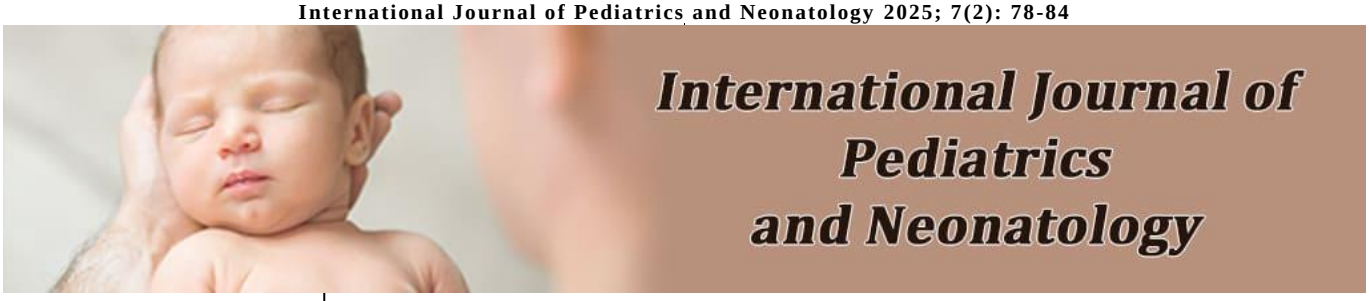

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Comparison of knowledge, attitude and awareness about human papilloma virus infection and vaccine among adolescent urban and rural secondary school girls: A comparative cross-sectional study

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Abstract
Background: Cervical cancer remains a leading cause of morbidity and mortality among women in India. Persistent infection with high-risk human papillomavirus (HPV) types is the primary cause of cervical cancer, yet awareness and uptake of HPV vaccination among adolescents remain low, especially in rural communities.
Objectives: To compare knowledge and awareness, attitudes, willingness, and perceived barriers regarding HPV infection and vaccination among urban and rural secondary school girls in Bengaluru, India.
Methods: A cross-sectional comparative study was conducted in August 2024 among 200 secondary school girls (classes 7^{th}-10^{th}), with equal representation from urban and rural areas. Data were collected using a structured, pre-tested questionnaire assessing demographics, knowledge of cervical cancer and HPV, attitude toward HPV vaccination, willingness to vaccinate, and perceived barriers. Following a health education session and group discussions, post-intervention assessments were completed. Data were analyzed using descriptive statistics and chi-square tests.
Results: Urban participants demonstrated significantly higher knowledge of HPV and its vaccine (50% good knowledge) compared to rural participants (4% good knowledge; $p<0.0001$). Positive attitudes toward HPV vaccination were reported by 43% of urban girls and only 4% of rural girls ($p<0.0001$). Willingness to receive the vaccine was low overall, with only 5% of urban participants and none of the rural participants expressing willingness ($p = 0.029$). The most frequently cited barriers among rural girls included lack of awareness (52%), and concerns about side effects or social stigma, all significantly higher than in the urban group.
Conclusion: Substantial disparities exist between urban and rural secondary school girls in HPV knowledge, attitudes, and vaccine acceptance. Addressing these gaps through targeted educational interventions, community engagement, and removal of financial barriers is essential to improve HPV vaccine uptake and reduce the burden of cervical cancer in India.

Keywords: Human papillomavirus, HPV vaccine, cervical cancer, knowledge, attitude, barriers, adolescent girls, urban-rural, India

Introduction
Cervical cancer remains a major public health challenge worldwide, ranking as the fourth most common cancer among women, with an estimated 604,000 new cases and 342,000 deaths annually, according to the World Health Organization (WHO) [1]. In India, cervical cancer accounts for nearly one-fifth of the global burden, making it the second most common cancer among Indian women and a leading cause of cancer-related mortality in the country [2, 3]. Persistent infection with high-risk types of human papillomavirus (HPV) is recognized as the principal cause of cervical cancer, with HPV types 16 and 18 responsible for over 70% of cases [4].
HPV vaccination has emerged as a highly effective primary prevention strategy, with evidence demonstrating that timely immunization can prevent up to 90% of HPV-related cervical cancers [5, 6]. The WHO and the Government of India recommend HPV vaccination for adolescent girls, ideally before the onset of sexual activity, and several states have begun

to implement school-based or public vaccination programs [7]. However, the uptake of HPV vaccine in India remains suboptimal due to a range of factors including limited awareness, sociocultural barriers, vaccine cost, and concerns about safety and efficacy [8, 9].

