

IMMUNISATION STATUS AND DETERMINANTS OF VACCINE HESITANCY AMONG CHILDREN UNDER FIVE YEARS OF AGE

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ABSTRACT

OBJECTIVES

This study aimed to determine immunisation status and identify demographic, socioeconomic, access-related, and caregiver factors associated with incomplete immunisation among children under five years.

METHODOLOGY

This descriptive cross-sectional study enrolled 345 children who presented to the Department of Paediatrics, Ayub Teaching Hospital, Abbottabad, from October 2025 to April 2026 using non-probability consecutive sampling. Parents or guardians completed a pre-tested structured questionnaire, and immunisation status was verified from Expanded Programme on Immunisation records when available and supplemented with caregiver recall. Children were categorised as fully, partially, or not immunised. We assessed associations using chi-square tests and Cramer's V, followed by binary logistic regression for incomplete immunisation.

RESULTS

The mean child age was 28.15 ± 17.19 months. Overall, 212 (61.4%) children were fully immunised, 103 (29.9%) partially immunised, and 30 (8.7%) non-immunised. Frequently reported barriers were fear of side effects (49.0%), lack of schedule knowledge (42.6%), and unawareness of the need for immunisation (41.2%). Immunisation status was significantly associated with residence, socioeconomic status, parental education, and parental occupation. After adjustment, low socioeconomic status, unawareness of follow-up doses, misconceptions about contraindications, lack of a nearby vaccination facility, concern about lost wages, and poor schedule knowledge independently predicted incomplete immunisation.

CONCLUSION

More than one-third of children had incomplete immunisation. Improving completion requires caregiver education, clear counselling about contraindications and adverse effects, reliable reminders for subsequent doses, and practical service-delivery measures that reduce geographic and economic barriers for vulnerable families. Targeted outreach should consistently prioritise rural and socioeconomically disadvantaged households.

KEYWORDS: Immunisation Status, Vaccine Hesitancy, Children Under Five, Expanded Programme On Immunisation, Caregivers, Pakistan

INTRODUCTION

Immunisation remains one of the most effective interventions to reduce childhood morbidity and mortality. Children are vaccinated against several serious infections including: tuberculosis, poliomyelitis, diphtheria, pertussis, tetanus, hepatitis B, pneumococcal disease, Haemophilus influenzae type b infection, and measles.¹ Completing the recommended childhood immunisation schedule not only protects vaccinated children but also supports herd protection in the community. Although effective vaccines are available, incomplete and delayed immunisation remains a significant issue in most developing countries, including Pakistan.² The Expanded Programme on

Immunisation was adopted to provide routine childhood vaccination and reduce the burden of vaccine-preventable diseases. Nevertheless, the uptake of vaccines is influenced by a number of factors other than access to vaccines.³ Caregiver knowledge, parental education, socioeconomic status, family income, place of residence, access to health facilities, and trust in vaccine safety all contribute to whether a child completes the immunisation schedule. Missed opportunities, lack of awareness of follow-up doses, inability to reach vaccination centers, and misinformation can lead to partial or complete immunisation gaps.^{4,5} Vaccine hesitancy is now understood as a significant impediment to successful immunisation coverage. It can occur even when

vaccination services are available and may be influenced by fear of adverse effects, misconceptions about contraindications, low perceived importance of vaccination, and doubts created by misinformation.⁶ Among families, practical barriers to immunisation include parents' work duties, transport difficulties, loss of daily wages, illness in children, and a lack of knowledge about the correct schedule, which can delay or interrupt immunisation. These barriers are especially important among under-five children because missed early childhood doses increase the risk of preventable infections.⁷ Routine immunisation coverage varies across regions and among people in Pakistan. Children in rural areas, low-income families, and families with poor parental education may be at higher risk of being under-vaccinated.⁸ Understanding local trends in immunisation status and the key causes of vaccine hesitancy is crucial for planning targeted interventions. For higher-risk families with incomplete immunisation, evidence from a tertiary care setting can guide clinicians, public health teams, and policymakers in designing counselling strategies, reminder systems, and outreach services. This study therefore aimed to determine the frequency of immunisation status and identify determinants of vaccine hesitancy among children under five years of age presenting to the Department of Pediatrics, Ayub Teaching Hospital, Abbottabad. The findings may highlight modifiable barriers and support practical strategies to improve childhood immunisation completion.

