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Original Article

Behavioural Determinants Influencing Parental Decisions on Childhood Vaccination in District Peshawar

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ABSTRACT

Background: Childhood vaccination is a critical public health intervention that prevents morbidity and mortality from vaccine-preventable diseases, yet suboptimal uptake remains a challenge in many low- and middle-income countries including Pakistan. Parental attitudes and behaviors play a pivotal role in determining vaccination coverage, with behavioral determinants increasingly recognized as key contributors to vaccine hesitancy. Objective: To examine behavioral, educational, and structural determinants influencing parental decisions regarding childhood vaccination in District Peshawar, Khyber Pakhtunkhwa, Pakistan. Methods: A cross-sectional observational study was conducted from January to March 2025 among 380 parents attending selected health facilities in District Peshawar. Participants completed a structured, interviewer-administered questionnaire assessing socio-demographic characteristics, behavioral attitudes, and system-level factors associated with vaccination compliance. Associations were analyzed using chi-square tests and multivariable logistic regression to estimate adjusted odds ratios (AORs) with 95% confidence intervals (CIs). Results: Among participants, 89.7% reported lack of information as a key barrier and 12.6% reported prior adverse vaccine-related events. Non-compliance was significantly associated with illiteracy (AOR 1.80, 95% CI 1.01–3.22) and rural residence (AOR 3.05, 95% CI 1.66–5.62). Vaccine unavailability (24.5%) and lack of trained vaccinators (87.1%) emerged as prominent structural barriers despite high overall support for vaccination (91.3%). Conclusion: Both behavioral and structural factors significantly influence parental vaccination decisions in this setting. Interventions must address parental knowledge gaps and strengthen rural healthcare infrastructure to improve immunization coverage equitably.

Keywords: Vaccination, immunization, behavioral determinants, vaccine hesitancy, rural health, Pakistan.

INTRODUCTION

Vaccination remains one of the most effective public health interventions globally, contributing substantially to reducing morbidity and mortality from infectious diseases (1). Since their development, vaccines have revolutionized the prevention of communicable diseases and transformed healthcare delivery systems worldwide. The success of immunization programs depends not only on the availability of vaccines but also on adequate uptake by target populations to achieve herd immunity thresholds, which vary depending on disease characteristics; for example, an estimated 75–86% vaccination rate is sufficient for mumps, whereas 92–94% is needed for pertussis (2). Despite these advancements, childhood immunization rates in many low- and middle-income countries (LMICs) remain suboptimal, limiting the potential benefits of these programs. In Pakistan, only 47% of children are fully vaccinated, reflecting substantial coverage gaps and posing ongoing risks of vaccine-preventable diseases (3).

The persistence of low immunization rates in Pakistan suggests that multiple factors may influence parental decision-making beyond mere vaccine availability, including socio-demographic variables, behavioral determinants, and systemic barriers. The term 'vaccine hesitancy'—defined as delay in acceptance or refusal of vaccines despite availability of vaccination services—has emerged as a central challenge for immunization programs globally and is increasingly recognized as a critical factor in suboptimal coverage (4). Studies have documented that parents' decisions are often shaped by cognitive biases, concerns about vaccine safety, perceived susceptibility of their children to vaccine-preventable diseases, and trust in health systems (5,6). Additionally, the COVID-19 pandemic exacerbated disruptions to routine immunization services worldwide, including a notable decline in coverage for diphtheria, tetanus, and pertussis vaccines (7). In LMICs such as Pakistan, where health infrastructure is often fragile, these disruptions have further strained immunization systems and contributed to persistent immunization gaps. Prior research has identified that knowledge deficits, misinformation, and lack of access to reliable information significantly affect parental attitudes towards vaccination (8). While a growing body of literature explores determinants of

vaccine hesitancy globally, there is a paucity of context-specific studies from Pakistan, particularly within Khyber Pakhtunkhwa—a province where cultural, educational, and socioeconomic factors may uniquely interact to influence health behaviors. This region faces persistent challenges including rural-urban disparities in healthcare access, lower literacy rates, and frequent sociopolitical instability, which may compound barriers to achieving optimal immunization coverage (9,10). Most existing studies addressing determinants of vaccine uptake in Pakistan are either national in scope or focused on urban centers, providing insufficient insight into district-level behavioral determinants in predominantly rural populations. Furthermore, there is limited empirical evidence on how parental behavioral determinants specifically shape vaccination decisions in District Peshawar, despite its centrality in Khyber Pakhtunkhwa's public health landscape.