Numerous studies conducted across India have documented significant gaps in HPV-related knowledge and vaccine awareness among adolescents and the general population. For example, Ramavath KK *et al*. [9]. found that only 28% of Indian adolescent girls had heard of HPV, and fewer than one in four correctly identified cervical cancer as a leading cause of cancer mortality among women [9]. Kumari S *et al*. [10]. reported that over 90% of rural adolescent girls were unaware of HPV infection or its vaccine [10]. Similarly, Gupta S *et al*. [11]. observed that less than half of adult women were aware of the HPV vaccine, and knowledge about vaccination eligibility, recommended age, and preventive benefits was even lower [11]. By contrast, studies among healthcare providers such as Aggarwal I *et al*. and Mandal M *et al*. revealed higher knowledge levels but still highlighted gaps in awareness regarding specific vaccine types, indications, and barriers to personal uptake [12, 13].

Barriers to HPV vaccination in India are multifactorial. Lack of awareness and knowledge, parental and community hesitancy, perceived social stigma, and financial constraints have all been identified as significant deterrents [9-13]. Given the disproportionately high burden of cervical cancer in India and the proven effectiveness of HPV vaccination, it is crucial to understand the levels of awareness, attitudes, and perceived barriers among adolescent girls, particularly in the context of urban-rural disparities. The present study was therefore undertaken to assess and compare the knowledge, attitudes, willingness, and barriers related to HPV infection and vaccination among urban and rural secondary school girls in Bengaluru, with the goal of informing targeted interventions to increase vaccine uptake and reduce cervical cancer risk.

Methodology

A cross-sectional comparative study was conducted in August 2024 among secondary school girls attending classes 7th to 10th in Bengaluru, Karnataka, India. The study included 200 participants: 100 from urban schools and 100 from rural schools, selected by purposive sampling. Girls aged 12-17 years who provided informed consent were eligible for participation. Ethical clearance was obtained from the institutional ethics committee prior to data collection.

Data were collected in three sequential phases. In the first phase, all participants completed a pre-tested, structured questionnaire that collected demographic details (including age, class, religion, parental education, socioeconomic status, and family type) and baseline knowledge regarding cervical cancer and HPV infection. In the second phase, participants received a standardized 20-minute health talk on cervical cancer, HPV infection, and HPV vaccination, delivered by the primary investigator in the local language. This was supplemented with visual aids and followed by group discussions lasting 15 minutes to clarify any doubts and encourage open conversation. In the third phase, a second questionnaire was administered to assess post-intervention knowledge, as well as participants' attitudes toward HPV vaccination and perceived barriers and concerns about vaccine uptake.

Knowledge assessment involved 12 multiple-choice items that measured awareness and understanding across several domains: awareness of cervical cancer and its symptoms, identification of HPV as a causative agent, knowledge of modes of transmission (including sexual transmission and the effect of multiple partners), awareness of the HPV vaccine and its preventive role, knowledge of the recommended age and timing of vaccination, continued need for Pap smear screening after vaccination, and recognition that the vaccine is not a cure. Each correct response was scored as 1, and incorrect or "don't know" responses were scored as 0. Total knowledge scores ranged from 0 to 12. Participants with scores of 8 or higher (≥67% correct) were categorized as having "good knowledge," while those with lower scores were considered to have "poor knowledge." Item-wise correct responses were also analyzed for both urban and rural groups.

