barranquilla, HPV vaccination was generally valued, but important knowledge gaps, myths, and low reported vaccination practice persisted. The study identified

a clear knowledge–intention–practice gap and exploratory territorial profiles that may guide differentiated public health action. Interventions should combine evidence-based counselling by health professionals, myth correction, school-community engagement, clear information about schedules and vaccination points, and georeferenced prioritization of territories with greater informational vulnerability. Because the study is cross-sectional, findings should be interpreted as associations and planning signals rather than causal effects.

Declarations

Ethics approval and consent to participate

Participants provided informed consent. The study was reviewed and approved by the Comité de Ética de Investigación en Seres Humanos de la Universidad Simón Bolívar, Barranquilla, Colombia. The project was registered under code PRO-CEI-USB-CE-0552-00 / CEI-USB-CE-0552-00. Ethical approval was issued after review in the committee session held on 26 July 2024, recorded in Act No. 161, and legalized through Project Approval Act No. 489 dated 30 July 2024. The project also received scientific approval from the Faculty of Health Sciences Scientific Committee through Act 640-031-2024, dated 8 July 2024.

Consent for publication

Not applicable; no identifiable individual-level data are presented.

Availability of data and materials

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request, subject to ethical and privacy restrictions.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

WJAP, FGP, and YPP contributed to study conception, data collection, and preliminary analysis. ADP contributed to methodological supervision, interpretation, and manuscript revision. All authors should review and approve the final manuscript before submission.

