JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

https://doi.org/10.61919/3xdm8d32

Original Article

Urban–Rural Disparities in Polio Vaccination in South Punjab, Pakistan: The Role of Community Perceptions, Barriers, and Health System Factors

Munawar Abbas[1], Muhammad Asif[1], Summaira Noor Malik[1]

[1] Department of Public Health, Times University, Multan, Pakistan

*Corresponding author: Muhammad Asif, drmuhammadasif@tum.edu.pk

"Cite this Article" **Received**: 24 January 2026; **Accepted**: 28 April 2026; **Published**: 08 May 2026
Author Contributions: Concept: MAb; Design: MAs; Data Collection: MAb; Analysis: MAs; Drafting: MAb and MAs. **Ethical Approval**: Times University, Multan, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: N/A.

ABSTRACT

Background: Polio eradication in Pakistan remains challenged by persistent gaps in vaccine acceptance, access, trust, and community engagement, particularly in underserved rural populations. Urban–rural differences in vaccination determinants require localized evidence to guide equitable eradication strategies. Objective: To compare community perceptions, perceived barriers, and factors associated with polio vaccination uptake among urban and rural residents of South Punjab, Pakistan. Methods: An analytical cross-sectional study was conducted among 600 adults, including 300 urban and 300 rural respondents. Data were collected through a structured, pilot-tested questionnaire assessing socio-demographic characteristics, awareness, socio-cultural influences, accessibility, institutional trust, communication barriers, and vaccination practices. Descriptive statistics, urban–rural comparisons, and multivariable logistic regression were used to identify factors associated with vaccination uptake. Results: Rural respondents reported higher barriers across most domains, including lack of awareness (63.7% vs. 50.3%), religious or cultural opposition (31.0% vs. 16.3%), limited campaign access (29.7% vs. 10.7%), transportation barriers (20.7% vs. 6.3%), and lack of schedule awareness (41.0% vs. 23.7%). Rural residence was independently associated with lower vaccination uptake (AOR=0.62, 95% CI: 0.45–0.85; p=0.003). Low awareness (AOR=0.48), poor access (AOR=0.55), transportation issues (AOR=0.58), low trust in government programmes (AOR=0.60), and religious influence (AOR=0.67) were also significant predictors. Conclusion: Polio vaccination disparities in South Punjab are driven by intersecting informational, socio-cultural, infrastructural, logistical, and institutional barriers. Rural-focused outreach, improved schedule communication, mobile vaccination services, and engagement of trusted community and religious leaders are essential to improve equitable vaccine uptake. Keywords: Polio vaccination; vaccine uptake; urban–rural disparity; vaccine hesitancy; community barriers; South Punjab; Pakistan.

INTRODUCTION

Poliomyelitis remains one of the most persistent vaccine-preventable public health challenges despite decades of coordinated eradication efforts. Since the launch of the Global Polio Eradication Initiative in 1988, substantial global progress has been achieved; however, continued transmission in endemic and high-risk areas shows that eradication is not determined by vaccine availability alone. Poliovirus transmission persists where immunization systems are weakened by social mistrust, misinformation, poor service accessibility, and structural inequalities. Children under five years remain particularly vulnerable, and missed or delayed vaccination continues to sustain reservoirs of infection in communities where routine and supplementary immunization activities do not reach all eligible children effectively (1).

ISSN 3007-0570 | © 2026 The Authors | CC BY 4.0

Polio vaccination through oral polio vaccine and inactivated polio vaccine has been central to reducing disease incidence and preventing paralysis and death. However, the effectiveness of vaccination programmes depends not only on biological efficacy but also on community acceptance, repeated dose adherence, caregiver knowledge, confidence in health workers, and the ability of health systems to reach underserved populations. Previous evidence has shown that vaccine uptake is shaped by multiple interacting factors, including awareness of disease severity, perceived vaccine safety, religious and cultural beliefs, trust in government programmes, accessibility of vaccination services, and household-level logistical constraints (2). These determinants are especially important in Pakistan, where polio eradication efforts continue to face vaccine refusal, misinformation, population mobility, inconsistent campaign coverage, and variable community engagement.

In Pakistan, the persistence of poliomyelitis reflects a complex interaction between biomedical, behavioural, social, and institutional determinants. Although vaccination campaigns are widely implemented, gaps remain in parental knowledge, attitudes, and practices regarding polio immunization. Misconceptions about vaccine safety, fear of adverse effects, doubts regarding repeated doses, and misinformation about government-led vaccination activities continue to affect community confidence. These barriers are not uniformly distributed; rather, they vary by socioeconomic position, education, place of residence, exposure to health communication, and trust in local health systems (3,4). Therefore, understanding vaccination behaviour requires a localized approach that examines not only whether vaccines are available but also whether communities accept, access, and complete vaccination as intended.

Urban–rural disparities are particularly important in the context of polio vaccination. Urban communities generally have greater exposure to health campaigns, better access to healthcare facilities, higher literacy levels, and more frequent contact with formal information channels. In contrast, rural communities may experience limited transportation, weaker health infrastructure, lower educational attainment, greater dependence on informal information networks, and stronger influence of traditional or religious belief systems. Studies from different regions of Pakistan have reported that rural residence may be associated with lower immunization coverage and higher vaccine hesitancy, although the magnitude and drivers of these associations vary across local contexts (5,6). This variation indicates that national-level findings cannot be assumed to represent all sub-regions equally.

