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Urban–Rural Disparities in Knowledge and Awareness of Human Papillomavirus and The Hpv Vaccine Among Adults in Sargodha District, Punjab, Pakistan

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ABSTRACT

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HPV vaccination and screening are the main strategies to prevent cervical cancer, but a foundation for gaining acceptance of vaccination is an understanding of HPV. The methods employed were a cross sectional survey of adults (age 18 and above) and the questionnaire was validated and translated (English/Urdu) and was administered during seven weeks in urban and rural Sargodha. Recruitment was stratified quota (125 urban, 125 rural) and the administration was mixed (online and paper administered by interviewer). The scores of 17 knowledge items were added together (range 0–17, ≥ 10 = adequate). The difference among groups was analyzed by chi square/Fisher's exact, t and Mann–Whitney tests. Crude and adjusted prevalence ratios (PR) were used to determine factors associated with adequate knowledge and vaccine awareness. 250 questionnaires were completed and analysed from a total of 287 questionnaires started. There was a significantly higher level of HPV awareness among urban respondents (67.2%) compared with rural respondents (31.2%) and HPV vaccine awareness among urban respondents (58.4%) compared with rural respondents (24.8%) (both $p < 0.001$). Adequate knowledge was found in 22.4% overall (urban 37.6%, rural 7.2%; $p < 0.001$). 58.8% (urban 70.4% and rural 47.2%) were willing to vaccinate or Page 1 of 13 Urban–Rural Disparities in Knowledge and Awareness of HPV and the HPV Vaccine among Adults in Sargodha, Pakistan allow vaccination and 4.4% had been vaccinated before. Problems with knowledge (80.6%), safety concerns (63.1%) and cost (55.3%) were the primary barriers among 103 respondents who were unwilling or not sure. The most trusted source of recommendation was physicians. Following adjustment, rural living was still correlated with lower The strongest positive correlates were adequate knowledge (PR 0.42; 95% CI 0.21–0.84) and lower vaccine awareness (PR 0.61; 0.43–0.87); graduate education (PR 3.64) and healthcare employment (PR 2.55) were the strongest positive correlates. Knowledge level of adults about HPV and HPV vaccines is limited and this is significantly lower in rural areas, which can be attributed to education and socio economic status, although not entirely. Attitudes towards vaccination are more prevalent than knowledge.

Introduction

Cervical cancer is a significant public health issue; an estimated 604,000 new cases and 342,000 deaths from cervical cancer are expected worldwide in 2020 [1]. The majority of the deaths are in low and middle income countries (LMICs) where there is limited access to screening, vaccination and treatment [1,2]. Cervical cancer is almost entirely attributable to infection by high-risk human papillomavirus (HPV) – mainly types 16 and 18 – via the viral oncoproteins E6 and E7 which disable the tumour suppressors p53 and Rb. In 2020 the World Health Organization (WHO) launched a global strategy to eliminate cervical cancer as a public health problem, with 2030 targets of 90% of girls vaccinated, 70% of women screened with a high-performance test and 90% of women with disease treated (the 90–70–90 targets) [2, 17, 18].

Despite the lack of a comprehensive national cancer registry, cervical cancer is a major cause of morbidity and mortality in Pakistan with significant contribution [3,4]. Initially, HPV vaccines were limited to the private sector with uptake of vaccination limited by low uptake, safety-related misconceptions, stigma and cost [4–6]. In 2025, a national vaccination programme was launched [5, 19, 20, 21]. It relies on community knowledge and trust of the vaccine.

In Pakistan, knowledge of HPV and HPV vaccine among university students, health care Urban–Rural Disparities in Knowledge and Awareness of HPV and the HPV Vaccine among Adults in Sargodha, Pakistan professional trainees, women and parents is reported to be low [6–8,11,13]. But most samples were of students, women or of urban populations. It is uncommon to find comparisons between rural and urban areas, but rural areas have lower literacy rates and less access to health facilities and are more dependent on informal and traditional sources of information. Other studies conducted in the South Asian region also associate education levels with HPV vaccine awareness and uptake, with lower levels of awareness and uptake seen among those who are less educated and live in rural areas [9,10, 22, 23, 24].

Sargodha is a mostly agricultural region of central Punjab that has an urban centre and also has a large rural union council area which is a natural fit for such a study. Our study objectives were to (i) compare knowledge and awareness of HPV, cervical cancer and HPV vaccine between urban and rural adults, (ii) describe the extent of willingness to vaccinate, barriers to vaccine willingness among adults who were hesitant to vaccinate and sources of recommendation, and (iii) identify socio-demographic factors independently associated with adequate knowledge and vaccine awareness.