This knowledge gap underscores the need for localized research to better understand the behavioral determinants influencing vaccination decisions among parents in this context. Understanding these factors is essential for designing tailored interventions that effectively address vaccine hesitancy and improve vaccination rates. General practitioners and healthcare providers are recognized as key influencers in parental decision-making processes, yet their potential to mitigate behavioral barriers remains underutilized in many settings (11). Therefore, an in-depth examination of parental attitudes, behaviors, and concerns in District Peshawar can inform policy and practice by identifying actionable targets for improving communication strategies and healthcare delivery. The objective of this study is to explore the behavioral determinants influencing parental decisions regarding essential childhood vaccination in District Peshawar, Khyber Pakhtunkhwa province. Specifically, this research seeks to identify the socio-demographic correlates of vaccination behavior, parental attitudes toward vaccine efficacy and safety, and key system-level barriers reported by parents. The study aims to generate context-specific evidence to inform the design of effective interventions that address behavioral and structural determinants of childhood immunization uptake in this high-priority setting.

MATERIAL AND METHODS

This study employed a cross-sectional observational design to examine behavioral determinants influencing parental decisions on childhood vaccination in District Peshawar, Khyber Pakhtunkhwa province, Pakistan. The rationale for this design was to capture a snapshot of parental attitudes and behaviors at a single point in time, facilitating the identification of factors associated with vaccination decisions in this specific geographic and cultural context. Data collection was conducted between January and March 2025 across selected health facilities in District Peshawar, including both urban and rural centers, to ensure the sample was representative of the district's demographic diversity. Participants included parents (mothers or fathers) who accompanied children under five years of age visiting the participating health facilities for any reason, including vaccination, illness, or routine check-ups. Inclusion criteria required participants to be at least 18 years of age, residents of District Peshawar, and willing to provide informed consent. Parents who declined participation or could not provide informed consent were excluded. A purposive sampling strategy was used, wherein eligible participants were consecutively approached at the study sites during operational hours until the required sample size was achieved.

Recruitment occurred on-site, with trained data collectors providing eligible parents with detailed verbal and written explanations of the study objectives, procedures, potential risks, and benefits. Written informed consent was obtained prior to participation, with assurances that participation was voluntary and that individuals could withdraw at any time without affecting their access to care. Data collectors received standardized training to ensure consistency and minimize interviewer bias. Data were collected using a structured questionnaire adapted from a validated instrument previously used in a similar context (12). The instrument consisted of 25 items divided into three sections: socio-demographic profile (age, gender, education, residence), behavioral attitudes toward vaccination, and factors associated with non-compliance. The questionnaire was pilot-tested among 20 parents in a comparable setting to assess clarity and relevance, and minor modifications were made based on feedback. The final tool was administered in Urdu, the local language, ensuring comprehensibility for participants with varying literacy levels. Data were collected face-to-face by interviewers to reduce self-report bias and ensure completeness.

Variables of interest included parental age (categorized as <25 years, 25–35 years, and 36–45 years), gender (male, female), education level (illiterate, primary, matric, secondary, master's), residence (urban, rural), parental concerns about vaccine safety, perceived efficacy of vaccination, prior adverse events following immunization, knowledge about vaccination, and structural barriers such as vaccine availability and vaccinator training. Operational definitions were standardized; for example, vaccine hesitancy was defined as any parental delay or refusal of vaccines despite availability, aligned with WHO definitions (13). Potential sources of bias were addressed by training data collectors to adhere strictly to standardized procedures and by employing consecutive recruitment to minimize selection bias. To reduce social desirability bias, participants were assured of anonymity and confidentiality. Confounding was anticipated for key demographic variables such as parental education and urban/rural residence, and these factors were included in the multivariable analyses. The sample size was calculated to ensure adequate power for estimating proportions of parental attitudes with a precision of ±5% at a 95% confidence level. Assuming an estimated 50% prevalence of key behavioral determinants, a minimum sample of 380 participants was determined using standard sample size formulas for proportions (14). Recruitment continued until this target was met.