Attitude toward HPV vaccination was assessed using five structured statements, each targeting a different aspect of participants' beliefs and acceptance of the vaccine. The statements were as follows: (1) "I believe the HPV vaccine is important for preventing cervical cancer in girls"; (2) "If given the opportunity, I am willing to receive the HPV vaccine myself"; (3) "I would recommend the HPV vaccine to my friends or family members"; (4) "I feel comfortable discussing HPV vaccination with my parents or guardians"; and (5) "I trust that the HPV vaccine is safe and effective." Participants indicated their level of agreement with each statement using a three-point Likert scale: Agree, Neutral, or Disagree. For analytical purposes, attitude was dichotomized: participants who agreed with at least three out of the five positive statements were classified as having a "positive attitude" toward HPV vaccination, while those who agreed with fewer than three were classified as having a "negative attitude."

Willingness to receive the HPV vaccine was measured by a direct question: "Would you be willing to take the HPV vaccine if it was made available to you?" with a Yes/No response.

Concerns and perceived barriers were evaluated by asking participants to indicate their primary concern about HPV vaccination (options: cost, side effects, efficacy) and to select any barriers to vaccination they perceived from a provided list (including lack of awareness, parental disapproval, fear of infertility, and social stigma). Multiple barriers could be selected.

All data were coded and analyzed using SPSS software (version XX). Categorical variables were summarized as frequencies and percentages. Comparisons between urban and rural groups were performed using the chi-square test. A p-value less than 0.05 was considered statistically significant.

Results

Participant Demographics

A total of 200 secondary school girls participated in the study, equally divided between urban (n=100) and rural (n=100) areas. The age distribution was similar across both groups, with most participants aged 12-15 years (urban: 75%; rural: 73%). There were no statistically significant differences in class or religion between the two groups (Table 1). Parental education and socioeconomic status, however, differed markedly. A significantly greater proportion of urban girls had parents with graduate-level

education or above (45% vs. 18%; $p<0.0001$), while the majority of rural participants' parents had education up to 10th standard (60%). Urban participants were more likely to belong to upper socioeconomic strata (30% vs. 8%; $p<0.0001$). Nuclear families predominated in urban areas (72%), whereas joint families were more common in rural areas (42%; p = 0.029).

Knowledge of HPV and Cervical Cancer

Knowledge regarding HPV and cervical cancer was significantly higher among urban participants compared to rural participants. For example, 85% of urban girls had heard of cervical cancer versus 40% in the rural group; 62% of urban participants had heard of HPV compared to 18% of rural participants. Similarly, urban participants outperformed their rural counterparts across all item-wise knowledge domains, including awareness of transmission, preventive measures, and recommended age for vaccination (Table 2a). Overall, half (50%) of urban participants demonstrated good knowledge (≥8 correct answers), compared to just 4% among rural participants ($\chi^2 = 53.41$, p = 0.0001) (Table 2b).

Attitude and Willingness Toward HPV Vaccination

A positive attitude toward HPV vaccination was reported by 43% of urban girls, compared to only 4% of rural girls ($\chi^2 = 42.09$, p = 0.0001). Willingness to receive the HPV vaccine was generally low, with only 5% of urban participants and none of the rural participants expressing willingness ($\chi^2 = 5.103$, p = 0.029) (Table 3).

Concerns and Perceived Barriers Regarding HPV Vaccine

The most common concerns cited about the HPV vaccine were side effects, cost, and doubts about efficacy. Concern about side effects was significantly higher in rural participants (40%) than urban (25%) (p = 0.011). Concerns regarding cost and efficacy did not differ significantly between groups (Table 4). When assessing perceived barriers, lack of awareness was the most frequently reported barrier in the rural group (52% vs. 18% in urban; $p<0.0001$), fear of infertility, and social stigma were also reported more commonly in rural participants, with all differences reaching statistical significance (Table 5).

Discussion

This cross-sectional comparative study assessed the knowledge, attitude, willingness, and barriers related to HPV infection and vaccination among secondary school girls in urban and rural areas of Bengaluru.

Demographic Characteristics: Context and Comparison

The present study included an equal number of urban and rural secondary school girls aged 12-17 years, enabling a direct comparison of demographic factors influencing HPV vaccine awareness and acceptance. While the age and class distribution in our sample was similar across groups, significant differences were observed in parental education and socioeconomic status, with urban girls far more likely to have parents with graduate-level education (45% vs. 18%) and to belong to higher socioeconomic strata.