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Figures

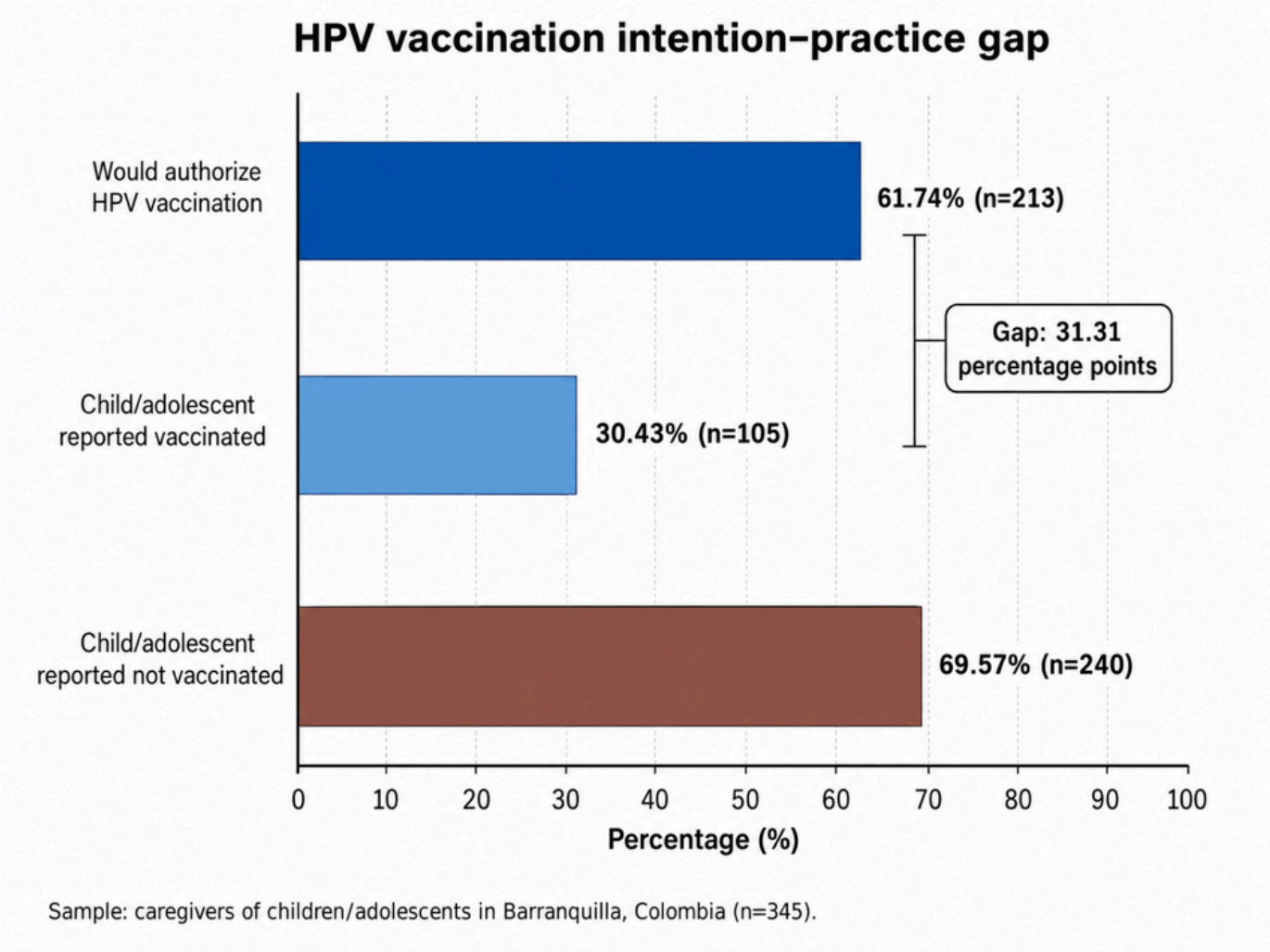


Figure 1

Intention–practice gap in HPV vaccination among caregivers.