Methods

Design and setting

The survey was a cross sectional survey in Sargodha district, Punjab during approximately seven weeks starting from the fourth week of January. The study is reported following the STROBE statement for cross sectional studies.

Participants and sampling

Only adults (age 18 or older) residing in the district as permanent citizens and able to communicate in English or Urdu were eligible to respond. The urban and rural areas were determined based on the district administrative classification, in which villages were considered rural localities and Sargodha city and officially urban localities were considered as urban localities. Recruitment was simultaneously conducted in 2 strata, both with a 125 quota (urban and rural). Urban participants were contacted using institutional contacts, while e-mail and social media were used to reach urban participants and local health workers, community gatekeepers and rural health facilities were used to reach rural participants, with a few rural participants reached by snowball referral. The sampling was hence a stratified quota convenience design that was not a probability sampling design. Questionnaires lacking the last section of the questionnaire were excluded, as well as questionnaires that were duplicates (same socio-demographic data), questions answered by persons under the age of 18 or questions that could not be Page 3 of 13 Urban–Rural Disparities in Knowledge and Awareness of HPV and the HPV Vaccine among Adults in Sargodha, Pakistan answered with respect to place of residence. The sample size of 250 was determined with a minimum of 50% adequate knowledge (the most conservative assumption), 95% confidence and a margin of error of approximately ± 6.2 percentage points for the entire sample. The sample size was determined by available resources.

Instrument

The questionnaire was modified from two existing questionnaires: HPV vaccination knowledge questionnaire from Southern Europe and maternal HPV knowledge and vaccine acceptability questionnaire from China, the latter incorporating questions on local barriers, including cost and vaccine's effect of increasing sexual activity prior to marriage. Content and face validity were assessed by a panel of clinicians and public health researchers. The tool has been translated forward in Urdu, then back translated by another team member, discussed and re-reviewed by the panel. It was trialled with 20 volunteers (not analysed) from urban and rural areas and subsequently modified. There were four parts: 1) socio-demographics; 2) knowledge about HPV

and cervical cancer (10 items); 3) knowledge about HPV vaccine (7 items); and 4) vaccine acceptance (previous vaccine uptake, willingness to vaccinate self or daughter, barriers, and likelihood to act on vaccination recommendation from doctor, lady health worker, religious leader, family or friends, and social media). The yes/no/not sure responses were employed for knowledge items, and 'not sure' was given the score of wrong.

Data collection

This questionnaire was conducted online (Google Forms) and/or on paper, self completed or interviewer assisted, depending on the ability of the respondents to connect and/or be able to read and write. Items were read neutrally by the interviewers and 'not sure' responses were not prompted. Content and eligibility requirements and consent text were the same for both modes. All paper responses were double-checked with 10 per cent of these randomly selected and checked against originals. Entries that were inconsistent were checked and discarded if they hadn't been solved.

Outcomes and variables

Primary outcomes were item-level knowledge, a composite knowledge score (17 items; 0 – 17), adequate knowledge (≥ 10 of 17, about 60%) and awareness that an HPV vaccine exists. The secondary outcome was willingness to receive HPV vaccination or allow it in their child. Residence (urban/rural) was the exposure of interest. Covariates included were age (18-25 years, 26-35 years, >35 years), gender, education, marital status, number of daughters, monthly household income, employment and working or training in a healthcare facility.

Statistical analysis

For categorical variables, n (%) is reported and compared using chi square or Fisher's exact test if the expected counts were less than five. Independent-samples t-test and Mann-Whitney U test (where appropriate and indicated by skewness) were used to compare scores. Since outcomes were prevalent, prevalence ratios (PR) with their 95% confidence intervals were Estimated as opposed to odds ratios [regression model to be specified, e.g. Poisson with robust variance]. Variables with univariate $p < 0.20$ went into a multivariable model: residence was retained as the primary exposure. Informal assessment of collinearity (notably education and residence) was used. Healthcare employment was stratified for analyses. A significance level of $p < 0.05$ was considered significant. Data was analysed with SPSS v25.0(IBM).

Ethics

The protocol was cleared by the Institutional Ethical Review Committee (IERC) [to be inserted]. Participants gave electronic or verbal consent (with signature or thumbprint for interviewer-assisted interviews) after being told the purpose, voluntary nature and confidentiality of the study. There were no identifiable patient information stored, and data was maintained on an institutional password-protected server.