METHODOLOGY

This descriptive cross-sectional study aimed to determine the frequency of immunisation status and identify determinants of vaccine hesitancy in children under five years of age. The study was conducted in the Department of Paediatrics, Ayub Teaching Hospital, Abbottabad, a tertiary care hospital, over six months from October 2025 to April 2026. The Institutional Medical and Ethics Review Committee, Ayub Medical Teaching Institution, Abbottabad, approved the study with reference number RC-EA-2024/252 on 04/10/2024. In addition, the College of Physicians and Surgeons Pakistan (CPSP) approved the synopsis under reference number CPSP/REU/PED-2023-010-7578, dated October 17, 2025. We obtained written informed consent from parents or legal guardians before enrollment, and conducted all procedures in accordance with ethical principles for human research. A sample of 345 children under the age of five was recruited using a non-probability consecutive sampling method, in which all eligible respondents who presented themselves during the study period were included. The sample size was calculated using a 95% confidence level and a 5%

margin of error, assuming a 34% proportion of partially immunised children based on previously published literature.⁹ Children of either gender aged less than five years presenting to the pediatric department were eligible for inclusion. We excluded children older than five years, those without vaccination records or whose caregivers could not recall immunisation history, and those with known medical contraindications to vaccination (such as severe allergic reactions). Additionally, we excluded families not permanently residing in the study area to avoid bias in accessibility-related variables. Immunisation status was categorised as fully immunised, partially immunised, and non-immunised according to the national Expanded Programme on Immunization (EPI) schedule, based on vaccination cards and caregiver recall. Vaccine hesitancy determinants included lack of awareness, fear of adverse effects, misconceptions about contraindications, logistical barriers, and socioeconomic constraints, assessed through structured questioning. After ethical approval, participants were recruited sequentially as long as they were eligible. We used a pre-tested structured questionnaire (proforma) to collect data. Data were collected through face-to-face interviews with parents or guardians, including demographic variables (age, gender, residence, socioeconomic status, parental education, occupation), immunisation status, and factors associated with vaccine hesitancy. Whenever available, EPI vaccination cards were used to verify immunisation status and supplemented by caregiver recall where necessary. All the variables were measured based on operational definitions. The researcher conducted data collection to ensure consistency and completeness. The data collection tool was adapted from previously published studies and aligned with study objectives. Before data collection, subject-matter experts reviewed the questionnaire to establish content validity, and minor changes were made to enhance clarity. The pilot testing phase was conducted to verify understanding and feasibility, and unclear items were reformulated. To ensure reliability, standardised questioning and standardised data-recording procedures were observed. All data were entered and analysed using IBM SPSS Statistics version 26. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

The mean age of the 345 children was 28.15 ± 17.19 months; 187 (54.2%) were male, and 196 (56.8%) lived in rural areas. Overall, 212 (61.4%) were fully immunised, 103 (29.9%) partially immunised, and 30 (8.7%) non-immunised. Thus, 133 children (38.6%) had incomplete immunisation. The most frequently reported

barriers were fear of side effects (49.0%), lack of knowledge of the immunisation schedule (42.6%), and unawareness of the need for immunisation (41.2%). Residence, socioeconomic status, parental education, and parental occupation were significantly associated with the three-category immunisation outcome, whereas age group, sex, and monthly-income category were not. Each measured barrier showed a significant unadjusted association with incomplete immunisation. In the multivariable model, low versus high socioeconomic status (AOR 176.91, 95% CI 11.62–2694.40), middle versus high socioeconomic status (AOR 58.04, 95% CI 3.75–898.36), unawareness of follow-up doses (AOR 26.81, 95% CI 5.14–139.96), misconceptions about contraindications (AOR 41.03, 95% CI 6.42–262.29), absence of a nearby health facility (AOR 79.13, 95% CI 9.36–668.90), concern about loss of wages (AOR 69.59, 95% CI 7.93–610.93), and lack of schedule knowledge (AOR 8.07, 95% CI 1.78–36.61) remained statistically significant. The very wide confidence intervals indicate imprecision and warrant cautious interpretation.