These demographic findings are consistent with several major Indian studies. For example, Ramavath KK *et al.* [9]. studied a large, diverse sample of adolescents aged 13-19 years from multiple cities and similarly found that parental literacy (76.2% literate parents overall) and higher socioeconomic status (over one-third from upper social class) correlated positively with HPV knowledge. Likewise, Gupta S *et al.* [11].'s adult sample was predominantly from lower and lower-middle socioeconomic classes (54.7% and 27.3%, respectively), which was reflected in their lower HPV awareness and vaccine willingness rates—paralleling our findings among rural participants.

In Kumari S *et al.* [10]., the majority of participants were from rural backgrounds and most (nearly 74%) were educated only up to class 12th or below; their study also reported extremely low knowledge and awareness of HPV, highlighting how lower education levels perpetuate poor health literacy. By contrast, studies focusing on healthcare professionals (such as Aggarwal I [12] and Mandal M [13]) included participants with at least a bachelor's degree (nursing or MBBS), and unsurprisingly, both knowledge and attitude scores were substantially higher in these groups. Taken together, our results and those of other Indian studies show that higher parental education and socioeconomic status consistently predict better HPV-related knowledge and acceptance. This demographic effect is evident across diverse settings and should guide future targeting of educational interventions and subsidy programs.

Knowledge and Awareness of HPV and Vaccination

Our results highlight a persistent gap in knowledge regarding HPV and its vaccine, particularly among rural adolescent girls. In our study, only 4% of rural participants demonstrated good knowledge about HPV and the vaccine, compared to 50% of their urban counterparts. These findings are consistent with the work of Kumari S *et al.* [10]., who reported that nearly 94% of their rural sample had never heard of HPV infection, and only 2% were aware of the HPV vaccine. Similarly, Ramavath KK *et al.* [9]. observed that only 28% of adolescent girls from diverse Indian cities knew about HPV, with even fewer aware of cervical cancer's connection to the virus or the availability of preventive vaccination.

The item-wise knowledge responses in our study further emphasize this gap. While 85% of urban participants had heard of cervical cancer, only 40% of rural girls had similar awareness. Awareness about HPV as the cause of cervical cancer, the means of transmission, and the preventive role of vaccination were consistently higher among urban girls, but both groups lagged behind the knowledge levels reported in studies of healthcare professionals. For example, Aggarwal I *et al.* [12]. and Mandal M *et al.* [13]. found that over 90% of doctors and nurses could correctly identify HPV and its link to cervical cancer, although even among these groups, detailed knowledge (e.g., about vaccine types and schedules) was sometimes lacking.

Despite these professional cohorts demonstrating far superior awareness, our findings align with those from community-based samples such as Gupta S *et al.* [11]., who reported that less than half of adult women were aware of the HPV vaccine, and only 2% knew the recommended vaccination age. Such pervasive gaps in knowledge among adolescents and the broader public underscore the urgent need for effective educational strategies.

Attitude and Willingness Toward HPV Vaccination

Attitudes toward HPV vaccination were similarly polarized along urban-rural lines. In our study, a positive attitude toward HPV vaccination was observed in 43% of urban girls, but just 4% of rural participants. This sharp contrast mirrors findings from Kumari S *et al*. [10]., who documented that nearly all rural adolescent girls were unaware or uncertain about HPV vaccination, and from Gupta S *et al*. [11]., where hesitancy was further compounded by doubts about the necessity and safety of the vaccine.

Willingness to receive the HPV vaccine was also markedly low in both groups in our study, but was especially poor among rural girls, with none expressing willingness. This is in stark contrast to the improvement in acceptance seen after educational interventions, as demonstrated by Ramavath KK *et al*. [9].: after a health talk, 74.4% of their participants indicated they would accept vaccination, and 76.5% agreed that cervical cancer prevention should be a top health priority. Similarly, Mandal M *et al*. [13]. found a positive attitude in over 70% of healthcare professionals, and Madhivanan *et al*. [8]. reported that 71% of parents would accept vaccination for their daughters when they believed the vaccine was safe and cervical cancer was a serious disease.