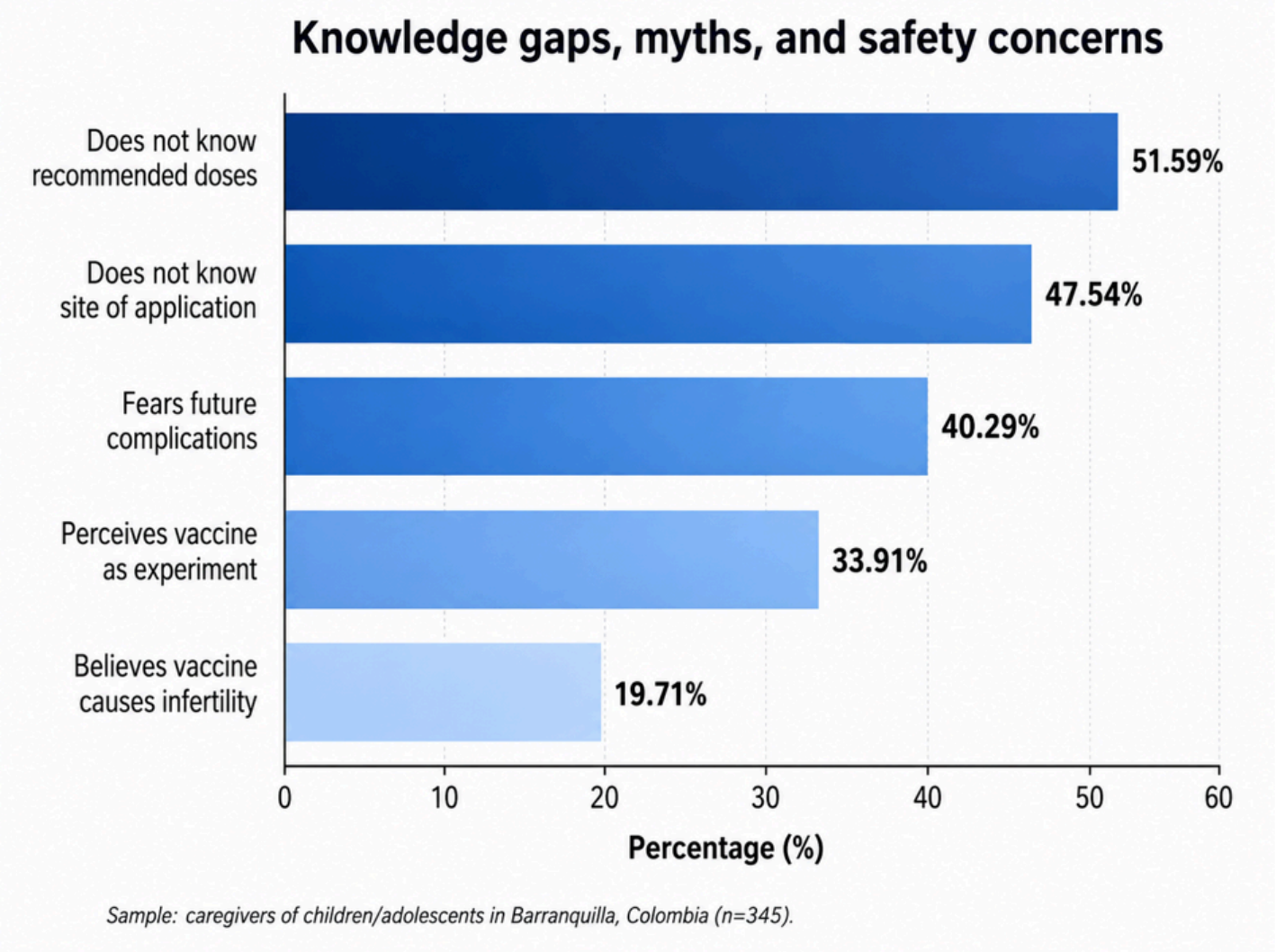


Figure 2

Knowledge gaps, myths, and safety concerns regarding HPV vaccination.

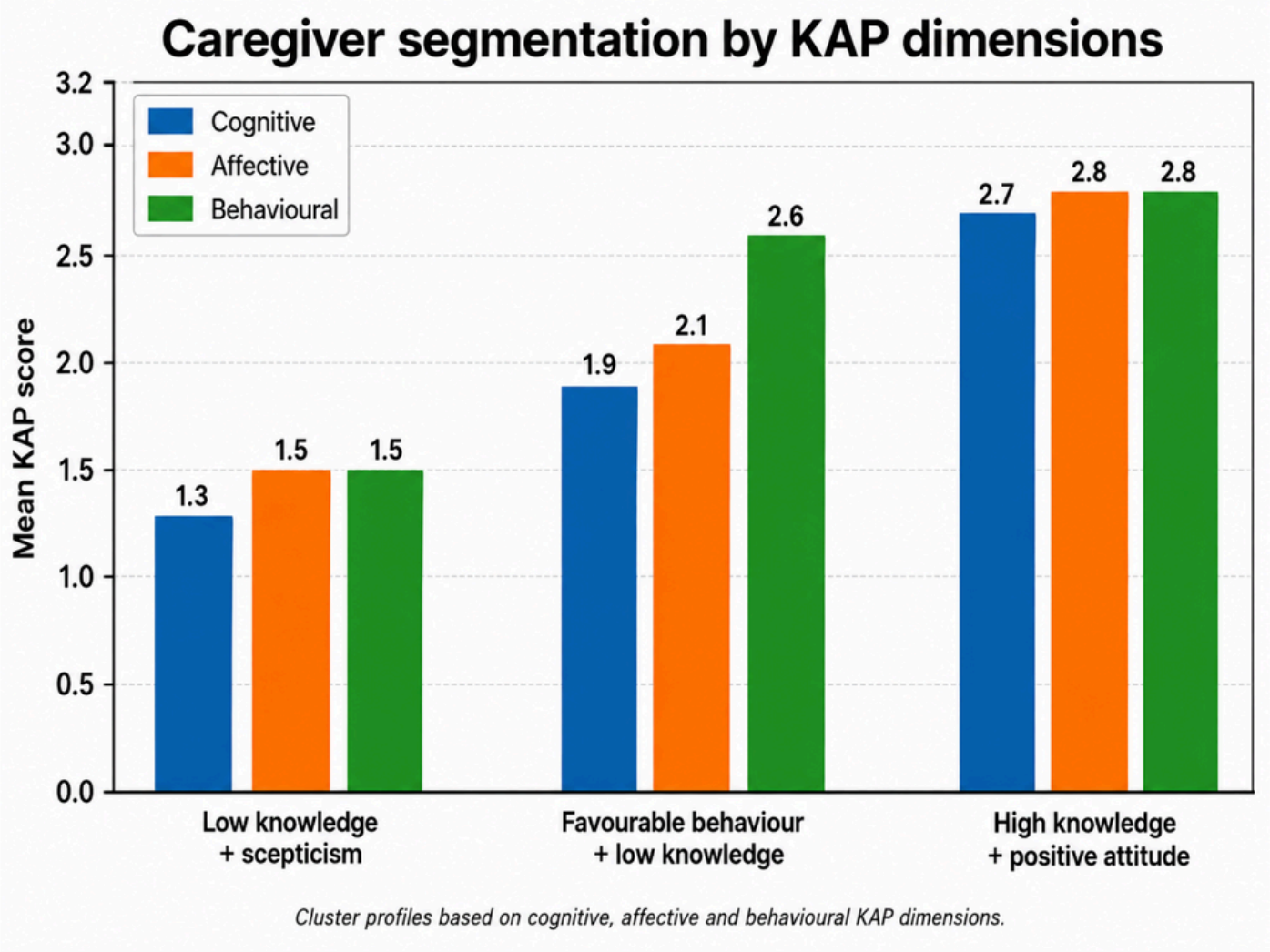


Figure 3

Cluster profiles by cognitive, affective, and behavioural KAP dimensions.