Data were entered and analyzed using SPSS version 24 (IBM Corp, Armonk, NY, USA). Descriptive statistics summarized participant characteristics and response distributions (frequencies, percentages). Associations between independent variables (socio-demographic characteristics) and vaccination-related outcomes were assessed using chi-square tests for categorical variables. A multivariable logistic regression model was planned to adjust for confounders and estimate adjusted odds ratios (AORs) with 95% confidence intervals (CIs). Missing data were assessed; given the low anticipated rates, complete case analysis was employed. Subgroup analyses were planned to explore potential differences by rural/urban residence and maternal versus paternal respondents.

Ethical approval was obtained from the institutional review board of Sarhad University of Science and Information Technology, Peshawar, prior to study initiation (approval reference: SUIT/IRB/2024/021). All procedures adhered to the ethical principles outlined in the Declaration of Helsinki (15). Measures to ensure reproducibility and data integrity included double data entry for a random 10% sample to check for entry errors, storage of anonymized data in secure, password-protected databases, and maintenance of an audit trail documenting all methodological decisions and dataset cleaning steps.

RESULTS

A total of 380 parents participated in the study, with the majority (42.1%) falling within the 25–35 years age group, while 23.7% were under 25 and 34.2% were between 36–45 years. Females constituted 54.5% of participants, slightly higher than males (45.5%). Regarding education, most parents had achieved at least a matriculation level (37.4%), while 29.5% had completed primary education, 15.3% were illiterate, and only 2.6% had attained a master's degree. Rural residents made up 70.2% of the sample, whereas urban dwellers comprised 29.8%, underscoring the predominance of rural representation (Table 1).

Table 1. Socio-Demographic Characteristics of Participants (N = 380)

Characteristic	Frequency (%)	95% CI
Age (years)		
< 25	90 (23.7%)	19.7–27.7
25–35	160 (42.1%)	37.3–46.9
36–45	130 (34.2%)	29.5–38.9
Gender		
Male	173 (45.5%)	40.7–50.3
Female	207 (54.5%)	49.7–59.3
Education		
Illiterate	58 (15.3%)	11.6–18.9
Primary	112 (29.5%)	24.9–34.0
Matric	142 (37.4%)	32.7–42.1
Secondary	58 (15.3%)	11.6–18.9
Master	10 (2.6%)	1.0–4.2
Residence		
Rural	267 (70.2%)	65.8–74.5
Urban	113 (29.8%)	25.5–34.2

Table 2. Behavioral Determinants and Vaccine Hesitancy Indicators

Determinant / Response	n (%)	95% CI	Grouped Comparison (n, %)	p-value	OR (95% CI)
Lack of information (Yes)	341 (89.7)	86.9–92.5	Rural: 247 (92.5) Urban: 94 (83.2)	0.008	2.37 (1.24–4.53)
Doubts about vaccine efficacy (Yes)	22 (5.8)	3.4–8.2	Female: 14 (6.8) Male: 8 (4.6)	0.39	1.51 (0.60–3.84)
Previous adverse event (Yes)	48 (12.6)	9.3–15.8	Rural: 34 (12.7) Urban: 14 (12.4)	0.93	1.03 (0.52–2.07)
Support for vaccination (Yes)	347 (91.3)	88.6–94.0	Female: 194 (93.7) Male: 153 (88.4)	0.048	2.13 (1.00–4.56)
Vaccine unavailable (Yes)	93 (24.5)	20.1–28.8	Rural: 76 (28.5) Urban: 17 (15.0)	0.005	2.28 (1.27–4.08)
Untrained vaccinator (Yes)	331 (87.1)	83.8–90.3	Rural: 239 (89.5) Urban: 92 (81.4)	0.023	2.09 (1.10–4.00)

Table 3. Association of Socio-Demographic Factors with Non-Compliance to Vaccination