Importantly, several studies, including ours, found that cost was a decisive factor influencing willingness. In Gupta S *et al*. [11]., willingness to vaccinate themselves or their daughters was threefold higher if the vaccine was provided free of cost, a finding echoed in our rural group's responses and by other authors as well.

Barriers and Concerns Regarding HPV Vaccination

Barriers to HPV vaccination in our population were predominantly related to lack of awareness, cost and social stigma—concerns that have been consistently reported in the literature. In our study, 52% of rural girls cited lack of awareness as a barrier. Ramavath KK *et al*. [9]. similarly identified cost (56.7%), lack of awareness (24.8%), and fear of side effects (15.6%) as the most significant obstacles. Gupta S *et al*. [11]. highlighted cost and fear of injections as major deterrents, with family resistance also contributing substantially. Even among healthcare professionals, Aggarwal I *et al*. [12]. and Mandal M *et al*. [13]. observed low vaccination uptake despite high knowledge, suggesting that additional barriers such as accessibility, cost, or hesitancy persist even among informed individuals. Concerns about side effects, vaccine efficacy, and the social perception of girls who receive the vaccine (e.g., fear of being labeled as sexually active) remain significant and must be addressed through culturally sensitive educational campaigns.

Implications for Policy and Practice

Collectively, these findings point to several actionable priorities. First, school-based and community educational programs—especially in rural areas—can substantially improve awareness and vaccine acceptance. Second, removing financial barriers by subsidizing or providing the HPV vaccine free of charge will likely increase uptake, particularly among socioeconomically disadvantaged groups. Third, involvement of parents, teachers, and healthcare professionals as advocates and educators can help dispel misconceptions, reduce stigma, and empower girls to make informed choices about their health.

Limitations

Our study was limited to a single urban-rural catchment area, which may restrict generalizability. Additionally, self-reported data may be subject to recall and social desirability bias. Nevertheless, the consistency of our findings with other large-scale Indian studies supports the validity and broader relevance of these observations.

Table 1: Demographic Characteristics of Study Participants

Demographic Factor	Urban (n=100)	Rural (n=100)	p-value
Age (years)			
12-13	40 (40%)	35 (35%)	0.784
14-15	35 (35%)	38 (38%)	
16-17	25 (25%)	27 (27%)	
Class			
7th	25 (25%)	27 (27%)	
8th	30 (30%)	25 (25%)	0.947
9th	25 (25%)	28 (28%)	
10th	20 (20%)	20 (20%)	
Religion			
Hindu	75 (75%)	80 (80%)	0.721
Muslim	18 (18%)	12 (12%)	
Christian	7 (7%)	8 (8%)	
Parents' education			
Up to 10th std	20 (20%)	60 (60%)	<0.0001
12th/PUC	35 (35%)	22 (22%)	
Graduate & above	45 (45%)	18 (18%)	
Socioeconomic status			
Lower	10 (10%)	38 (38%)	<0.0001
Middle	60 (60%)	54 (54%)	
Upper	30 (30%)	8 (8%)	
Type of family			
Nuclear	72 (72%)	58 (58%)	0.029
Joint	28 (28%)	42 (42%)	

Item-wise Correct Responses to HPV Knowledge Questions

Table 2a: Knowledge of HPV Vaccine

Knowledge Question	Urban (n=100)	Rural (n=100)
1. Heard of cervical cancer	85 (85%)	40 (40%)
2. Heard of HPV	62 (62%)	18 (18%)
3. Knows HPV is a cause of cervical cancer	58 (58%)	15 (15%)
4. Knows HPV is transmitted sexually	52 (52%)	10 (10%)
5. Knows that having multiple partners increases risk	48 (48%)	7 (7%)
6. Knows there is a vaccine to prevent HPV	50 (50%)	10 (10%)
7. Knows recommended age for HPV vaccination	30 (30%)	4 (4%)
8. Knows vaccine is most effective before sexual debut	28 (28%)	3 (3%)
9. Knows that regular Pap smear is important post-vaccination	40 (40%)	12 (12%)
10. Knows HPV vaccine is not a cure for cervical cancer	38 (38%)	8 (8%)
11. Knows at least one symptom of cervical cancer	46 (46%)	13 (13%)
12. Knows that early vaccination is safe	35 (35%)	6 (6%)