Table 1: Participant Characteristics and Immunisation Status

Panel A. Demographic Characteristics		
Variable	Category	n (%) / Mean ± SD
Age (months)	Mean ± SD	28.15 ± 17.19
	Range	2–59
Age group	<1 year	78 (22.6)
	1–3 years	156 (45.2)
	3–5 years	111 (32.2)
Gender	Male	187 (54.2)
	Female	158 (45.8)
Residence	Rural	196 (56.8)
	Urban	149 (43.2)
Monthly income (PKR)	Mean ± SD	82,710.14 ± 45,825.47
Socioeconomic status	Low	138 (40.0)
	Middle	143 (41.4)
	High	64 (18.6)
Parental education	Uneducated	121 (35.1)
	Up to matric	139 (40.3)
	Bachelor or above	85 (24.6)
Parental occupation	Unemployed/Housewife	162 (47.0)
	Labor/Skilled	119 (34.5)
	Professional	64 (18.6)
Panel B. Immunization status		
Immunization Status	Frequency (n)	(%age)
Fully immunised	212	61.4
Partially immunised	103	29.9
Non-immunised	30	8.7
Total	345	100

Table 2: Reported Determinants and Barriers Related to Vaccine Hesitancy

Determinant	Yes n(%age)	No n(%age)
Unaware of need for immunisation	142 (41.2)	203 (58.8)
Unaware of need to return for follow-up doses	126 (36.5)	219 (63.5)
Place and time of immunisation unknown	118 (34.2)	227 (65.8)
Fear of side effects or reactions	169 (49.0)	176 (51.0)
Wrong beliefs about contraindications	97 (28.1)	248 (71.9)
Lack of motivation	121 (35.1)	224 (64.9)
Busy parents	135 (39.1)	210 (60.9)
Lack of nearby health facility	102 (29.6)	243 (70.4)
Concern for loss of work/wages	88 (25.5)	257 (74.5)
Child illness	109 (31.6)	236 (68.4)
Lack of knowledge of immunisation schedule	147 (42.6)	198 (57.4)
Child away from home	76 (22.0)	269 (78.0)

Table 3: Association of Immunisation Status with Demographic Variables

Variable	Fully	Partially	Non	χ²	Cramer's V	p-value
	%age					
Age group				8.380	0.110	0.079
<1 year	59.0	33.3	7.7			
1–3 years	62.8	32.1	5.1			
3–5 years	61.3	24.3	14.4			
Gender				0.563	0.040	0.755
Female	63.3	27.8	8.9			
Male	59.9	31.6	8.6			
Residence				27.900	0.284	<0.001
Rural	51.0	34.7	14.3			
Urban	75.2	23.5	1.3			
Socioeconomic status				115.185	0.409	<0.001
Low	28.3	53.6	18.1			
Middle	77.6	18.9	3.5			
High	96.9	3.1	0.0			
Parental education				138.635	0.448	<0.001
Uneducated	22.3	55.4	22.3			
Up to matric	74.1	23.7	2.2			
Bachelor or above	96.5	3.5	0.0			
Parental occupation				30.078	0.209	<0.001
Unemployed/Housewife	58.6	29.6	11.7			
Labor/Skilled	50.4	41.2	8.4			
Professional	89.1	9.4	1.6			
Monthly income category				5.312	0.088	0.257
Low	53.7	36.1	10.2			
Middle	67.8	26.1	6.1			
High	62.3	27.9	9.8			

Table 4: Association of Reported Hesitancy/Barrier Factors with Incomplete Immunization

Factor	Fully	Incomplete	χ^2	Cramers V	p-value
	%age				
Unaware of need for immunisation	78.3	27.8	86.001	0.499	<0.001
Unaware of follow-up doses	86.3	27.1	123.770	0.599	<0.001
Place/time unknown	85.8	33.8	98.253	0.534	<0.001
Fear of side effects	69.8	21.1	77.752	0.475	<0.001
Wrong beliefs about contraindications	93.9	36.8	131.500	0.617	<0.001
Lack of motivation	80.2	40.6	56.245	0.404	<0.001
Busy parents	77.8	33.8	66.416	0.439	<0.001
No nearby health facility	90.1	39.1	102.066	0.544	<0.001
Loss of wages concern	96.2	39.8	136.707	0.629	<0.001
Child illness	85.8	40.6	77.421	0.474	<0.001
Lack of schedule knowledge	77.8	24.8	93.945	0.522	<0.001
Child away from home	100.0	42.9	155.369	0.671	<0.001

