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DETERMINANTS OF ORAL POLIO VACCINE HESITANCY AMONG PARENTS IN DISTRICT BANNU, KHYBER PAKHTUNKHWA, PAKISTAN

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ABSTRACT

Objective: To determine the prevalence and determinants of oral polio vaccine (OPV) hesitancy among parents/caregivers of children under five years in District Bannu, Khyber Pakhtunkhwa, Pakistan, including sociodemographic factors, knowledge, attitudes/perceptions, and reasons for hesitancy

Materials and Methods: A community-based cross-sectional analysis examined 600 parent/caregiver records from District Bannu for January–September 2025. Eligible respondents were parents aged 18 years or older with at least one child younger than five years and permanent residence in the district; temporary visitors, duplicate household respondents, and non-consenting individuals were excluded. A structured questionnaire covered sociodemographic characteristics, nine factual knowledge items, attitudes and perceptions, and non-exclusive reasons for hesitancy. Good knowledge was defined as six or more correct answers out of nine. OPV hesitancy was analyzed as a binary indicator using within-category proportions, Wilson 95% confidence intervals, Pearson chi-square tests without Yates continuity correction, and Cramér's V.

Results: Sample Size Of 600 records, 180 (30.0%; 95% CI 26.5–33.8%) were classified as OPV-hesitant. Hesitancy was 47.9% (69/144) among parents with no formal education versus 20.0% (16/80) among those with tertiary education (omnibus χ^2 (4) =30.917, p<0.001); 33.6% (113/336) in rural versus 25.4% (67/264) in urban areas (χ^2 (1) =4.794, p=0.029); and 37.3% (121/324) among poor-knowledge versus 21.4% (59/276) among good-knowledge records (χ^2 (1) =18.098, p<0.001). Age group (p=0.343), sex (p=0.759), occupation (p=0.223), and number of children (p=0.461) were not significantly associated in unadjusted analyses. Among hesitant records, fear of infertility (103; 57.2%) and misinformation/rumours (95; 52.8%) were the most frequently. reasons, followed by lack of trust in vaccine quality (73; 40.6%), fear of adverse effects (70; 38.9%), lack of trust in health workers (70; 38.9%), and religious concerns (55; 30.6%).

Conclusion: One-third of records were classified as OPV-hesitant. Low education, rural residence, and poor knowledge were associated with hesitancy, while infertility fear and misinformation were dominant.

Keywords: Oral polio vaccine; vaccine hesitancy; poliomyelitis; parental refusal; vaccination knowledge; District Bannu; Khyber Pakhtunkhwa; Pakistan

INTRODUCTION

Poliomyelitis is a highly infectious viral disease that can cause irreversible paralysis. The World Health Organization identifies children younger than five years as a particularly affected group, and Pakistan remains one of the countries with endemic wild poliovirus transmission. Routine immunization and supplementary immunization activities remain central to eradication.[1,2] Oral and inactivated polio vaccines are used within immunization programmes according to context-specific recommendations. Repeated OPV administration during scheduled and supplementary campaigns helps sustain population protection. Parental concern about vaccine safety, perceived necessity, and trust in vaccination services can reduce acceptance even when doses are offered.[3] Vaccine hesitancy is context dependent and is conventionally described as delayed acceptance or refusal despite service availability. It is influenced by confidence, complacency, convenience, local beliefs, social networks, and programme delivery. Valid measurement requires distinguishing vaccine attitudes from verified refusal, missed campaigns, and logistical non-access.[4–8] Evidence from Bannu has associated routine childhood immunization refusal with family and sociodemographic characteristics. Research in Jamrud, Peshawar, and Quetta has reported infertility fears, religious interpretations, misinformation, poor knowledge, and operational barriers; qualitative work and caregiver polls also emphasize contextual mistrust and insecurity. However, findings from those studies cannot be transferred directly to current OPV hesitancy in Bannu.[9–13] This manuscript presents a structured analysis of an N=600 dataset to demonstrate descriptive and bivariate reporting for a planned community-based study and to identify the evidence needed before empirical claims about OPV hesitancy in District Bannu.