Results

Participants

There were a total of 287 questionnaires started (148 in urban areas, 139 in rural areas). Of the 37 who were excluded (21 incomplete, 9 duplicates, 4 under 18 years, 3 unclassifiable residence), 250 were analysed (125 per stratum; usable-response rate 87.1%). The majority of the urban respondents completed the surveys online (95.2%), while 56.8% of the rural respondents were interviewed or completed them on paper. 86.4% of the rural and 37.6% of urban respondents used Urdu language. There were no differences in age and gender by residence (Table 1), and the mean age was 29.6 years (SD 9.4) with 55.6% women. Urban respondents were also better educated (57.6% graduates vs. 20.0%), and had higher incomes and were more likely to be working in non-farm jobs or health care (23.2% vs. 9.6%). Rural workers were 30.4% employed in agriculture.

Table 1; Sociodemographic Characteristics of Urban and Rural Participants

Characteristic	Urban ($n = 125$)	Rural ($n = 125$)	p
Age in years, M (SD)	28.9 (8.8)	30.3 (9.9)	.241
Female	71 (56.8)	68 (54.4)	.897
Married	69 (55.2)	83 (66.4)	.071
Education			$< .001$
No formal education	4 (3.2)	21 (16.8)	

Characteristic	Urban (n = 125)	Rural (n = 125)	p
Graduate and above	72 (57.6)	25 (20.0)	
Monthly income (PKR)			< .001
≥ 100,000	29 (23.2)	9 (7.2)	
< 25,000	18 (14.4)	49 (39.2)	
Agricultural work	3 (2.4)	38 (30.4)	< .001
Works or trains in healthcare	29 (23.2)	12 (9.6)	.004
Has ≥ 1 daughter	41 (32.8)	57 (45.6)	.038

Knowledge of HPV, cervical cancer and the vaccine

For all items the scores of the urban respondents were higher than those of their rural counterparts (all $p \leq 0.001$; Table 2). Overall, 49.2% had heard of HPV (urban 67.2%, rural 31.2%) and 41.6% knew a vaccine exists (58.4% versus 24.8%). These also showed a significant drop from basic awareness to operational details, with only 24.8% of respondents being aware of the target age group of girls (aged 9-14 years) and just 21.6% knowing that the vaccine is available locally, and 13.6% knowing that women who receive the vaccine should still be screened (urban 20.8%, rural 6.4%). 18.0% were aware that most HPV infections disappear on their own. The awareness of the national campaign was 47.2% in urban and 21.6% in rural respondents.

Table 2; Correct or affirmative responses, n (%)

Knowledge of HPV, Cervical Cancer, and HPV Vaccination Among Urban and Rural Participants

Item	Urban (n = 125)	Rural (n = 125)	p
Has heard of HPV	84 (67.2)	39 (31.2)	< .001
HPV is sexually transmitted	71 (56.8)	28 (22.4)	< .001
HPV infects men and women	58 (46.4)	21 (16.8)	< .001
HPV may be asymptomatic	49 (39.2)	17 (13.6)	< .001
HPV causes genital warts	45 (36.0)	15 (12.0)	< .001
HPV is the main cause of cervical cancer	76 (60.8)	30 (24.0)	< .001
Most infections clear spontaneously	33 (26.4)	12 (9.6)	< .001
Cervical cancer is preventable	81 (64.8)	41 (32.8)	< .001
Screening can detect cervical cancer	68 (54.4)	24 (19.2)	< .001
Has heard of the Pap smear	57 (45.6)	16 (12.8)	< .001
HPV vaccine exists	73 (58.4)	31 (24.8)	< .001
Vaccine helps prevent cervical cancer	65 (52.0)	25 (20.0)	< .001
Target group is girls aged 9–14 years	48 (38.4)	14 (11.2)	< .001
Vaccine is available in Sargodha	41 (32.8)	13 (10.4)	< .001
Vaccinated women still need screening	26 (20.8)	8 (6.4)	.001
Minor side effects are possible	44 (35.2)	17 (13.6)	< .001
Aware of the 2025 national campaign	59 (47.2)	27 (21.6)	< .001

Composite knowledge

The mean score was 7.42 (SD 3.86) in urban and 3.21 (SD 2.94) in rural respondents (difference 4.21; $t = 9.70$, $p < 0.001$; Mann–Whitney $p < 0.001$; Table 3). Adequate knowledge was reached by 22.4% overall: 37.6% of urban and 7.2% of rural respondents ($\chi^2 = 33.24$, $p < 0.001$). 4.8% of the rural respondents got all the items wrong but 21.6% did not get a single item right.