South Punjab represents an important setting for examining these disparities because it includes both urban centres and widely distributed rural communities with marked differences in literacy, socioeconomic status, healthcare access, and cultural context. Despite its public health relevance, limited empirical evidence has focused specifically on community perceptions, barriers, and health-system factors influencing polio vaccination in this region. Existing studies from other provinces or national datasets provide useful background but do not fully explain the localized determinants of vaccine acceptance and uptake in South Punjab. This creates an important evidence gap for designing context-sensitive interventions that can address both demand-side barriers, such as misinformation and mistrust, and supply-side barriers, such as limited campaign access and service delivery constraints.

Using a population, intervention/exposure, comparison, and outcome framework, the present study focused on adult community residents of South Punjab, with residence in rural versus urban settings considered the primary exposure of interest. The outcomes included knowledge, attitudes, practices, perceived barriers, and reported determinants of polio vaccination uptake. The study was designed to compare urban and rural respondents and to identify socio-demographic, cultural, institutional, communication-related, and logistical factors associated with vaccination behaviour. It was hypothesized that rural residence would be associated with lower awareness, greater perceived barriers, weaker trust in vaccination systems, poorer access to services, and reduced likelihood of polio vaccination uptake compared with urban residence.

MATERIALS AND METHODS

This study used an analytical cross-sectional design to assess and compare community perceptions, perceived barriers, and factors associated with polio vaccination uptake among urban and rural populations in South Punjab, Pakistan. The cross-sectional approach was appropriate because the study aimed to measure knowledge, attitudes, practices, access-related barriers, socio-cultural influences, institutional trust, and reported vaccination behaviour at a single point in time within two residential groups. The study was conducted in selected urban and rural communities of South Punjab, a region characterized by marked variation in socioeconomic status, literacy, healthcare access, transportation infrastructure, and exposure to public health communication. Urban respondents were recruited from metropolitan localities with comparatively greater access to healthcare services and public health messaging, whereas rural respondents were recruited from village communities where health facilities, transport access, and formal communication channels were comparatively limited.

The study population consisted of adult residents aged 18–60 years who had lived in the selected study area for at least six months. This residency criterion was used to ensure that participants had sufficient exposure to local vaccination campaigns, health services, and community-level communication patterns. Both male and female respondents were included because household decisions about child vaccination may be influenced by gender roles, caregiving responsibilities, and family decision-making structures. Individuals were eligible if they were permanent or semi-permanent residents of the selected locality, were within the required age range, and provided informed consent. Individuals with severe illness or cognitive impairment that prevented meaningful participation, and those unwilling to provide informed consent, were excluded.

A total sample of 600 participants was included, with equal allocation of 300 respondents from urban areas and 300 respondents from rural areas. The sample size was calculated using OpenEpi on the basis of an assumed 50% prevalence of adequate knowledge, attitudes, and practices regarding polio vaccination, a 95% confidence level, and a 5% margin of error. Equal recruitment from urban and rural settings was used to allow direct comparison between residential groups and to improve precision for subgroup-level estimates. Participants were selected from predefined urban and rural communities, and eligible respondents were approached through community-based recruitment. Informed consent was obtained before data collection, and participation remained voluntary throughout the study.

Data were collected through face-to-face interviews using a structured questionnaire developed to assess socio-demographic characteristics, knowledge and awareness regarding polio vaccination, attitudes toward vaccination, reported vaccination practices, perceived community barriers, religious and cultural influences, accessibility and infrastructure challenges, institutional trust, communication gaps, and logistical constraints. The questionnaire was initially prepared in English and translated into Urdu to ensure linguistic and cultural suitability for the study population. Interview administration was used to reduce nonresponse caused by literacy barriers and to allow standardized explanation of questions where needed without influencing responses. Interviews were conducted in participants' homes or community settings that allowed privacy and comfort, and each questionnaire required approximately 20–30 minutes to complete.

Before the main survey, the questionnaire was pilot-tested among 30 participants, including 15 urban and 15 rural respondents, to assess clarity, cultural relevance, response time, and internal consistency. Minor wording refinements were made after the pilot to improve comprehension and reduce ambiguity in the Urdu version. Reliability analysis from the pilot demonstrated acceptable internal consistency across the major questionnaire domains, including knowledge (Cronbach's $\alpha=0.81$), attitude ($\alpha=0.83$), practice ($\alpha=0.78$), and perceived barriers ($\alpha=0.86$). These findings supported the use of the questionnaire for the main data collection phase.

The primary exposure variable was place of residence, categorized as urban or rural. Other independent variables included age, gender, marital status, education level, awareness level, religious influence, access to vaccination services, trust in government programmes, transportation difficulties, financial or logistical barriers, and perceived community-level barriers. The main outcome was polio vaccination uptake, assessed through reported vaccination practice. Awareness was assessed through responses related to knowledge of polio vaccination importance, campaign information, schedule awareness, and vaccine-related understanding. Access to services was evaluated using responses related to campaign reach, service availability, transportation, waiting time, facility readiness, and ability to obtain vaccination. Trust was assessed through perceptions of government programmes, healthcare worker reliability, and confidence in vaccination activities. Socio-cultural influence was assessed through perceived effects of religious beliefs, cultural norms, myths, rumours, and community leader involvement.