Table 2b: Knowledge of HPV Vaccine among Urban and Rural Participants

Knowledge Level	Urban (n=100)	Rural (n=100)	Chi-square	p-value
Good	50 (50%)	4 (4%)	53.41	0.0001
Poor	50 (50%)	96 (96%)		

Table 3: Attitude and Willingness to Take HPV Vaccine Among Urban and Rural Participants

Response	Urban (n=100)	Rural (n=100)	Chi-square	p-value
Attitude				
Positive	43 (43%)	4 (4%)	42.09	0.0001
Negative	57 (57%)	96 (96%)		
Willingness				
Yes	5 (5%)	0 (0%)	5.103	0.029
No	95 (95%)	100 (100%)		

Table 4: Greatest Concern about Vaccine

Concern	Urban (n=100)	Rural (n=100)	Chi-square	p-value
Cost	20 (20%)	30 (30%)	2.667	0.053
Side effects	25 (25%)	40 (40%)	5.128	0.011
Efficacy	30 (30%)	33 (33%)	0.208	0.324

Table 5: Perceived Barriers to HPV Vaccination

Barrier	Urban (n=100)	Rural (n=100)	Chi-square	p-value
Lack of Awareness	18 (18%)	52 (52%)	21.16	<0.0001
Fear of Infertility	10 (10%)	25 (25%)	7.14	0.008
Social Stigma	7 (7%)	20 (20%)	6.79	0.009