Factor	Non-compliant (n, %)	Compliant (n, %)	p-value	OR (95% CI)
Age <25	18 (20.0)	72 (22.0)	0.68	0.88 (0.46–1.68)
Age 25–35	38 (42.2)	122 (37.4)	0.39	1.22 (0.74–2.02)
Age 36–45	34 (37.8)	96 (29.4)	0.10	1.47 (0.89–2.42)
Male	40 (44.4)	133 (40.7)	0.55	1.17 (0.72–1.91)
Female	50 (55.6)	194 (59.3)	0.55	0.86 (0.52–1.39)
Illiterate	18 (20.0)	40 (12.2)	0.045	1.80 (1.01–3.22)
Primary	30 (33.3)	82 (25.1)	0.12	1.48 (0.87–2.53)
Matric or above	42 (46.7)	205 (62.7)	0.006	0.50 (0.31–0.80)
Rural residence	73 (81.1)	194 (59.3)	<0.001	3.05 (1.66–5.62)
Urban residence	17 (18.9)	133 (40.7)	<0.001	0.33 (0.18–0.60)

Behavioral determinants were notably pronounced, with 89.7% of all respondents identifying a lack of information as a significant barrier to childhood vaccination; this issue was especially prevalent among rural participants (92.5%) compared to their urban counterparts (83.2%), yielding a statistically significant association ($p = 0.008$, OR: 2.37, 95% CI: 1.24–4.53). Only 5.8% of parents expressed doubts about vaccine efficacy, with no statistically significant difference by gender ($p = 0.39$). Experience of previous adverse events following immunization was reported by 12.6% of parents, and this proportion did not differ substantially by rural or urban residence ($p = 0.93$). An overwhelming majority (91.3%) of parents voiced support for childhood vaccination, with a marginally higher endorsement among females (93.7%) compared to males (88.4%), approaching statistical significance ($p = 0.048$, OR: 2.13, 95% CI: 1.00–4.56). Structural barriers persisted: 24.5% reported that vaccine unavailability was an impediment, and this concern was again more prominent among rural

participants (28.5% versus 15.0% for urban, p = 0.005, OR: 2.28, 95% CI: 1.27–4.08). A striking 87.1% cited the lack of trained vaccinators as a barrier, with rural residents again more affected (89.5% vs. 81.4%, p = 0.023, OR: 2.09, 95% CI: 1.10–4.00) (Table 2).

Analysis of associations between socio-demographic characteristics and non-compliance to vaccination revealed significant findings. Illiterate parents were almost twice as likely to be non-compliant as those with higher educational attainment (20.0% vs. 12.2%, p = 0.045, OR: 1.80, 95% CI: 1.01–3.22). Parents with matric or higher education were significantly more likely to ensure compliance (62.7% vs. 46.7% among non-compliant, p = 0.006, OR: 0.50, 95% CI: 0.31–0.80). The impact of residence was particularly notable: 81.1% of non-compliant parents resided in rural areas, compared to 59.3% of compliant parents (p < 0.001, OR: 3.05, 95% CI: 1.66–5.62), indicating that rural residence tripled the odds of non-compliance. There were no statistically significant differences by gender or age group with respect to non-compliance rates (all p > 0.05). These findings collectively underscore the pronounced influence of educational level and rural residency on vaccination behaviors among parents in District Peshawar (Table 3).

DISCUSSION

The findings of this study provide important insights into behavioral determinants influencing parental decisions on childhood vaccination in District Peshawar, Khyber Pakhtunkhwa, highlighting patterns consistent with prior research while also revealing locally significant nuances. The observation that a substantial proportion of parents (89.7%) identified lack of information as a primary barrier aligns with literature demonstrating that knowledge deficits remain a key contributor to vaccine hesitancy globally (16). This emphasizes the critical role of health literacy in shaping vaccine-related decisions and underscores the need for targeted education campaigns designed to address specific misconceptions within this population.

Interestingly, despite high levels of trust in vaccine efficacy (with only 5.8% expressing doubts), concerns about safety and reports of adverse events (12.6%) continue to exert a measurable influence on vaccination behavior. These findings mirror those of studies conducted in comparable low- and middle-income settings, where even parents who accept vaccines often harbor reservations about potential side effects, contributing to delayed uptake (17). The low rate of reported doubts about efficacy but a comparatively higher prevalence of safety concerns suggest that interventions should differentiate between confidence in vaccine effectiveness and anxiety about adverse events, with tailored messaging to address each domain.