Several steps were used to improve data quality and reduce bias. Interviewers used the same structured questionnaire for all respondents to maintain consistency in data collection. Questions were administered in a neutral manner to reduce interviewer influence and social desirability bias. The inclusion of both urban and rural respondents allowed comparison across residential contexts, while the pilot study helped identify unclear wording that could have introduced measurement bias. Data were checked for completeness at the time of collection, and questionnaires with missing or inconsistent responses were reviewed against source forms where possible. Completed questionnaires were stored securely, and data were entered into SPSS version 26 using a password-protected database. Double-checking of entered data was performed to minimize transcription errors and improve data integrity.

Data analysis was performed using SPSS version 26. Descriptive statistics were used to summarize socio-demographic characteristics, perceived barriers, cultural and religious influences, accessibility challenges, institutional factors, communication strategies, and vaccination-related practices. Frequencies and percentages were reported for categorical variables. Urban and rural groups were compared descriptively across all major domains. For inferential analysis, associations between residence and vaccination-related outcomes were examined, and multivariable logistic regression was used to identify factors independently associated with polio vaccination uptake. Adjusted odds ratios with 95% confidence intervals were reported for key predictors, including residence, gender, education level, awareness level, religious influence, access to services, trust in government programmes, and transportation difficulties. Statistical significance was set at $p<0.05$. Variables included in the regression model were selected on the basis of conceptual relevance to vaccination uptake and observed differences across study domains.

Ethical approval for the study was obtained from the Institutional Review Board of TIMES University, Multan. All participants were informed about the purpose of the study, voluntary nature of participation, expected interview process, confidentiality protections, and their right to withdraw at any stage without penalty. Written or verbal informed consent was obtained before data collection according to participant literacy and field conditions. No personal identifiers were used in the analysis, and findings were reported only in aggregate form to protect participant anonymity and confidentiality.

RESULTS

A total of 600 respondents were included, with equal representation from urban and rural communities (300 each). The two groups were comparable for age distribution and gender, but significant differences were observed for marital status and education level. Education showed the strongest urban–rural disparity, with higher secondary or above education reported by 43.7% of urban respondents compared with 17.7% of rural respondents, while no formal education was more frequent in rural respondents (15.7%) than urban respondents (5.7%) ($p<0.001$).

Table 1. Socio-demographic Characteristics of Respondents by Residence

Variable	Category	Urban n (%)	Rural n (%)	Total n (%)	p-value
Age	18–25	53 (17.7)	47 (15.7)	100 (16.7)	0.912
	26–35	97 (32.3)	93 (31.0)	190 (31.7)	
	36–45	75 (25.0)	79 (26.3)	154 (25.7)	
	46–60	56 (18.7)	63 (21.0)	119 (19.8)	
	60+	19 (6.3)	18 (6.0)	37 (6.2)	
Gender	Male	164 (54.7)	177 (59.0)	341 (56.8)	0.323
	Female	136 (45.3)	123 (41.0)	259 (43.2)	
Marital status	Single	117 (39.0)	93 (31.0)	210 (35.0)	0.049
	Married	168 (56.0)	197 (65.7)	365 (60.8)	
	Divorced/Widowed	15 (5.0)	10 (3.3)	25 (4.2)	
Education level	No formal education	17 (5.7)	47 (15.7)	64 (10.7)	<0.001
	Primary education	39 (13.0)	107 (35.7)	146 (24.3)	
	Secondary education	113 (37.7)	93 (31.0)	206 (34.3)	
	Higher secondary or above	131 (43.7)	53 (17.7)	184 (30.7)	

Perceived barriers were consistently more frequent among rural respondents. Lack of awareness was the most common barrier overall, reported by 57.0% of respondents, with a significantly higher frequency in rural participants than urban participants (63.7% vs. 50.3%; OR=1.73, 95% CI: 1.25–2.40; p=0.001). The largest rural excess was observed for transportation barriers (20.7% vs. 6.3%; OR=3.85, 95% CI: 2.24–6.63; p<0.001) and limited campaign access in remote areas (29.7% vs. 10.7%; OR=3.53, 95% CI: 2.27–5.50; p<0.001).