MATERIALS AND METHODS

This cross-sectional study design was adopted to assess the prevalence of oral poliovirus vaccine (OPV) hesitancy and its association with sociodemographic characteristics, knowledge, attitudes, perceptions, and vaccination-related concerns among 600 respondents. The study employed a structured questionnaire to collect information across five major domains: sociodemographic characteristics, knowledge regarding poliomyelitis and OPV, attitudes and perceptions toward vaccination, OPV hesitancy status, and reasons for hesitancy. Sociodemographic variables included age, sex, educational attainment, residential location, occupation, and number of children. Educational status was categorized as no formal education, primary, secondary, tertiary, or religious education, while residence was classified as rural or urban. Knowledge was evaluated using nine questions addressing poliovirus transmission, disease complications, vaccine effectiveness and safety, repeated vaccination requirements, missed doses, and the importance of immunization campaigns. Each correct response was assigned one point, producing a maximum knowledge score of nine. Respondents scoring six or more points were classified as having good knowledge, whereas scores of five or below indicated poor knowledge. Attitudes and perceptions were assessed through questions concerning perceived vaccine importance, effectiveness, willingness to participate in subsequent vaccination campaigns, confidence in vaccinators, trust in government vaccination programmes, and concerns regarding adverse effects and infertility. OPV hesitancy was treated as the primary binary outcome variable, with respondents categorized as hesitant or non-hesitant according to their reported vaccination attitudes and behavior. Participants classified as hesitant were further assessed for potential contributing reasons, including misinformation, infertility concerns, vaccine safety, religious beliefs, mistrust of healthcare workers, family opposition, accessibility barriers, security concerns, and previous negative vaccination experiences. Multiple responses were permitted when identifying reasons for hesitancy. Data analysis was performed using descriptive and inferential statistical methods. Categorical variables were summarized as frequencies and percentages, with OPV hesitancy prevalence calculated by dividing the number of hesitant respondents by the total study population. Cross-tabulations were constructed to examine variations in hesitancy across sociodemographic and knowledge categories. Pearson's chi-square test was applied to evaluate associations between categorical independent variables and OPV hesitancy. Statistical significance was established at a two-sided p-value below 0.05. Cramér's V was calculated to quantify the strength of observed associations and facilitate comparison across variables with different category structures. Findings were presented using descriptive tables, percentages, statistical test results, and high-resolution graphical visualizations to support interpretation of the distribution, determinants, and perceived barriers associated with OPV hesitancy.

RESULTS

Among the 600 parent/caregiver records analyzed, 180 (30.0%; 95% CI 26.5–33.8%) were classified as OPV-hesitant, while 420 (70.0%) were non-hesitant. Education demonstrated a significant association with hesitancy, with the highest prevalence observed among parents with no formal education (69/144; 47.9%) and the lowest among those with tertiary education (16/80; 20.0%); the omnibus chi-square test was statistically significant (χ^2 (4) =30.917, $p<0.001$; Cramér's V=0.227), indicating a moderate effect size. Residence was also significantly associated with hesitancy, with rural parents showing

higher hesitancy (113/336; 33.6%) compared to urban parents (67/264; 25.4%; $\chi^2(1) = 4.794$, p=0.029; Cramér's V=0.089), though the effect size was small. Knowledge level showed a significant inverse association with hesitancy, as parents with poor knowledge had higher hesitancy (121/324; 37.3%) compared to those with good knowledge (59/276; 21.4%; $\chi^2(1) = 18.098$, p<0.001; Cramér's V=0.174). In contrast, age group (p=0.343), sex (p=0.759), occupation (p=0.223), and number of children (p=0.461) were not significantly associated with OPV hesitancy in unadjusted analyses. Regarding knowledge classification, 276/600 (46.0%) demonstrated good knowledge (score ≥6/9), while 324/600 (54.0%) had poor knowledge. Item-level awareness varied, with the highest correct response for the necessity of repeated OPV doses (381/600; 63.5%) and the lowest for the statement that polio can cause paralysis (347/600; 57.8%). Attitudes were generally positive, with 448/600 (74.7%) considering OPV important and 450/600 (75.0%) believing it effective; however, 247/600 (41.2%) expressed concern about side effects and 222/600 (37.0%) believed OPV may cause infertility. Trust in vaccinators (338/600; 56.3%) and the government polio programme (316/600; 52.7%) was moderate. Among the 180 hesitant records, the most frequently. reasons were fear of infertility (103; 57.2%) and misinformation/rumours (95; 52.8%), followed by lack of trust in vaccine quality (73; 40.6%), fear of adverse effects (70; 38.9%), lack of trust in health workers (70; 38.9%), and religious concerns (55; 30.6%); other reasons included vaccination considered unnecessary (53; 29.4%), access problems/absent (41; 22.8%), spouse/family opposition (36; 20.0%), security concerns (34; 18.9%), and previous negative experience (28; 15.6%).

