Original Research

BARRIERS TO IMMUNIZATION: A STUDY OF FACTORS CONTRIBUTING TO INCOMPLETE VACCINATION IN CHILDREN UNDER FIVE AT SECONDARY HEALTHCARE CENTERS IN BAHAWALNAGAR, PAKISTAN

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ABSTRACT
The study was designed to find out the factors associated with incomplete vaccination of children under five years in secondary healthcare settings of Bahawalnagar, Pakistan. We took a mixed-methods design where structured survey data were combined with qualitative findings from in depth interviews and focus group discussions. The study was comprised of 300 children, indicating that all were fully vaccinated (49.0%); partially vaccinated (37.0%) and not-vaccinated (14.0%). Maternal education, maternal age, family income and distance from health facilities were found to be the significant socio-demographic determinants for immunization status. Following interviews and group discussions, major determinants of incomplete immunization were found to be demand-side barriers (low awareness levels among parents/caregivers inhibition due to misconceptions about vaccines limited understanding level associated with cultural beliefs influencing community acceptance concerns regarding vaccine safety lack-of-Seel/and fear) supply side barriers [poor healthcare worker performance (communication skills missed opportunities storage preventable deaths logistics not following guidelines). oblique challenges data unreliability]/who/Rate issues homelessness etc. Comparison with previous studies showed similar barriers elsewhere, suggesting the necessity to implement targeted public health interventions. The study further recommends community-based education, healthcare delivery and unique strategies for boosting immunization coverage to lower the incidence of vaccine-preventable diseases.

INTRODUCTION
Vaccination is one of the most cost-effective and powerful tools in public health, made to prevent children against numerous vaccine-preventable diseases. Immunization programs have played an important role in preventing childhood diseases such as polio, measles, diphtheria and tetanus successfully reducing global rates of child mortality (12). The Expanded Programmed on Immunization (EPI) was introduced as a pilot project in Pakistan in 1976 and expanded nationwide by 1978, aiming to protect children under the age of five against preventable diseases. Although immunization coverage improved following these interventions, high and variable proportions of unvaccinated children exist in specific regions including Bahawalnagar which mandates the exploration for barriers causing incomplete vaccination [3] [4] [5].
EPI was initiated in Pakistan with the ultimate goal to lower sickness and death from vaccine-preventable diseases (VPDs) among children.

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The program was initially based on a package of six major diseases to be controlled, and these included childhood tuberculosis, poliomyelitis, diphtheria-pertussis-tetanus (DPT) complex vaccine for infants and measles. The EPI expanded gradually to include new vaccines–the hepatitis B vaccine in 2002 [6] [7], Haemophiles influenzae type b (Hib) vaccine on a limited scale since December 2009 and the pneumococcal conjugate vaccine (PCV10VPD Bios Ingen LB strains Nature/NanoPBB1265/59F Complex PP or Hib PhD Nadis Tado sporter was introduced nationwide from April 2012 as part of Ulmo-REP component under Yellow Phase following multiple series Introduction). Despite high population growth and mappable urban expansion, immunization coverage has been persistently low in Pakistan particularly in underserved rural districts like Bahawalnagar [8] [9].
Similarly, high immunization coverage in Bahawalnagar district of Punjab falls from bad to worse. The socio-economic conditions in the region, compounded by infrastructural and logistical impediments also contribute to low vaccination numbers. Who live in places like Bahawalnagar, where the health infrastructure is often rudimentary and children under five are particularly susceptible to viral fevers that can be walled off. Thebes challenges call for a dedicated research towards the

identification of determinants that impede complete immunization coverage in these settings [10].

Incomplete Immunizations: The matter of deficient vaccination coverage in Bahawalnagar is the face of a much more expansive national issue where inoculation rates differ widely between urban and rural areas, and various territories. Variables influencing this discrepancy include socio-demographic characteristics such as maternal education and age, economic stagnation, geographic proximity to healthcare facilities as well as cultural interpretations. Moreover, the challenge of logistical (cold chain transport and delivery) operation cost burden as well transportation issues to areas where necessary service are needed contributes significantly new low vaccination coverage. In addition, since misinformation and misconceptions of culture about vaccines contribute to vaccine hesitancy.