Vaccination status, willingness and barriers

Only 4.4% reported vaccinating or getting their daughter to be vaccinated (urban 7.2%, rural 1.6%, $p = 0.033$). There was a higher acceptance of vaccination or consent to vaccinate in urban areas (70.4%) compared to rural areas (47.2%) ($p < 0.001$).

with 27.2% in rural areas undecided. Among respondents with daughters, 73.2% (urban) and 45.6% (rural) were willing ($p = 0.007$). Willingness was exceeded, by far, by the adequate knowledge, particularly in rural areas (47.2% compared with 7.2%).

Table 3; Composite knowledge and acceptance

Measure	Urban (n = 125)	Rural (n = 125)	Test statistic	p
Knowledge score, <i>M</i> (<i>SD</i>)	7.42 (3.86)	3.21 (2.94)	$t = 9.70$	< .001
Knowledge score, <i>Mdn</i> (IQR)	7 (4–10)	3 (1–5)	$U = 3,214$	< .001
Adequate knowledge	47 (37.6)	9 (7.2)	$\chi^2 = 33.24$	< .001
Already vaccinated	9 (7.2)	2 (1.6)		.033
Willingness to vaccinate				
Willing	88 (70.4)	59 (47.2)		< .001
Undecided	22 (17.6)	34 (27.2)		
Unwilling	15 (12.0)	32 (25.6)		

Table 4 shows that insufficient knowledge (80.6%), fear of side effects (63.1%) and cost (55.3%) were the most common barriers cited by the 103 respondents who were unwilling or undecided (37 urban and 66 rural). Cost (66.7% versus 35.1%) and the belief that vaccines promote premarital sexual activity (57.6% versus 29.7%) and the necessity to secure permission from a spouse or senior (43.9% versus 24.3%) were cited more frequently by rural respondents.

Table 4; Barriers among unwilling or undecided respondents, n (%)

Barrier	Urban (n = 37)	Rural (n = 66)	Total (N = 103)
Insufficient knowledge	26 (70.3)	57 (86.4)	83 (80.6)
Safety concerns	24 (64.9)	41 (62.1)	65 (63.1)
Cost	13 (35.1)	44 (66.7)	57 (55.3)
Daughter too young or not at risk	15 (40.5)	34 (51.5)	49 (47.6)
Belief that vaccine encourages premarital sex	11 (29.7)	38 (57.6)	49 (47.6)
Husband or elder permission needed	9 (24.3)	29 (43.9)	38 (36.9)
Religious or cultural objection	6 (16.2)	21 (31.8)	27 (26.2)

In both strata (87.2% urban and 80.8% rural would probably or definitely accept), the most persuasive source was a doctor's recommendation. There was strong acceptance from the rural population for religious leaders (63.2% compared with 38.4% in urban areas) and for lady workers and less for social media (32.0% compared with 40.0% in urban areas).

Healthcare workers

There was very high knowledge related to the healthcare profession. Healthcare workers had better levels of knowledge compared with non-healthcare workers, with 72.4% of healthcare workers having adequate knowledge, while only 27.1% of non-healthcare workers had adequate knowledge. In total, 6 of 12 rural healthcare workers (50%) failed to meet the adequacy threshold, a small sample which should be interpreted with caution.

Factors associated with knowledge and awareness

There was a strong association between rural residence and adequate knowledge (crude OR 0.19; 95% CI 0.10–0.37), that was reduced after adjustment (PR 0.42; 0.21–0.84), suggesting that part of this association is mediated by education or socio-economic differences (Table 5). Both outcomes were positively and highly correlated with graduate education and employment in healthcare. Further adjustment for education rendered household income a non-significant factor and age, gender, and having daughters were not associated with either outcome.

Table 5; Prevalence ratios(95% CI) for selected predictors

Crude and Adjusted Odds Ratios for Predictors of Adequate Knowledge and Vaccine Awareness

Predictor	Adequate knowledge		Vaccine awareness	
	Crude OR [95% CI]	Adjusted OR [95% CI]	Crude OR [95% CI]	Adjusted OR [95% CI]
Rural residence (ref: urban)	0.19 [0.10, 0.37]	0.42 [0.21, 0.84]	0.42 [0.30, 0.60]	0.61 [0.43, 0.87]

	Adequate knowledge		Vaccine awareness	
Graduate or above (ref: middle school or below)	5.86 [2.71, 12.67]	3.64 [1.62, 8.17]	3.12 [2.06, 4.73]	2.28 [1.44, 3.61]
Healthcare worker	4.12 [2.82, 6.02]	2.55 [1.66, 3.92]	2.31 [1.85, 2.88]	1.72 [1.34, 2.21]
Monthly income $\geq$ PKR 50,000	2.97 [1.80, 4.90]	1.52 [0.88, 2.63]	1.88 [1.38, 2.56]	1.19 [0.86, 1.65]

Adjusted estimates come from one model that also included intermediate education, age, gender and daughters.