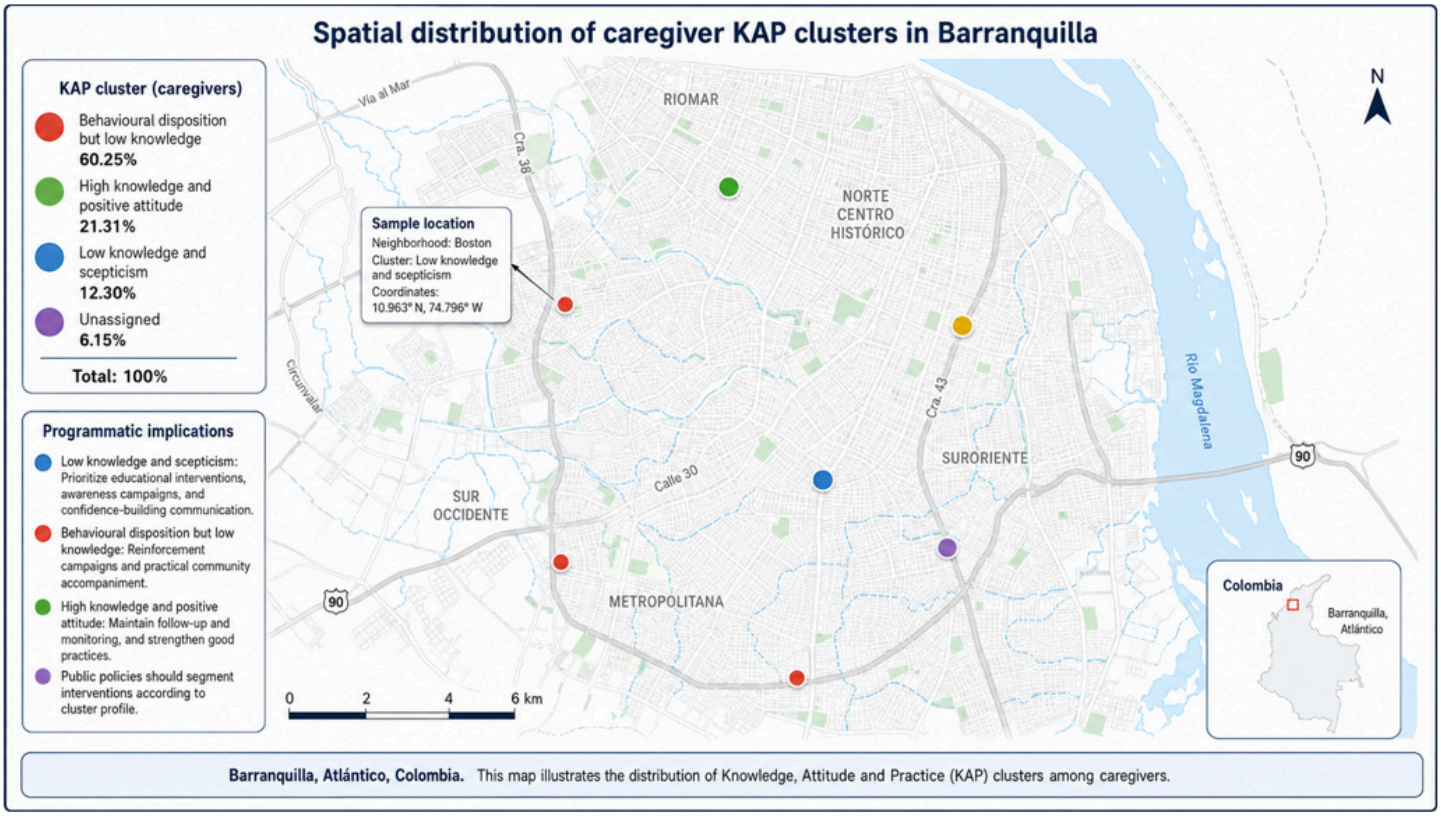


Figure 4

Exploratory neighbourhood-level KAP map for Barranquilla. Exact coordinates should not be published; a final anonymized high-resolution map should be generated for submission.