Table 2. Perceived Community Barriers to Polio Vaccination

Barrier	Urban n (%)	Rural n (%)	Total n (%)	OR Rural vs Urban (95% CI)	p-value
Lack of awareness	151 (50.3)	191 (63.7)	342 (57.0)	1.73 (1.25–2.40)	0.001
Religious/cultural opposition	49 (16.3)	93 (31.0)	142 (23.7)	2.30 (1.56–3.41)	<0.001
Inadequate infrastructure	61 (20.3)	76 (25.3)	137 (22.8)	1.33 (0.91–1.95)	0.145
Financial/logistical challenges	39 (13.0)	73 (24.3)	112 (18.7)	2.15 (1.40–3.30)	<0.001
Limited campaign access	32 (10.7)	89 (29.7)	121 (20.2)	3.53 (2.27–5.50)	<0.001
Mistrust/fear of vaccine	41 (13.7)	67 (22.3)	108 (18.0)	1.82 (1.19–2.78)	0.006
Lack of transportation	19 (6.3)	62 (20.7)	81 (13.5)	3.85 (2.24–6.63)	<0.001
Health concerns	21 (7.0)	34 (11.3)	55 (9.2)	1.70 (0.96–3.00)	0.066

Religious, cultural, and community-level influences differed significantly by residence. Rural respondents were more likely to report that religious beliefs had a strong influence on vaccination decisions (34.3% vs. 20.3%), that many myths or rumours existed about vaccination (28.0% vs. 16.3%), and that cultural beliefs influenced acceptance (33.0% vs. 20.3%). These differences were statistically significant across all three domains.

Table 3. Religious, Cultural, and Community Influences on Polio Vaccination

Variable	Response	Urban n (%)	Rural n (%)	Total n (%)	p-value
Religious beliefs influence vaccination	Yes, a lot	61 (20.3)	103 (34.3)	164 (27.3)	<0.001
	Yes, to some extent	119 (39.7)	127 (42.3)	246 (41.0)	
	No	81 (27.0)	48 (16.0)	129 (21.5)	
	Don't know	39 (13.0)	22 (7.3)	61 (10.2)	
Local myths/rumours	Many rumours	49 (16.3)	84 (28.0)	133 (22.2)	0.001
	Present but not widely believed	61 (20.3)	71 (23.7)	132 (22.0)	
	No myths	171 (57.0)	134 (44.7)	305 (50.8)	
	Not sure	19 (6.3)	11 (3.7)	30 (5.0)	
Cultural beliefs affect acceptance	Yes	61 (20.3)	99 (33.0)	160 (26.7)	0.002
	No	199 (66.3)	171 (57.0)	370 (61.7)	
	Not sure	40 (13.3)	30 (10.0)	70 (11.7)	

Accessibility findings showed that rural respondents experienced greater service-related disadvantage. Vaccination services were described as "very accessible" by 40.3% of urban respondents compared with only 24.7% of rural respondents, while complete inaccessibility was reported by 20.7% of rural respondents compared with 10.0% of urban respondents (p<0.001). Missed vaccination schedules also

differed significantly by residence (p<0.001), particularly due to transportation problems and lack of awareness of campaigns.

Table 4. Accessibility and Infrastructure Challenges

Variable	Response	Urban n (%)	Rural n (%)	Total n (%)	p-value
Campaign reach	Widespread/accessibile	121 (40.3)	93 (31.0)	214 (35.7)	0.056
	Does not reach remote areas	139 (46.3)	163 (54.3)	302 (50.3)	
	Not sure	40 (13.3)	44 (14.7)	84 (14.0)	
Accessibility of services	Very accessible	121 (40.3)	74 (24.7)	195 (32.5)	<0.001
	Somewhat accessible	149 (49.7)	164 (54.7)	313 (52.2)	
	Not accessible	30 (10.0)	62 (20.7)	92 (15.3)	
Missed vaccination schedule	Personal/family issues	39 (13.0)	38 (12.7)	77 (12.8)	<0.001
	Transportation problems	18 (6.0)	51 (17.0)	69 (11.5)	
	Unaware of campaign	21 (7.0)	62 (20.7)	83 (13.8)	
	Did not miss vaccination	211 (70.3)	149 (49.7)	360 (60.0)	

Institutional and social determinants also varied by residence. Rural respondents were significantly more likely to distrust healthcare worker training, report poor transportation or road infrastructure, perceive limited community involvement, identify financial constraints, fear side effects, and report disruption due to political or social unrest. Poor road infrastructure was reported by 49.7% of rural respondents compared with 32.3% of urban respondents (p<0.001), while fear of side effects was reported by 40.7% of rural respondents compared with 26.3% of urban respondents (p<0.001).

Table 5. Institutional, Social, and Political Factors Affecting Polio Vaccination

Variable	Key Response	Urban n (%)	Rural n (%)	Total n (%)	p-value
Healthcare workers properly trained	Yes, reliable	181 (60.3)	159 (53.0)	340 (56.7)	0.004
Poor road infrastructure	Yes	97 (32.3)	149 (49.7)	246 (41.0)	<0.001
Community involvement	Little involvement	147 (49.0)	181 (60.3)	328 (54.7)	0.007
NID campaign frequency	Need more campaigns	151 (50.3)	171 (57.0)	322 (53.7)	0.070
Community leaders increase success	Yes, crucial	183 (61.0)	199 (66.3)	382 (63.7)	0.338
Financial constraints	Major issue	97 (32.3)	141 (47.0)	238 (39.7)	0.001
Reluctance due to side effects	Yes, many afraid	79 (26.3)	122 (40.7)	201 (33.5)	<0.001
Lack of trust in government	Yes	79 (26.3)	103 (34.3)	182 (30.3)	0.074
Incentives encourage vaccination	Yes	121 (40.3)	149 (49.7)	270 (45.0)	0.061
Political/social unrest	Disrupts campaigns	68 (22.7)	99 (33.0)	167 (27.8)	0.018

Communication-related findings showed a significant urban–rural difference. Rural respondents more frequently preferred community-based campaigns (49.7% vs. 39.0%), whereas urban respondents more often identified social media as a useful tool (27.7% vs. 17.0%). Difficulty due to lack of schedule or location awareness was substantially higher in rural respondents, with 41.0% reporting that they were not informed compared with 23.7% of urban respondents (p<0.001).

