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Vaccination Coverage and Its Association with the Incidence of Infectious Diseases in Peshawar: A Cross-Sectional Study

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Abstract

Background:
Although vaccination is a fundamental component of public health, vaccine-preventable diseases (VPDs) persist in low-resource environments due to differences in immunization coverage. The northwest Pakistani city of Peshawar is still at high risk of outbreaks because of sociopolitical unrest, vaccine hesitancy, and problems with access to healthcare.

Objective:
To evaluate vaccination rates among Peshawar's under-five population and investigate how they relate to the prevalence of prevalent infectious diseases.

Methods:
From January to June 2024, 800 households in Peshawar's urban, semi-urban, and peri-urban areas participated in a community-based cross-sectional survey. A standardized WHO-based questionnaire was used to gather data, and caregiver recollection and EPI vaccination cards were used for verification. Measles, polio, diarrhea, pneumonia, hepatitis B, and tuberculosis disease incidences throughout the previous 12 months were documented. After correcting for sociodemographic and healthcare access factors, logistic regression models were used to find correlations between vaccination status and disease outcomes.

Results:
Of the 800 children surveyed, 62.5% were fully vaccinated, 24% partially vaccinated, and 13.5% not vaccinated. Full immunization was significantly associated with reduced odds of measles (OR=5.8; $p<0.001$), diarrhea (OR=2.1; $p=0.002$), pneumonia (OR=0.6; $p=0.03$), and hepatitis B (OR=0.4; $p=0.01$). Higher maternal education (OR=2.3; $p<0.01$), household income (OR=1.7; $p=0.02$), and proximity to healthcare (OR=1.9; $p=0.004$) were significant predictors of complete vaccination. Despite national efforts, substantial gaps remain, particularly in peri-urban and semi-urban zones.

Conclusion:
Vaccination coverage in Peshawar is suboptimal and directly correlated with increased incidence of preventable childhood infections. Targeted, community-sensitive strategies focusing on education, accessibility, and public trust are essential for improving vaccine uptake and reducing disease burden in the region

Keywords:
Vaccination coverage, Infectious diseases, Peshawar, Immunization, Cross-sectional study, Measles, Diarrhea, Polio, Public health, EPI Pakistan

Introduction

Long acknowledged as one of the most effective public health measures, vaccination has greatly lowered morbidity and death from infectious diseases all over. Mass immunization campaigns have led to the eradication of illnesses like smallpox and a significant drop in the prevalence of others like polio, measles, and diphtheria (1).

Though many developing nations, especially those in poverty, war, and inadequate healthcare systems, have not yet reached the full potential of immunization programs despite these successes. Peshawar, the capital of Khyber Pakhtunkhwa (KP) province in Pakistan, is one such area.

Peshawar has a special combination of difficulties for vaccination coverage. These consist of sociopolitical unrest, regular insurgency-related disturbances, vaccine skepticism based on false information and cultural values, low maternal education, and restricted access to healthcare (2,3). National initiatives such as the Expanded Programme on Immunization (EPI) have not stopped these elements from helping to sustain vaccine-preventable diseases (VPDs) including polio and measles in the area. Aiming to immunize children under five against ten life-threatening diseases—including polio, measles, diphtheria, pertussis, tetanus, hepatitis B, Haemophilus influenzae type b (Hib), pneumococcal illness, rotavirus, and tuberculosis—EPI in Pakistan

Although national-level vaccination rates have gotten better, notable regional differences remain. The ongoing reporting of polio cases in Peshawar, despite worldwide eradication efforts, highlights the need for local studies examining vaccination coverage and its direct link to disease incidence. There are, however, few thorough community-based studies done in Peshawar evaluating both coverage and practical health results.

This study is to assess vaccination coverage in Peshawar and investigate its correlation with the occurrence of common infectious illnesses among children under five. The results can support customized public health actions and improve vaccination plans in this high-risk area.

Methodology

Study Design and Setting

A community-based cross-sectional study was conducted from January to June 2024 across selected urban, semi-urban, and peri-urban localities in Peshawar. The design employed stratified random sampling to ensure inclusion from diverse socioeconomic and geographic areas.

Sampling Frame and Participants

The sampling frame was constructed using local administrative records, with Union Councils categorized by the District Health Office. Within each stratum, clusters were randomly selected. Households with at least one child aged 0–5 years were approached through door-to-door visits. Written informed consent was obtained from caregivers, preferably mothers.

Data Collection Tools

Data were collected using a structured questionnaire adapted from the WHO Immunization Coverage Cluster Survey Manual (5). It comprised five sections:

1. **Demographics**: Age and gender of child, parental education, occupation, household income, and number of children.
2. **Vaccination Records**: Verified via EPI cards and supplemented by caregiver recall.
3. **Healthcare Access**: Distance to health facility, vaccine availability, and frequency of visits.
4. **Knowledge and Attitudes**: Caregiver understanding of immunization, beliefs, and information sources.
5. **Health Outcomes**: Incidence of six infectious diseases in the past 12 months — measles, polio, diarrhea, pneumonia, hepatitis B, and tuberculosis.