Table 5: Multivariable Logistic Regression of Factors Associated with Incomplete Immunisation

Variable	AOR (Exp B)	95% CI	p-value
Residence (Rural vs Urban)	2.77	0.54 – 14.17	0.221
Socioeconomic Status			0.001
Low vs High	176.91	11.62 – 2694.40	<0.001
Middle vs High	58.04	3.75 – 898.36	0.004
Parental Education			0.105
Uneducated vs Bachelor+	8.97	0.63 – 127.24	0.105
Matric vs Bachelor+	1.96	0.15 – 25.50	0.606
Unaware of follow-up doses	26.81	5.14 – 139.96	<0.001
Fear of side effects	0.89	0.20 – 4.04	0.881
Wrong beliefs about contraindications	41.03	6.42 – 262.29	<0.001
No nearby health facility	79.13	9.36 – 668.90	<0.001
Loss of wages concern	69.59	7.93 – 610.93	<0.001
Lack of schedule knowledge	8.07	1.78 – 36.61	0.007

DISCUSSION

The present study assessed immunisation status and determinants of vaccine hesitancy among 345 children under five years of age. In this study, 61.4% of children were fully immunised, 29.9% were partially immunised, and 8.7% were not immunised. These findings show that although more than half of the children had completed vaccination, a substantial proportion still had missed or incomplete doses, indicating a continued gap in routine immunisation coverage. The most frequent barriers were fear of side effects, lack of knowledge regarding the immunisation schedule, and unawareness of the need for vaccination.

Socioeconomic status, parental education, residence, and several hesitancy-related factors were significantly associated with incomplete immunisation. The percentage of fully vaccinated children in the present study is greater than the 48.4% complete vaccination coverage provided by Shahid et al. in Matiari, Pakistan, where the coverage and timeliness of vaccination among children vaccinated with EPI antigens were characterised as low.¹⁰ However, this is lower than the results of Mughal et al. in Rawalpindi, where 83.8% of children were fully vaccinated and 72.8% of parents reported never delaying a child's vaccination.¹¹ This disparity could be attributed to differences in study location, parental literacy, urban and rural distribution, access to vaccination centres, and caregiver awareness. Only 43.3% of children under the age of two were fully immunised, 32.5% were partially immunised, and 24.2% had no immunisation at all; these are findings from another recent study in Pakistan conducted by Hussan et al.¹² Most commonly reported barrier in the current study was fear of side effects since it affects 49.0% of the caregivers. This finding is similar to a recent study by Sikander et al. in Lahore, where vaccine hesitancy among parents of children below five years was 33.7%, with the most significant contributors being concern about side effects, misinformation, and insufficient information.¹³ Likewise, Mughal et al. found that 38.1 per cent of parents worried about vaccine side effects, further supporting the role of safety concerns in postponing or avoiding childhood vaccination.¹¹ Sahoo et al. also found that vaccine hesitancy among caregivers of under-five children is an important issue in childhood vaccination acceptance.¹⁴ Incomplete immunisation was also usually caused by lack of knowledge about the immunisation schedule and the need to be vaccinated. This is consistent with Khaliq et al., who investigated the reasons behind childhood immunisation refusal in urban slums in Karachi and identified caregiver-level barriers associated with refusal, misinformation, and incomplete understanding of the benefits of vaccination.¹⁵ Sikander et al. also reported similar findings, and among the most prominent determinants of vaccine hesitancy among parents of children under five was a lack of adequate information. These results suggest that vaccine hesitancy does not necessarily imply total rejection; in most cases, it is associated with confusion, incomplete counselling, fear, and poor communication between healthcare workers and caregivers.¹³ In the present study, residence was also strongly related to immunisation status, with urban children having higher immunisation completion rates than rural children. This observation is supported by recent evidence from resource-constrained environments. Getnet et al. examined DHS data from 48 geographically diverse, resource-constrained countries and found that