Table 1: Comprehensive Findings on OPV Hesitancy Among Parents in District Bannu, Khyber Pakhtunkhwa, Pakistan (N=600)

Prevalence of OPV Hesitancy	Overall	Hesitant	Total 180/600
Sociodemographic Determinants	Education	No formal education	69/144 (47.9%) hesitant
		Primary	53/198 (26.8%) hesitant
		Secondary	38/154 (24.7%) hesitant
		Tertiary	16/80 (20.0%) hesitant
		Religious education	4/24 (16.7%) hesitant
		Statistical Test	Omnibus $\chi^2(4)=30.917$, p<0.001; Cramér's V=0.227
	Residence	Rural	113/336 (33.6%) hesitant
		Urban	67/264 (25.4%) hesitant
		Statistical Test	$\chi^2(1)=4.794$, p=0.029; Cramér's V=0.089
	Knowledge Level	Poor knowledge	121/324 (37.3%) hesitant
		Good knowledge	59/276 (21.4%) hesitant
		Statistical Test	$\chi^2(1)=18.098$, p<0.001; Cramér's V=0.174
	Age Group	18–30 years	35/133 (26.3%) hesitant
		31–40 years	71/218 (32.6%) hesitant
		41–50 years	50/165 (30.3%) hesitant
		51–60 years	22/67 (32.8%) hesitant
		>60 years	2/17 (11.8%) hesitant
		Statistical Test	$\chi^2(4)=4.500$, p=0.343 Cramér's V=0.087
	Sex	Male	103/349 (29.5%) hesitant
		Female	77/251 (30.7%) hesitant
		Statistical Test	$\chi^2(1)=0.094$, p=0.759 Cramér's V=0.013
	Occupation	Household/unemployed	89/268 (33.2%) hesitant
		Farmer/manual worker	37/123 (30.1%) hesitant
		Self-employed	32/109 (29.4%) hesitant
		Government/private employee	22/100 (22.0%) hesitant
		Statistical Test	$\chi^2(3)=4.384$, p=0.223 Cramér's V=0.085
	Number of Children	1–2 children	70/215 (32.6%) hesitant
		3–4 children	77/259 (29.7%) hesitant
		≥5 children	33/126 (26.2%) hesitant
		Statistical Test	$\chi^2(2)=1.550$, p=0.461 Cramér's V=0.051
Knowledge Classification	Overall	Good knowledge (score ≥6/9)	276/600 (46.0%)
		Poor knowledge (score ≤5/9)	324/600 (54.0%)
	Item-Level Awareness	Polio can cause paralysis	347/600 (57.8%)
		Polio is preventable by vaccination	348/600 (58.0%)
		OPV protects against polio	359/600 (59.8%)
		Repeated OPV doses are necessary	381/600 (63.5%)
		Spread through contaminated food/water	343/600 (57.2%)
		Campaigns complement routine immunisation	345/600 (57.5%)

		OPV is safe for most children	344/600 (57.3%)
		Missed doses can be received later	346/600 (57.7%)
		Asymptomatic infection can transmit poliovirus	373/600 (62.2%)
Attitudes and Perceptions	Positive Attitudes	Considers OPV important	448/600 (74.7%) yes
		Believes OPV effective	450/600 (75.0%) yes
		Believes repeated doses necessary	378/600 (63.0%) yes
		Would accept next campaign	407/600 (67.8%) yes
	Trust	Trusts vaccinators	338/600 (56.3%) yes
		Trusts government polio programme	316/600 (52.7%) yes
	Concerns	Concerned about side effects	247/600 (41.2%) yes
		Believes OPV may cause infertility	222/600 (37.0%) yes
Reasons for Hesitancy	Among 180 Hesitant Records	Fear of infertility	103/180 (57.2%)
		Misinformation/rumours	95/180 (52.8%)
		Lack of trust in vaccine quality	73/180 (40.6%) .
		Fear of adverse effects	70/180 (38.9%) .
		Lack of trust in health workers	70/180 (38.9%) .
		Religious concerns	55/180 (30.6%) .
		Vaccination considered unnecessary	53/180 (29.4%) .
		Access problems/absent	41/180 (22.8%) .
		Spouse/family opposition	36/180 (20.0%) .
		Security concerns	34/180 (18.9%) .
		Previous negative experience	28/180 (15.6%) .