Variables Measured

- **Dependent Variables**: Disease incidence (binary per disease).
- **Independent Variables**: Vaccination status (full, partial, none), maternal education, income, proximity to healthcare, and caregiver knowledge score.

Statistical Analysis

Data were analyzed using SPSS version 26. Descriptive statistics summarized demographics and vaccination coverage. Associations between categorical variables were assessed using chi-square tests. Logistic regression models were used to adjust for confounders. A p-value <0.05 was considered statistically significant.

Results

Table 1: Vaccination Coverage by Area (n = 800)

Vaccination Status	Urban (%)	Peri-Urban (%)	Semi-Urban (%)	Total (n)	Total (%)
Fully Vaccinated	71.2%	58.4%	49.6%	500	62.5%
Partially Vaccinated	18.3%	26.7%	32.1%	192	24.0%
Not Vaccinated	10.5%	14.9%	18.3%	108	13.5%

Table 2: Demographic Characteristics of Participants

Variable	Category	Value
Mean Age of Children		2.3 years (SD: 1.6)
Gender Distribution	Male / Female	51.2% / 48.8%
Maternal Education Level	Illiterate / Primary / Secondary+	42% / 29% / 29%

Avg. Monthly Household Income		PKR 28,500
Households Below Poverty Line		41%
Access to Health Facility	Within 5 km	67%

Table 3: Incidence of Infectious Diseases (Past 12 Months)

Disease	Number of Cases (n)	Percentage (%)
Measles	65	8.1%
Polio	4	0.5%
Diarrhea (frequent)	187	23.4%
Pneumonia	90	11.3%
Hepatitis B	23	2.9%
Suspected TB	14	1.8%

Table 4: Association Between Vaccination Status and Disease Incidence

Disease	Comparison Group	Odds Ratio (OR)	95% CI	p-value
Measles	Unvaccinated vs. Fully Vaccinated	5.8	3.2 – 10.6	<0.001
Diarrhea	Partially Vaccinated vs. Fully	2.1	1.4 – 3.0	0.002
Pneumonia	Fully Vaccinated vs. Not Vaccinated	0.6	0.4 – 0.9	0.030
Hepatitis B	Fully Vaccinated vs. Not Vaccinated	0.4	0.2 – 0.9	0.010

Table 5: Predictors of Full Vaccination (Multivariate Analysis)

Factor	Odds Ratio (OR)	95% CI	p-value
Maternal Education ≥ Secondary	2.3	1.5 – 3.4	<0.01
Household Income > Median	1.7	1.1 – 2.7	0.020
Proximity (<5 km) to Health Facility	1.9	1.3 – 2.8	0.004

Discussion

This paper draws attention to notable vaccination deficiencies in Peshawar. A number lower than Pakistan's national average of 75% stated by UNICEF (6), almost 38% of children under five were either not fully vaccinated or totally unvaccinated. The close correlations between inadequate vaccination and rising disease incidence revealed in this study fit with worldwide research (7,8), therefore underlining the preventive impact of total immunization.

Among the biggest predictors of inadequate immunization were low maternal education, financial difficulties, and faraway health services. These results support research from urban and rural areas of Pakistan, where maternal literacy regularly improves child health markers (9,10). Access to immunization services is still limited because of economic constraints and inadequate infrastructure (11, 12).

Though the prevalence of polio was low at 0.5%, it is still a major issue. Along with Afghanistan, Pakistan is among the few nations still home to wild poliovirus (13). This underlines the importance of constant monitoring and focused vaccination efforts, particularly in areas vulnerable to war such as KP.

Though not statistically assessed, vaccine hesitancy appeared anecdotally throughout interviews. Caregivers mentioned religious misunderstandings, vaccine source distrust, and infertility-related rumors—concerns reflected in other area research (14,15). Although this study did not measure vaccine hesitancy, qualitative analysis conducted throughout data gathering suggests it is still a major obstacle. Building trust calls for public health initiatives to include culturally relevant educational campaigns including religious and community leaders.

Policy solutions could be financial incentives such conditional cash transfers, integration of EPI into maternal and child health initiatives, and mobile outreach teams for distant locations. Improving both supply dependability and disease surveillance could be achieved by strengthening cold chain logistics and real-time monitoring (16).

Conclusion

With notable effects on childhood health, vaccination coverage in Peshawar stays below ideal levels. The study verifies that under-vaccination is closely related to more preventable disease rates. Important obstacles are low maternal education, poverty, restricted access to health treatments, and ongoing misinformation. To meet these difficulties and enhance immunization results in this high-priority area, focused, community-sensitive policies are absolutely necessary.

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