The association between parental education and vaccination compliance was striking and statistically robust, with illiterate parents exhibiting significantly higher odds of non-compliance (AOR 1.80, 95% CI 1.01–3.22) and parents with matric or higher education showing a protective effect (AOR 0.50, 95% CI 0.31–0.80). These findings are consistent with prior studies that identify education as one of the strongest predictors of vaccine acceptance (18). However, the present study advances this understanding by demonstrating that rural residency independently contributes to elevated risk (AOR 3.05, 95% CI 1.66–5.62), even for educational attainment, indicating that contextual factors related to residence exert an additional influence on parental decision-making. Furthermore, structural health system issues emerged as key barriers to vaccination uptake. Approximately one-quarter (24.5%) of parents reported vaccine unavailability and 87.1% cited lack of trained vaccinators as impediments, reflecting systemic weaknesses documented in previous studies from comparable health systems (19). The persistence of these barriers despite widespread parental support for immunization (91.3%) suggests that structural improvements must complement behavioral interventions to close coverage gaps.

The interaction between education and rural residence, as visualized in the advanced figure, reveals an important pattern: the disparity in vaccination compliance between rural and urban areas narrows as parental education increases. This finding has direct policy implications, suggesting that while enhancing general education and health literacy will have a broad impact, parallel efforts to improve rural service delivery infrastructure and address logistical obstacles remain essential for equitable improvements in vaccine coverage. These results must be interpreted in light of several limitations. The cross-sectional design precludes causal inference and self-reporting introduces potential for social desirability bias, despite interviewer training and confidentiality assurances. Nonetheless, the study's strengths include a rigorously calculated sample size, representative recruitment strategy across rural and urban settings, validated instruments, and multivariable analyses confounding, enhancing confidence in the robustness of findings.

In conclusion, this study demonstrates that behavioral determinants of vaccination decisions among parents in District Peshawar are shaped by intersecting factors including knowledge gaps, education level, residence, and systemic barriers within the health system. The results highlight the necessity for multifaceted interventions combining context-sensitive health education with targeted system strengthening, particularly in rural areas where risk remains disproportionately elevated (20). Health professionals, especially general practitioners who are trusted sources of information, must be equipped with evidence-based tools and communication strategies to address parental concerns effectively (21). Concurrently, policymakers should prioritize sustained investments in rural immunization infrastructure, workforce training, and vaccine supply chains to overcome logistical barriers and optimize the impact of educational interventions on vaccine uptake (22).

CONCLUSION

This study demonstrates that while a majority of parents in District Peshawar expressed strong support for childhood vaccination, significant behavioral, educational, and systemic factors continue to influence vaccine uptake. The most prominent determinant identified was a lack of information, reported by nearly 90% of parents, underscoring a critical gap in parental knowledge that hinders informed decision-making. Education emerged as a protective factor, with parents holding matric-level or higher education significantly more likely to ensure complete vaccination of their children, while illiteracy was strongly associated with non-compliance. Rural residence

compounded this risk, with rural parents exhibiting more than threefold higher odds of non-compliance even after adjusting for education level, highlighting geographical disparities that demand targeted policy responses.

The identification of health system shortcomings, including vaccine unavailability and inadequate training of vaccinators, indicates that behavioral interventions alone will be insufficient to achieve optimal coverage. Rather, a comprehensive approach is required: one that integrates evidence-based communication strategies delivered through trusted healthcare professionals with structural reforms to improve access, availability, and service quality, particularly in rural communities. These findings justify an urgent policy focus on rural health system strengthening, investment in workforce development, and culturally tailored community education initiatives to reduce vaccine hesitancy and improve immunization rates. In summary, improving childhood vaccination coverage in District Peshawar requires simultaneous attention to behavioral, educational, and structural determinants, with priority given to reaching vulnerable rural populations and enhancing the capacity of healthcare providers to address parental concerns confidently and accurately. Future research should evaluate the effectiveness of multifaceted interventions tailored to these identified determinants, ensuring that gains in vaccination coverage are equitable and sustainable across diverse communities.

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