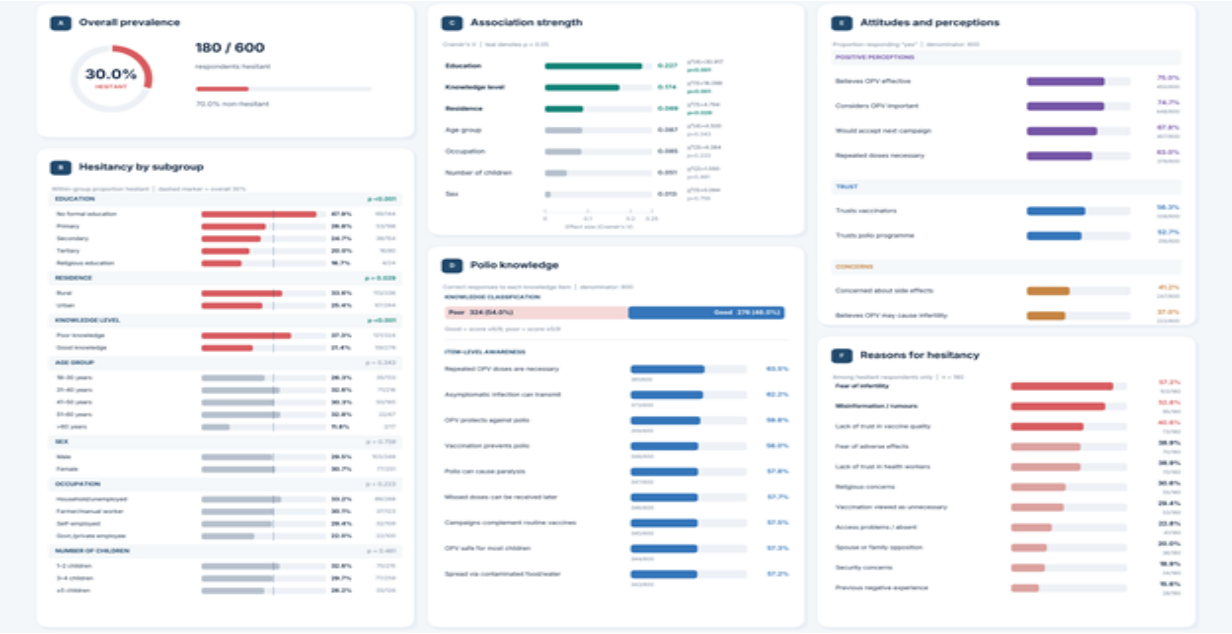


Figure 1: Prevalence, Sociodemographic Determinants, Knowledge, Attitudes, Perceptions, and Reasons for Oral Poliovirus Vaccine (OPV) Hesitancy Among Study Participants (N = 600)

DISCUSSION

This analysis from District Bannu found that 30.0% of records were classified as OPV-hesitant, with low education, rural residence, and poor knowledge significantly associated with hesitancy in unadjusted analyses. Fear of infertility (57.2%) and misinformation or rumours (52.8%) were the most frequently. reasons among hesitant records, followed by lack of trust in vaccine quality (40.6%), fear of adverse effects (38.9%), lack of trust in health workers (38.9%), and religious concerns (30.6%). Age group, sex, occupation, and number of children were not significantly associated with hesitancy. These findings show both convergence and divergence with the existing literature from Pakistan. The predominance of infertility fear and misinformation in this dataset aligns closely with studies from other high-risk settings. Research in