Table 6. Awareness and Communication Strategies

Variable	Response	Urban n (%)	Rural n (%)	Total n (%)	p-value
Preferred promotion method	Community-based campaigns	117 (39.0)	149 (49.7)	266 (44.3)	0.007
	Social media	83 (27.7)	51 (17.0)	134 (22.3)	
	Religious leaders	61 (20.3)	69 (23.0)	130 (21.7)	
	Current methods sufficient	31 (10.3)	21 (7.0)	52 (8.7)	
	Don't know	8 (2.7)	10 (3.3)	18 (3.0)	
Difficulty due to lack of schedule/location awareness	Yes, not informed	71 (23.7)	123 (41.0)	194 (32.3)	<0.001
	Yes, but eventually received	77 (25.7)	71 (23.7)	148 (24.7)	
	No, always informed	152 (50.7)	106 (35.3)	258 (43.0)	

Multivariable logistic regression showed that rural residence was independently associated with lower odds of polio vaccination uptake (AOR=0.62, 95% CI: 0.45–0.85; p=0.003). Low awareness had the strongest negative association with uptake (AOR=0.48, 95% CI: 0.34–0.69; p<0.001), followed by poor service access (AOR=0.55, 95% CI: 0.39–0.77; p<0.001), transportation issues (AOR=0.58, 95% CI: 0.42–0.80; p=0.001), low trust in government programmes (AOR=0.60, 95% CI: 0.43–0.83; p=0.002), and religious influence (AOR=0.67, 95% CI: 0.49–0.91; p=0.011).

Table 7. Factors Associated With Polio Vaccination Uptake

Variable	Category	Adjusted Odds Ratio	95% CI	p-value
Residence	Rural vs urban	0.62	0.45–0.85	0.003
Gender	Female vs male	1.28	0.95–1.72	0.102
Education level	Primary vs higher	0.71	0.50–1.01	0.058
	Secondary vs higher	1.12	0.79–1.59	0.521
Awareness level	Low vs high	0.48	0.34–0.69	<0.001
Religious influence	Yes vs no	0.67	0.49–0.91	0.011
Access to services	Poor vs good	0.55	0.39–0.77	<0.001
Trust in government	Low vs high	0.60	0.43–0.83	0.002
Transportation issues	Yes vs no	0.58	0.42–0.80	0.001

A domain-wise comparison confirmed that rural respondents experienced a consistently higher burden across all major barrier categories. The greatest absolute urban–rural differences were observed for lack of schedule awareness (41.0% vs. 23.7%), limited campaign access (29.7% vs. 10.7%), transportation issues (20.7% vs. 6.3%), religious opposition (31.0% vs. 16.3%), and lack of awareness (63.7% vs. 50.3%). These findings indicate that rural disadvantage was not confined to one factor but extended across knowledge, socio-cultural, infrastructure, institutional, logistical, and communication domains.

Table 8. Key Barriers to Polio Vaccination by Domain

Domain	Barrier	Urban %	Rural %	Absolute Difference	p-value
Knowledge	Lack of awareness	50.3	63.7	+13.4	0.001
Socio-cultural	Religious opposition	16.3	31.0	+14.7	<0.001
Socio-cultural	Myths/rumours	16.3	28.0	+11.7	0.001
Infrastructure	Limited campaign access	10.7	29.7	+19.0	<0.001
Infrastructure	Transportation issues	6.3	20.7	+14.4	<0.001
Institutional	Lack of trust	26.3	34.3	+8.0	0.074
Logistical	Financial challenges	13.0	24.3	+11.3	<0.001
Communication	Lack of schedule awareness	23.7	41.0	+17.3	<0.001

Overall, the results demonstrate marked urban–rural disparities in polio vaccination determinants in South Punjab. Rural residence was associated with lower vaccination uptake and a greater burden of informational, cultural, institutional, infrastructural, logistical, and communication barriers. The strongest independent predictors of reduced uptake were low awareness, poor access to services, transportation difficulties, low trust in government programmes, religious influence, and rural residence.