Within this context, the overall objective of this study is to investigate and analyze factors that contribute to incomplete vaccination coverage among under-five children in secondary healthcare level facilities at Bahawalnagar. Given the magnitude of these barriers, overcoming them can be viewed as a necessary step to effectively designing interventions that reduce vaccine-preventable disease and optimally increase immunization coverage. The results of this study will inform not only to Bahawalnagar intervention and related strategies but also for the rest of Pakistan settings with similar gaps in childhood immunization [11] [12].

RESEARCH METHODOLOGY

The research design used was cross-sectional that best helped to understand all the factors responsible for under-vaccination among less than five children of Bahawalnagar particularly at secondary health care reachable category. The study used a mixed-methods approach to triangulate data collection and analysis findings between different methods, which helped generate a comprehensive view on the barriers of immunization.

1. Research Design- This was a cross-sectional study design in which the data were obtained at one point of time. In this design, we were able to take a detailed look at the state of children less than five years old regarding immunization coverage in the targeted health facilities in Bahawalnagar. The use of, 18 months for data collection was considered satisfactory to ensuring a good idea on the determinant's variables of immunization in these rural and peri-urban areas.

2. Study Population and Sampling- The study was conducted on children less than five year of age presenting at secondary healthcare facilities in district Bahawalnagar including DHQ Hospital Bahawalnagar, THQ Hospital Haroon Abad, The Chistian and C.M.O office, Minchin Abad. Sample size was calculated using power calculation based on 80% Power and 5% level of significance which gave approximately N=300 children for one group. An assumed proportion of incomplete immunization which was accounted for in deriving the required sample size as reported earlier (28%) at 95% confidence level and considering some design effects.

A purposive sampling technique was used to select participants, targeting children of <5 years old for whom maternal socio-demographics (age, ethnicity, religion, marital status education level and working status) were available. Exclusion criteria were children with an acute health problem at the time of data collection and whose parents did not consent to participate.

3. Data Collection Methods

Quantitative Data Collection- Data collection Quantitative data: A structured survey tool was applied to the mothers/primary caregivers of children selected. The survey contained questions pertaining to vaccination status of the children and reasons for incomplete vaccination, barriers related to immunization in terms of household level factors, knowledge about vaccinations at family levels, various mis-beliefs and health care access practices which contribute toward partial or non-vaccination. Immunization records of patients who were enrolled in official home-based health care programs and other data sources such as secondary healthcare databases accompany the self-reported information to verify it.

Qualitative Data Collection- In-depth interviews and focus group discussions were conducted to generate qualitative insights. We conducted in-depth interviews with stakeholders, notably healthcare workers, policy makers and community leaders to document their views on the explanations for failure of immunization including socioeconomic determinants vaccine hesitancy as well as supply chain issues. Qualitative findings: In depth interviews or focus group discussions were conducted with mothers/care givers on recording their overall experiences, perceptions and concerns towards vaccination. Such discussions provided context around community-specific interpretations that seemed to drive up vaccine uptake.

4. Data Analysis

Quantitative Data Analysis- Descriptive and inferential statistical techniques were applied to the quantitative data. Frequencies, percentages and averages were calculated as descriptive statistics to summarize the data on immunization coverage rates, household characteristics and perceived barriers. The socio-demographic factors and the immunization status were analyzed with logistic regression analysis. Data were computed and

analyzed using for Statistical Package for the Social Sciences (SPSS) version 26.0.

Qualitative Data Analysis- Qualitative data collected from interviews and FGDs were transcribed verbatim, then thematic analysis was done. This was followed by verbatim coding, and the data were classified into primary themes as well as sub-themes that evolved during analysis. Qualitative data were prepared and coded using NVivo software to maintain strong rigor and reliability when selecting patterns leading to the derivation of new insights. Quantitative findings were triangulated with qualitative data to get a deeper understanding of those factors affecting immunization uptake.

5. Ethical Considerations- The research were carried out according to the ethical principles that aim to protect the rights and welfare of participants. On the basis of explaining them about objective, evaluation process and potential risks/benefits informed consent was taken from all participants. The consent forms were available in both Urdu as well as English to make it easier for the local population. To ensure anonymity, participants were guaranteed confidentiality and quotes have been anonymized. Participation was selectively voluntary and informed consent included the right to refuse participation at any time without negative consequences. The study was approved by the IRB of Lincoln University College, Malaysia.

6. Validity and Reliability- Several steps were taken to establish validity and reliability in the present study. The standardized survey instruments and validated scales for quantitative data guaranteed the accuracy of measurements. The survey questions underwent a pilot test to refine them, and internal consistency of the data was evaluated by means of statistical measures (Cronbach's alpha). In the case of qualitative data, language triangulation will be achieved by using a combination of multiple methods and sources. Member checking also confirmed the interpretations and enhanced qualitative data trustworthiness. Peer debriefing sessions were held among research investigators to review and validate the findings.