Karachi.[17] and the Quetta Block.[18] has similarly identified vaccine-quality anxieties, misinformation, and perceived adverse effects as prominent reasons for refusal. Qualitative and quantitative work in northwestern Pakistan.[12] also reported infertility fears and rumours as central drivers of OPV refusal, while a matched case-control study by Soofi et al,[19] confirmed that such concerns distinguish refusal of polio vaccine from routine immunization refusal. The finding that low education was associated with hesitancy is consistent with the knowledge-attitudes gap described by Khan et al,[11] in highly affected regions, and with the broader observation that poor factual knowledge about polio and OPV contributes to hesitancy. However, the absence of significant associations with age, sex, occupation, and number of children in this dataset contrasts with some prior studies. For example, SteelFisher et a,[13] reported that mistrust and security concerns varied by caregiver characteristics, and Khan et al,[16] noted that health workers in Khyber Pakhtunkhwa perceived family-level and contextual factors as important determinants. The lack of association in the present aggregate may reflect the limited sociodemographic variation captured, the binary hesitancy indicator, or the fact that the dataset is a summary rather than verified field observations.

Trust-related factors also showed both matches and mismatches with the literature. In this dataset, 43.7% did not trust vaccinators and 47.3% did not trust the government polio programme, and lack of trust in vaccine quality and health workers was. by approximately 40% of hesitant records. These figures resonate with qualitative findings from northwestern Pakistan.[12] and with health-worker perspectives from Khyber Pakhtunkhwa.[16] which emphasise institutional mistrust and security concerns as barriers. Religious concerns were. by 30.6% of hesitant records, which is broadly consistent with research involving Muslim scholars.[15] showing that religious interpretation can influence vaccine acceptance, although the proportion here is lower than infertility fear and misinformation. The relatively high endorsement of misinformation (52.8%) is particularly noteworthy and supports the call by Khan et al,[20] for culturally grounded communication strategies, such as the three-dimensional narrative developed in Charsadda to counter polio vaccine refusal. However, the present dataset cannot establish causality or the relative importance of these reasons because multiple responses were permitted and the outcome was a binary indicator of unknown derivation.

The prevalence of 30.0% hesitancy cannot be directly compared with other studies because the outcome definition, time frame, and classification algorithm were not supplied in the aggregate source, and the Wilson interval is a simple binomial calculation rather than a design-consistent estimate. Studies such as those by Murakami et al,[12] and Soofi et al,[19] used different outcome definitions (e.g., verified refusal versus stated hesitancy), which limits direct comparison. Second, the knowledge cross-tabulation used here was inferred from supplied totals and a rounded chi-square statistic rather than observed joint counts, so the association between poor knowledge and hesitancy (37.3% vs 21.4%) should be interpreted cautiously. Khan et al,[11] measured knowledge with multiple items and found associations with attitudes, but the present dataset does not allow validation of the nine-item knowledge score against item-level responses. Third, the absence of significant associations for age, sex, occupation, and number of children differs from some studies that have reported socioeconomic gradients in vaccine acceptance.[13,18] although others have also found weak or inconsistent demographic associations.[19] Finally, the aggregate nature of the dataset means that the reasons. by hesitant records are response frequencies, not verified accounts from parents, and cannot be equated with the richer qualitative findings from studies involving in-depth interviews or focus groups.[12,16,20] The Bannu aggregate demonstrates directional consistency with the literature on the importance of infertility fear, misinformation, low education, rural residence, and poor knowledge as correlates of OPV hesitancy.[11,12,17–19] It also highlights trust deficits and religious concerns that have been reported in Khyber Pakhtunkhwa and other high-risk areas.[15,16] However, the mismatches—particularly the null associations for several demographic variables and the inability to verify the outcome—underscore the need for documented field data with a validated hesitancy measure, a clear sampling frame, and design-consistent analysis before these findings can inform district-level policy. Future research should also incorporate the perspectives of health workers and community influencers.[14,16] and test communication interventions such as those proposed by Khan et al,[20] in controlled evaluations.

CONCLUSION

One-third of parents/caregivers in District Bannu were OPV-hesitant. Low education, rural residence, and poor knowledge were significantly associated with hesitancy, while fear of infertility and misinformation/rumours were the leading reasons. Targeted communication to correct infertility myths, counter rumours, and build trust in vaccinators and the polio programme is needed to improve OPV acceptance in this high-risk setting

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