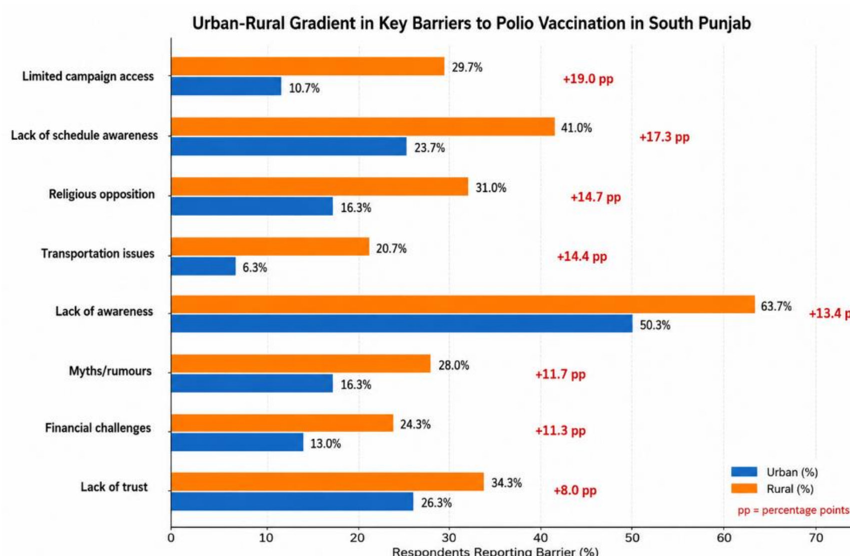

Figure 1 Urban–Rural Gradient in Key Barriers to Polio Vaccination in South Punjab, Pakistan.

Comparison of urban and rural respondents reporting major barriers to polio vaccination, including lack of awareness, transportation difficulties, religious opposition, myths and rumours, financial challenges, limited campaign access, lack of schedule awareness, and institutional mistrust. Rural

populations consistently demonstrated higher barrier prevalence across all domains, with the largest absolute differences observed for limited campaign access and lack of vaccination schedule awareness. The figure demonstrates a pronounced rural disadvantage across multiple determinants of polio vaccination uptake in South Punjab. The greatest urban–rural disparity was observed for limited campaign access, reported by 29.7% of rural respondents compared with 10.7% of urban respondents, representing a 19.0 percentage-point difference. Similarly, lack of awareness regarding vaccination schedules affected 41.0% of rural respondents versus 23.7% of urban respondents (+17.3 percentage points). Religious opposition and transportation difficulties also showed marked rural excesses, with differences of +14.7 and +14.4 percentage points, respectively. Although lack of awareness remained highly prevalent in both groups, rural respondents continued to report substantially greater burden (63.7% vs. 50.3%). Collectively, the figure highlights that barriers to vaccination in rural communities are multidimensional and involve overlapping communication, infrastructural, socio-cultural, logistical, and institutional challenges that may contribute to lower vaccination uptake and persistence of immunization inequities.

DISCUSSION

This study demonstrated substantial urban–rural disparities in polio vaccination determinants in South Punjab, with rural residence independently associated with lower odds of vaccination uptake. The finding that rural respondents had reduced vaccination uptake compared with urban respondents is consistent with the broader evidence that polio eradication in Pakistan is shaped not only by vaccine supply but also by social trust, community acceptance, accessibility, and health-system reach (1,2). The adjusted model showed that rural residence remained significant after accounting for other determinants, suggesting that place of residence reflects a cluster of disadvantages rather than a single isolated exposure. These disadvantages included lower awareness, stronger socio-cultural influence, poorer access to services, greater transportation difficulty, and lower institutional trust.

Low awareness emerged as the strongest independent predictor of reduced vaccination uptake, with respondents having low awareness showing markedly lower odds of vaccination. This supports previous Pakistani studies showing that incomplete knowledge about polio, vaccine schedules, disease severity, and the need for repeated doses contributes to hesitancy and missed vaccination opportunities (3,4,7). In the present study, lack of awareness was reported by 63.7% of rural respondents compared with 50.3% of urban respondents, indicating that information gaps remain widespread but are more concentrated in rural communities. This pattern suggests that standard campaign messaging may be insufficient for populations with lower literacy, limited media exposure, and weaker contact with formal healthcare systems.

Socio-cultural influences also played an important role. Religious opposition, myths, rumours, and cultural beliefs were more frequently reported in rural areas, and religious influence remained significantly associated with lower vaccination uptake in multivariable analysis. These findings are consistent with evidence that vaccine hesitancy in polio-endemic and high-risk settings is often reinforced by group norms, religious interpretation, perceived community approval, and informal misinformation networks (12–15,23,24). The higher rural burden of myths and religious concerns does not imply uniform resistance among rural communities; rather, it suggests that vaccination behaviour is shaped by trusted local voices. Therefore, religious and community leaders should not be treated as peripheral stakeholders but as central partners in demand generation and misinformation correction.

Access to vaccination services was another major determinant. Poor access significantly reduced the likelihood of vaccination uptake, and rural respondents were more likely to report limited campaign reach, lack of transport, poor road infrastructure, and lack of schedule awareness. These findings align with previous literature showing that geographical isolation, weak infrastructure, campaign planning gaps, and missed children remain important barriers to immunization in underserved Pakistani settings

(18,19,25). Importantly, access barriers may persist even when caregivers are willing to vaccinate their children. This means that awareness campaigns alone cannot close the gap unless they are paired with service delivery improvements, mobile outreach, flexible campaign timing, and better communication about vaccination schedules and locations.