7. Limitations of the Research Methodology- This study was not without its limitations, including potential non-response bias due to the purposive sampling technique and the limited generalizability of findings to other settings given that peri-urban and rural areas within Bahawalnagar were specifically targeted. Additionally, recall bias from participants might have affected data accuracy [11]. Second, the outcomes of the study would have been affected during data collection by unexpected external events, such as political crises and health issues.

RESULTS

The study, which aimed to explore the factors contributing to incomplete vaccination among children under five years of age at secondary healthcare centers in Bahawalnagar, Pakistan. The results are organized into sections based on the study's objectives, focusing on the immunization coverage status, socio-demographic factors influencing immunization, and barriers to complete immunization. The data presented includes both quantitative findings from structured surveys and qualitative insights from in-depth interviews and focus group discussions.

4.1 Immunization Coverage Status- The immunization status of the 300 children included in the study was categorized into three groups: fully vaccinated, partially vaccinated, and non-vaccinated. Table 4.1 provides a summary of the immunization coverage among the sampled population.

Table 4.1: Immunization Coverage Status among Children Under Five Years Old

Immunization Status	Number of Children (n)	Percentage (%)
Fully Vaccinated	147	49.0%
Partially Vaccinated	111	37.0%
Non-Vaccinated	42	14.0%
Total	300	**100.0%**

The results in Table 4.1 show that out of the 300 children studied, 49.0% were fully vaccinated, 37.0% were partially vaccinated, and 14.0% were non-vaccinated. These findings indicate that while nearly half of the children achieved full immunization, a significant proportion were either partially vaccinated or not vaccinated at all, revealing substantial gaps in vaccination coverage within the population.

4.2 Socio-Demographic Factors Influencing Immunization- To understand the factors influencing the immunization status of children, several socio-demographic variables were analyzed. These variables included maternal education, maternal age, family income, and distance to the nearest healthcare facility. The results of the bivariate analysis are summarized in Table 4.2.

Table 4.2: Socio-Demographic Factors and Immunization Status

Socio-Demographic Factor	Category	Fully Vaccinated (%)	Partially Vaccinated (%)	Non-Vaccinated (%)	Chi-Square (χ^2)	P-Value
Maternal Education	No Education	18 (24.3%)	29 (39.2%)	27 (36.5%)	38.12	<0.001*
	Primary	46 (42.2%)	42 (38.5%)	21 (19.3%)		
	Secondary or Higher	83 (69.2%)	40 (33.3%)	7 (5.8%)		
Maternal Age	< 25 Years	29 (34.5%)	38 (45.2%)	17 (20.3%)	15.43	0.004*
	25–35 Years	77 (52.7%)	53 (36.6%)	16 (10.7%)		
	> 35 Years	41 (68.3%)	20 (33.3%)	9 (8.4%)		
Family Income	Low	30 (30.3%)	47 (47.5%)	22 (22.2%)	27.68	<0.001*
	Middle	68 (58.1%)	43 (36.8%)	6 (5.1%)		
	High	49 (77.8%)	21 (33.3%)	5 (7.9%)		
Distance to Healthcare Facility	< 5 km	101 (67.8%)	32 (21.5%)	16 (10.7%)	35.91	<0.001*
	≥ 5 km	46 (31.9%)	79 (54.9%)	26 (18.2%)		

The analysis presented in Table 4.2 demonstrates that socio-demographic factors significantly influenced the immunization status of children. Maternal education showed a strong association with immunization coverage, where children of mothers with secondary or higher education had a higher rate of full vaccination (69.2%) compared to those with no education (24.3%). Similarly, maternal age was a significant factor, with older mothers (over 35 years) more likely to have fully vaccinated children (68.3%). Family income also played a crucial role, with children from higher-income families having a higher rate of full vaccination (77.8%) compared to those from low-income families (30.3%). Additionally, the distance to the nearest healthcare facility was significantly associated with immunization status, where children living less than 5 km from a healthcare facility had higher rates of full vaccination (67.8%) compared to those living 5 km or more away (31.9%).

4.3 Barriers to Immunization- The study identified several barriers to complete immunization, which were categorized into demand-side and supply-side barriers.