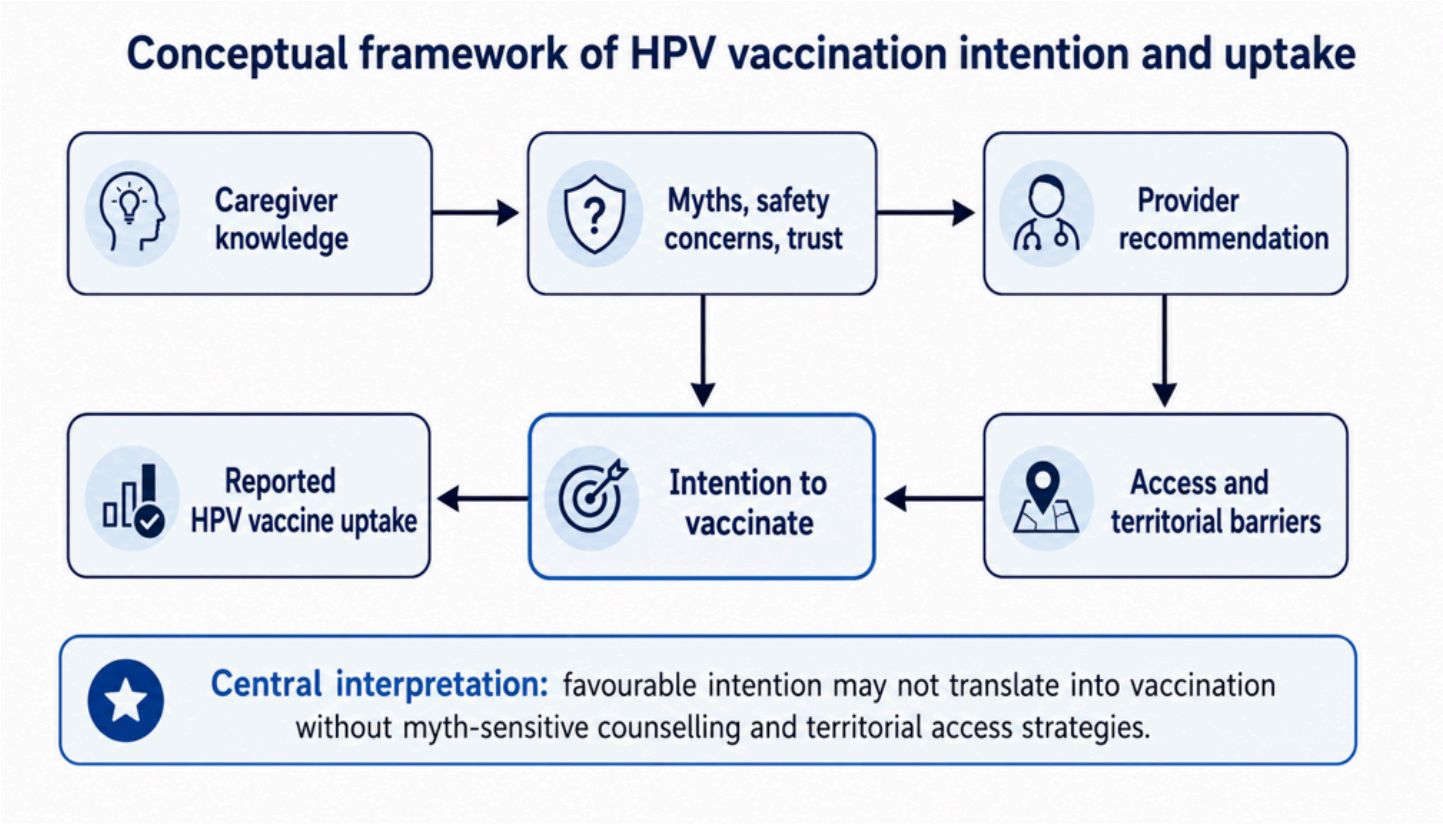


Figure 5

Conceptual model of the HPV vaccination intention–practice gap.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- STROBEChecklist.pdf