Institutional trust was also independently associated with vaccination uptake. Respondents with low trust in government programmes had significantly lower odds of vaccination, and rural respondents reported higher levels of distrust than urban respondents. This supports previous evidence that mistrust of government-led campaigns, doubts about healthcare workers, fear of side effects, and weak community engagement can undermine vaccine confidence (6,20). The finding that many respondents viewed community leader involvement as crucial suggests that trust-building interventions should be locally embedded rather than delivered only through centralized public health messaging. Strengthening vaccinator training, improving respectful communication, and ensuring continuity of outreach teams may help reduce institutional distance between communities and vaccination programmes.

The domain-wise analysis showed that the rural disadvantage was multidimensional. The largest absolute rural excesses were seen for limited campaign access, lack of schedule awareness, religious opposition, transportation issues, and lack of awareness. This pattern indicates that rural under-vaccination is produced through overlapping informational, infrastructural, socio-cultural, logistical, and institutional pathways. Such clustering is important because single-component interventions are unlikely to be sufficient. A household may accept vaccination but still miss a campaign because of poor communication; another may receive information but remain hesitant because of religious rumours; another may trust vaccination but be unable to access services due to distance or transport barriers. Effective eradication strategies must therefore integrate health education, trust-building, logistics, and service delivery (27)

The findings have practical implications for polio eradication in South Punjab and similar high-risk settings. Rural-focused interventions should include intensified community-based awareness campaigns, locally adapted Urdu and regional-language communication, advance notification of campaign dates, mobile vaccination teams for remote settlements, transport-sensitive microplanning, and engagement of religious leaders, teachers, local influencers, and community health workers. Urban strategies may additionally benefit from digital and social media communication, as urban respondents were more likely to identify social media as a useful tool. However, digital communication should complement rather than replace interpersonal outreach, particularly in communities where trust depends on direct engagement.(28).

This study has limitations. Its cross-sectional design prevents causal inference, and the findings should be interpreted as associations rather than proof of cause and effect. Vaccination practices and barriers were self-reported, which may introduce recall bias or social desirability bias. Although equal urban and rural sample sizes strengthened comparative analysis, the findings may not fully represent all districts or subpopulations of South Punjab. Some constructs, such as awareness, trust, and access, were measured through questionnaire responses and may not capture all dimensions of these complex concepts. Despite these limitations, the study provides useful regional evidence by combining descriptive comparisons with multivariable analysis and by identifying multiple modifiable determinants of vaccination uptake.

CONCLUSION

This study found substantial urban–rural disparities in polio vaccination determinants in South Punjab, Pakistan, with rural residence independently associated with lower vaccination uptake. Low awareness, poor access to services, transportation difficulties, low trust in government programmes, and religious influence were significant predictors of reduced uptake. Rural respondents experienced a higher burden across nearly all domains, including knowledge deficits, socio-cultural resistance, limited campaign access, logistical barriers, institutional mistrust, and communication gaps. These findings indicate that

improving polio vaccination coverage requires integrated rural-focused strategies rather than isolated awareness campaigns. Strengthening mobile outreach, improving schedule communication, engaging trusted religious and community leaders, enhancing vaccinator credibility, and addressing transportation and infrastructure barriers are essential to reducing inequities and supporting sustained progress toward polio eradication in Pakistan.

REFERENCES

1. Ataullahjan A, Ahsan H, Soofi S, Habib MA, Bhutta ZA. Eradicating polio in Pakistan: a systematic review of programs and policies. Expert Rev Vaccines. 2021;20(6):661-678.

2. Ezezika O, Mengistu M, Opoku E, Farheen A, Chauhan A, Barrett K. What are the barriers and facilitators to polio vaccination and eradication programs? A systematic review. PLOS Glob Public Health. 2022;2(11):e0001283.

3. Mumtaz O, Yousaf A, Khan S, Rizvi Z, Jamshaid F, Hussain A. Assessment of knowledge, perception, attitudes and barriers to polio vaccination among parents. Biol Clin Sci Res J. 2024;5(1):1363.

4. Habib MA, Tabassum F, Hussain I, Khan TJ, Syed N, Shaheen F, et al. Exploring knowledge and perceptions of polio disease and its immunization in polio high-risk areas of Pakistan. Vaccines. 2023;11(7):1206.

5. Ahsan M, Raza H, Ali S, Raza MH. Predictors of polio immunization hesitancy: a cross-sectional study from Mardan, Pakistan. ASEAN J Sci Eng Educ. 2021;1(3):199-212.

6. Khattak FA, Rehman K, Shahzad M, Arif N, Ullah N, Kibria Z, et al. Prevalence of parental refusal rate and its associated factors in routine immunization by using WHO Vaccine Hesitancy Tool: a cross-sectional study at district Bannu, KP, Pakistan. Int J Infect Dis. 2021;104:117-124.

7. Zahra T, Parvez A, Ahmad H, Iftikhar H, Mushtaq F, Ayub S. Determinants of parental knowledge and attitude towards poliomyelitis and its immunization in Sialkot city: a mixed-method study. Biomedica. 2023;39(1):25-32.

8. Iqbal M, Sial A. Knowledge, Health Practices and Policies for Hepatitis for Midwifery and Nurses in Allied and District Hospital Faisalabad. Journal of Health and Rehabilitation Research. 2023 Dec 3;3(2):286-92.