incomplete basic vaccination varied geographically, with Pakistan as one of the hotspots of incomplete basic vaccination.⁸ They also stated that residence, wealth index, maternal education, media exposure, distance to a health facility, and country-level income status were significantly related to incomplete vaccination. Kebede et al. also indicated that rural living, poor wealth deprivation, family size, and lack of maternal healthcare utilisation were determinants of incomplete immunisation among children aged 12-23 months in Ethiopia.¹⁶ In the present study, socioeconomic status was strongly associated with immunisation status. Children in lower socioeconomic households were more likely to be unable to complete immunisation than children in higher socioeconomic households. This is consistent with Khan et al., who reported in an urban Dhaka study that low household income was significantly related to incomplete vaccination.¹⁷ Likewise, Getnet et al. found that poor and middle-income groups had greater chances of incomplete basic vaccination than richer groups in resource-limited countries.⁸ These results suggest that barriers to immunisation are not only knowledge-based but also related to affordability, transport, time loss, and access to services. In the present study, several hesitancy-related variables were significantly associated with incomplete immunisation. These included lack of awareness of subsequent doses, misconceptions about contraindications, lack of proximity to health facilities, concerns about lost wages, and ignorance of schedules. Habib et al. in Pakistan reported similar findings, linking inequity in access and low vaccine uptake to urban slums.¹⁸ Khan et al. also highlighted income-based missed opportunities and barriers to completing immunisation in young children in Dhaka.¹⁷ These findings show that vaccine hesitancy is not a one-factor problem; it is a complex issue shaped by awareness, trust, socioeconomic pressure, and health-system accessibility. In the present study, multivariate regression identified low socioeconomic status, lack of awareness of follow-up doses, erroneous beliefs about contraindications, absence of a nearby health facility, fear of losing wages, and lack of schedule knowledge as independent predictors of incomplete immunisation. This is consistent with recent international evidence. According to Endalamew et al., several household and health services-related factors determined immunisation coverage, with a significant percentage of children partially immunised.¹⁹ It was also revealed that incomplete vaccination depended on individual-level and community-level determinants, such as education, wealth index, residence, media exposure, health insurance, and distance to health facility (Getnet et al.). These results justify the need for integrated interventions that include caregiver education and

improved access to services.⁸ These findings support the need for integrated interventions that combine caregiver education with improved service access. Another interesting observation in the present investigation was that the fear of side effects was a significant variable in descriptive analysis but not as an independent predictor in its adjusted form. This implies that fear can co-occur with other determinants, including poor knowledge, misinformation, and lack of counseling. Recent studies also support this interpretation. Li et al. also stated that changing perceptions, trust, and attitudes towards the vaccine led to caregiver vaccine hesitancy.²⁰ Patel et al. also explained hesitancy among caregivers of children under five in semi-urban settings as a combination of knowledge gaps, concerns, and contextual barriers.²¹ Thus, merely addressing fears of side effects may not be enough unless communication also improves knowledge of vaccination benefits, contraindications, and the need to vaccinate on time.

LIMITATIONS

The study was hospital-based and used non-probability consecutive sampling; therefore, the proportions observed should not be interpreted as population-level immunisation coverage for Abbottabad or Pakistan. The cross-sectional design establishes association, not causality. Vaccination cards were used when available, but reliance on caregiver recall in some cases may have produced recall or classification error. The questionnaire grouped several access, knowledge, socioeconomic, and attitudinal barriers under the broad concept of vaccine hesitancy and was not reported as a formally validated multidimensional hesitancy scale. Some adjusted odds ratios were extremely large with wide confidence intervals, suggesting sparse data in reference categories and possible model instability; interpret these estimates cautiously. Future community-based studies should use age-appropriate dose verification, validated hesitancy instruments, and adequately powered multilevel models.

CONCLUSIONS

Only 61.4% of children were fully immunised, leaving 38.6% with partial or no immunisation. Incomplete immunisation was associated with socioeconomic disadvantage, gaps in knowledge about follow-up and schedules, misconceptions about contraindications, limited access to services, and concern about lost wages. Improving completion requires integrated caregiver education, reminder-recall systems, accessible vaccination services, and targeted outreach to rural and economically vulnerable families.

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The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.



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