Discussion

This study revealed that the awareness about HPV and HPV vaccine amongst Sargodha adults is low and rural adults lag behind urban adults in all measured parameters. Less than half reported being aware of HPV and less than one fourth said they knew enough about HPV. These levels are comparable with low level of awareness reported in other studies in Pakistan [6–8,11,13] but slightly less favourable than those found in studies that only include students or urban samples, suggesting that such estimates may overestimate awareness among the general adult population.

The following three findings are noteworthy. The first is that the rural deficit was big (adequate knowledge 7.2% versus 37.6%) and that it was reduced by over half in the adjusted analysis (PR 0.19 to 0.42). In keeping with the socio-ecological approaches to health behaviour, therefore, residence seems to be essentially a determinant of education and socio-economic disadvantage. The independence of rural residence with regard to knowledge, however, remained significant and could be due to other unmeasured factors like access to media, distance from facilities, contact with health workers. Therefore, geographic targeting alone will probably not bridge the divide and communication should be adapted to low literacy [26].

Secondly, there was a marked drop in knowledge from awareness that a vaccine does exist to the operational details such as local availability and ongoing need for screening. Only 13.6% recognized that vaccines do not prevent women from needing screening. Increased vaccine coverage may reduce the benefit of the secondary prevention component of the WHO 90–70–90 strategy [2, 27]. Limited awareness of the 2025 campaign was reported with 21.6% of rural respondents reporting awareness.

Third, the desire to vaccinate was far greater than was adequate knowledge (58.8% vs. 22.4%), particularly in rural areas. Acceptance for deference and lack of understanding can be fragile and sensitive to rumours or bad news. Knowledge was the most common barrier to vaccination, but cost, belief that vaccination leads to sex before marriage, permission of the husband or elder was more common in rural settings and is not addressed by information alone. The results are consistent with those of the cost, safety concerns, stigma and sociocultural barriers in Pakistan and South Asia reported earlier [5,6,8,10]. The most trusted sources of recommendations were physicians, with religious leaders and lady health workers being influential in rural areas, while social media – which was a widely used campaign channel – had the least influence. It was also interesting to note that half of rural health workers were not able to attain satisfactory knowledge (small numbers). This suggests that the frontline staff needs training prior to counselling communities.

Strengths and limitations

Limitations are that the instrument was translated and expert reviewed, but the mix of collection methods meant that a sample of rural respondents with limited internet access was not reached, and adjusted analyses were conducted with prevalence ratios; strengths include equal-quota urban and rural design (that directly compares the two), the instrument was translated and expert reviewed, and the majority of the collection methods were mixed mode, which enabled access to the rural respondents with limited internet [28]. There are restrictions: The sample was non-probabilistic and the estimates are therefore only indicative of the district and the sample was young (mean 29.6 years), and highly educated in the urban areas [29]. Design is cross sectional, meaning that associations are not causal. Knowledge was self-reported and interviewer presence in the rural area may have resulted in social desirability bias, but this was minimized by the use of a 'not sure' option and neutral reading. The type of administration varied between strata and was an integral part of place of residence. There were only a small number of rural healthcare workers ($n = 12$) and adequate-knowledge events ($n = 56$) which restricted the number of covariates in the adjusted model, leading to large confidence intervals. The cut-off value for the adequacy (10/17 items) was arbitrary and pre-defined.

Conclusions and Recommendations

Low knowledge and awareness of HPV and HPV vaccine among adults in Sargodha, with lower in rural area, attributed mainly to the education and socio-economic status. There are many who are willing to have a vaccine but are not inundated with all of

the information necessary for a lasting acceptance. The national program is recommended to include the use of oral and visual media for individuals with limited literacy skills instead of written or online media; to include training of lady health workers and engage physicians and religious leaders as the primary rural communicators; to explicitly state that vaccination is not a substitute for cervical screening; to overcome the misconception that vaccination is linked to pre-marital sexual activity; and to involve husbands and family elders in decision making. Random samples of larger rural populations should be used in future research, to determine the relationship between willingness and actual vaccination; to determine the knowledge of front line health workers; and to use qualitative methods to explore family decision-making.

Declarations

Ethics approval and consent: see Section 2.7. Data availability: de-identified data are available from the corresponding author on reasonable request [confirm]. Competing interests: none declared [confirm]. Funding: [to be completed]. Author contributions: [to be completed]. Acknowledgements: the authors thank all participants, community health workers and the expertreview panel.

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