9. Iqbal M, Sial A. Early Child Marriages, Unintended Pregnancies, and its impact on the Health of Young Girls in South Punjab. Journal of Health and Rehabilitation Research. 2023 Dec 3;3(2):272-9.

10. Mukhtar F, Lawan HM, Bukar B, Yaya J, Lawan AM. Determinants of knowledge and attitude of mothers towards polio vaccine in Konduga local government area, Borno State, Nigeria. J Arid Zone Econ. 2025;5(7):92-100.

11. Helen S, Kasham HA, Ghumdia JA, Sympathy DY. Attitude of mothers toward the immunization of under-five children against poliomyelitis in Maraba Rido, Kaduna State. BW Acad J. 2022;1(1).

12. Onoja AJ, Babarinde JD, Sanni FO, Babarinde MT, Onoja SI. How poliomyelitis eradication interventions have affected the knowledge, attitudes and uptake of polio vaccines among Nigerian women. Asian J Med Health. 2022;20:16-23.

13. Agrawal P, Neel A, Deresse AS, Gerber S, Alonge O. Facilitators and barriers to community engagement in the global polio eradication initiative: a mixed methods study. PLOS Glob Public Health. 2023;3(4):e0001643.

14. Shafique F, Nayab H, Asim N, Akbar N, Shafi N, Manzoor S, et al. Attitude and perception towards vaccination against poliomyelitis in Peshawar, Pakistan. Rev Saude Publica. 2021;55:104.

15. Sillab FA, Moghri J, Najar AV, Marvi A, Sana A, Naghipour M, Hooshmand E. Breaking barriers: a qualitative study on polio vaccine hesitancy in Herat Province, Afghanistan. BMC Public Health. 2025;25(1):2820.

16. Saleh W, Jami H. Group influence on attitudes towards polio vaccination in Pakistan: role of group identification and perceived group support for polio vaccines. J Pak Med Assoc. 2022;72(5):802-806.

17. Majidulla A, Sultan MA, Zaman A, Shafique M, Ahmed S, Naz F, et al. Engage less, provide more: community health workers' perspectives on how to overcome opposition to polio vaccination in Pakistan. Glob Public Health. 2025;20(1):2465645.

18. Kareem HM, Hameed HG. Knowledge and attitude of the medical staff toward poliomyelitis and polio vaccination campaign: a cross-sectional study in Al-Najaf Al-Ashraf city, Iraq. Kufa Med J. 2024;20(1):202-211.

19. Azhar S, Rashid L, Islam T, Akhtar S, Hopkins KL, Sommers T, et al. Knowledge, attitudes, and practices of vaccinators about expanded programs on immunization: a cross-sectional study. Front Public Health. 2024;12:1366378.

20. Ben Hamida A, Alam F, Stewart B, Ahmad S, Sherani EN, Khan H, et al. Estimating proportions of missed children and reasons for non-vaccination following implementation of "reaching the unreached" multiantigen immunization campaign—South Khyber Pakhtunkhwa, Pakistan, July–August 2023. Front Public Health. 2025;13:1591325.

21. Khan N, ur Rehman F, Khan K, Hassan N. Progress and challenges in polio vaccination in Pakistan: a review on efforts, outcomes and future directions. Pak-Euro J Med Life Sci. 2025;8(3):715-722.

22. Soofi SB, Vadsaria K, Mannan S, Habib MA, Tabassum F, Hussain I, et al. Factors associated with vaccine refusal, polio and routine immunization, in high-risk areas of Pakistan: a matched case-control study. Vaccines. 2023;11(5):947.

23. Center START, Sankar-Gorton L, Shrestha L, Mulugeta A, Levin C. Gender barriers to polio immunization in Nigeria: literature review. Gates Open Res. 2024;8:59.

24. Nasiri A, Farshidi H, Rezaei F, Dehdari T, Kazemi A, Rezapour H, Goshtaei M. Perceived barriers of migrants and refugees to vaccinate their children against measles and polio: a study in Iran. Int J Equity Health. 2023;22(1):253.

25. Lohiniva AL, Nurzhynska A, Alhassan H, Shetye M, Ayiku P. Understanding factors influencing polio vaccine uptake in Ghana: developing meaningful community mobilization and engagement strategies in collaboration with religious leaders. Am J Trop Med Hyg. 2022;107(6):1345.

26. Lohiniva AL, Nurzhynska A, Mueed A, Ali A, Ahmed K, Ayiku P, et al. Strengthening polio vaccine demand in Ghana: understanding the factors influencing uptake of the vaccine and the effectiveness of different message frames. PLoS One. 2023;18(2):e0279809.

27. Ahmad H, Sanef SA, Shahabudin WZ, Mohtar N, Hassan MR, Jeffree MS, et al. Socioecological challenges of polio supplementary immunization activities in the Asia-Pacific region: a systematic review. J Environ Public Health. 2023;2023:4801424.

28. Zulfiqar S, Akram R, Khan J. Potential barriers and facilitators of polio vaccination among parents at a tertiary care hospital of Rawalpindi: a cross-sectional study. Insights J Health Rehabil. 2025;3:383-391.