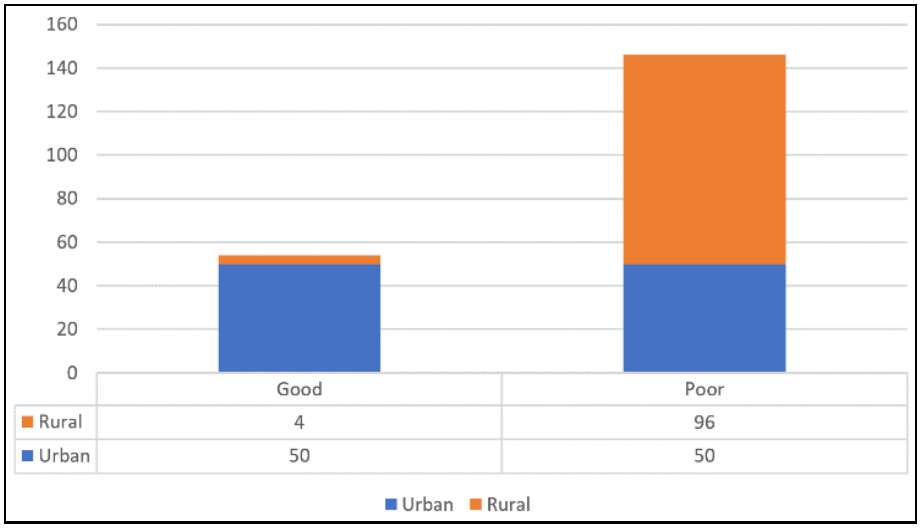

Fig 1: Knowledge of HPV Vaccine among Urban and Rural Participants

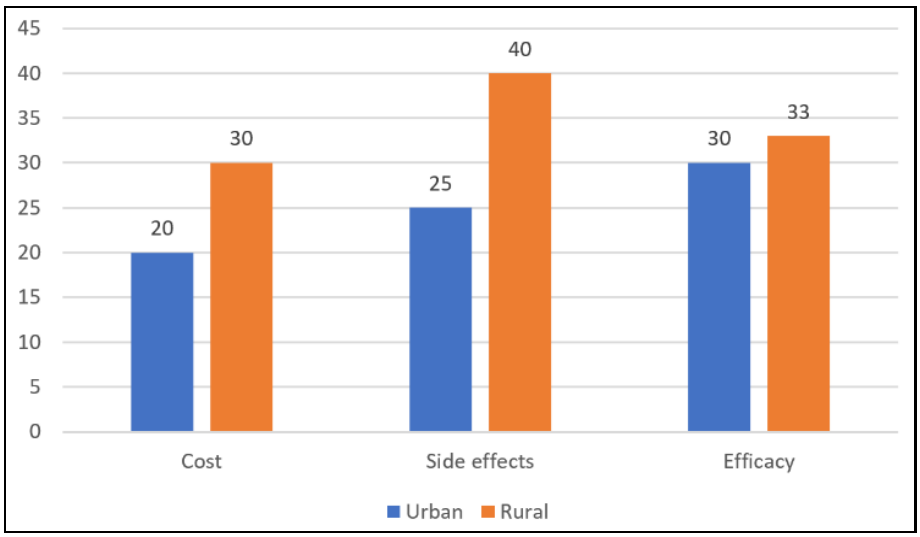

Fig 2: Greatest Concern about Vaccine

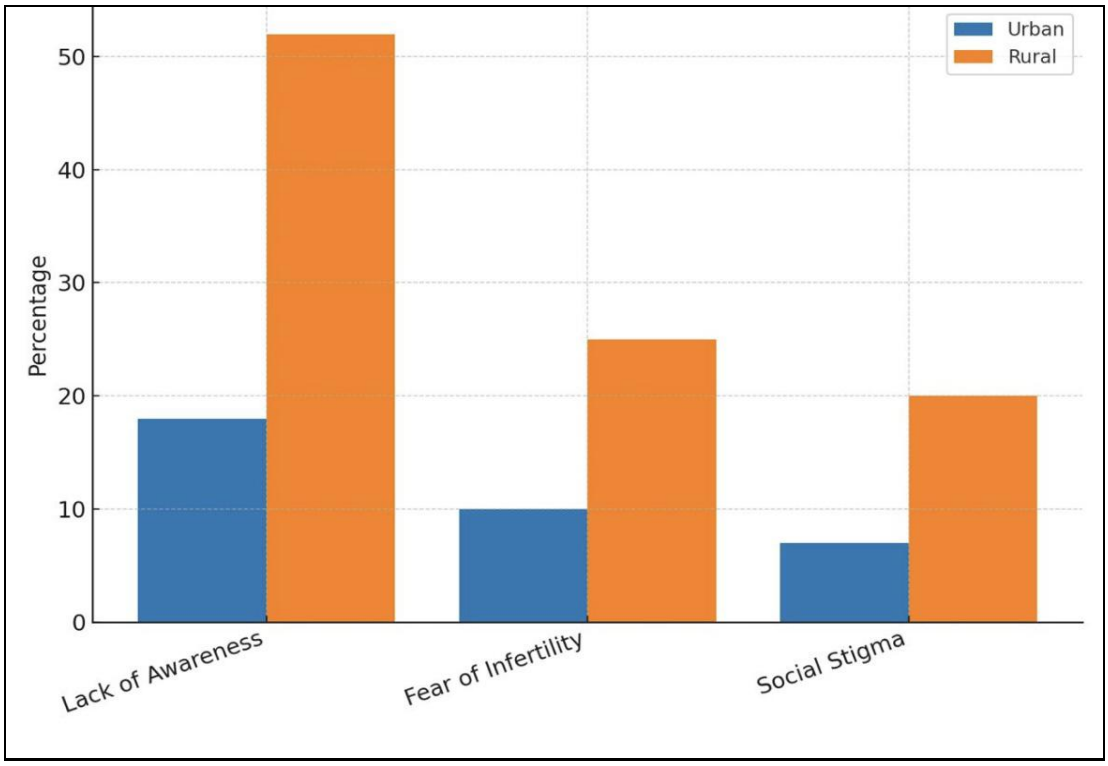

Fig 3: Perceived Barriers to HPV Vaccination

Conclusion

This study highlights a substantial gap in knowledge, attitude, and willingness regarding HPV vaccination among secondary school girls in Bengaluru, with urban participants demonstrating significantly better awareness and more favorable attitudes than their rural counterparts. Major barriers to vaccine acceptance—particularly among rural girls—included lack of awareness, fear of infertility, and social stigma. Targeted educational interventions, inclusive of parents and community stakeholders, are urgently needed to address these disparities and enhance HPV vaccine uptake, ultimately contributing to cervical cancer prevention in adolescent girls.

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