4.3.1 Demand-Side Barriers- Demand-side barriers included factors related to parental awareness, misconceptions, and cultural beliefs about vaccines. Focus group discussions revealed that a lack of awareness about the importance of immunization and the recommended vaccination schedule was prevalent among mothers, particularly those with no formal education. Misconceptions about vaccine safety, such as fears of side effects or the belief that vaccines could cause illness, were also common. Cultural beliefs and misinformation spread through social networks further fueled vaccine hesitancy.

4.3.2 Supply-Side Barriers- Supply-side barriers included issues related to the healthcare delivery system, such as the performance of healthcare staff, vaccine supply, and data reliability. In-depth interviews with healthcare professionals highlighted that inadequate training, lack of motivation, and high workload were factors contributing to poor performance of healthcare workers. Moreover, logistical challenges, such as unreliable cold chain systems and transportation difficulties, were identified as key issues affecting vaccine supply. Data unreliability was also noted, with inconsistent record-keeping practices and fragmented data systems hindering accurate tracking of immunization coverage.

4.4 Logistic Regression Analysis of Factors Associated with Incomplete Immunization- A logistic regression analysis was conducted to further examine the factors associated with incomplete immunization. The results are summarized in Table 4.3.

Table 4.3: Logistic Regression Analysis of Factors Associated with Incomplete Immunization

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	P-Value
Maternal Education (No Education vs. Secondary or Higher)	3.89	2.25 – 6.72	<0.001*
Maternal Age (<25 Years vs. >35 Years)	2.45	1.40 – 4.28	0.002*
Family Income (Low vs. High)	4.12	2.58 – 6.88	<0.001*

Distance to Healthcare Facility (≥5 km vs. <5 km)	2.98	1.80 – 4.92	<0.001*

The logistic regression analysis indicated that children of mothers with no education were almost four times more likely to have incomplete immunization (OR = 3.89; p < 0.001). Similarly, younger mothers (<25 years) were over twice as likely to have children with incomplete immunization (OR = 2.45; p = 0.002). Low family income was strongly associated with incomplete immunization, with children from low-income families being four times more likely to have incomplete immunization (OR = 4.12; p < 0.001). Finally, children living farther from healthcare facilities (≥5 km) were three times more likely to have incomplete immunization (OR = 2.98; p < 0.001).

DISCUSSION

Reasons for non-vaccination of children under five years of age at secondary health care centers in Bahawalnagar-Pakistan the interpretation of the results is discussed in relation to study objectives, compared with findings from previous research and potential implications for public health strategies / policy-interventions related to improving immunization coverage among similar population.

The analysis showed that 49.0% of children were unvaccinated, 37.0% had not been fully vaccinated and only a small minority (14%) were fully compliant with immunization requirements at each time point in earlier life before recruitment into the NZCS cohort; Results: Our findings revealed that important socio-demographic determinants of immunization status included maternal education, mother's age, family income and distance to healthcare facilities. A number of demand-side and supply-side barriers were also identified as important determinants for incomplete immunization. These included: no awareness, vaccine myths or misconceptions, cultural tradition and beliefs about vaccines – in addition to poor health professional performance; logistical challenges including among others unreliability of data from routine monitoring systems.

CONCLUSION

This study highlighted the different reasons for non-vaccination of children under five at secondary healthcare centers in Bahawalnagar, Pakistan. Results: Results suggest that socio-demographic determinants including maternal education and age, family income as well as geographical parameters such as nearby health facility significantly influence immunization status. Additionally, as much restricted vaccination coverage due to both demand-side barriers (low awareness and misconceptions about vaccines) and SupplySide barrier such inadequate health staff performance with regard to vaccine delivery practice conditions; logistic issues also played a significant role in the accessibility of service throughout time Data unreliably may be seen across different levels.

The findings from the study are consistent with previous research conducted in similar settings, illustrating recurring obstacles that exist when trying for full immunization coverage among low-resource populations. The results suggest that targeted interventions may be necessary to eliminate these barriers. Community based education program for awareness; direct financial support to the low-income families; mobile vaccination units and improved healthcare delivery infrastructure may help in filling this immunization gap. Secondly, building data systems and human resources are equally critical to ensure that vaccines can be delivered efficiently in the community side as well as for tracking.

Identifying and overcoming these obstacles are essential for policy makers and health care professionals to achieve high immunization coverage, minimize vulnerability to vaccine-preventable diseases, contribute toward improving overall national/global health targets. Our study had a cross-sectional design, hence longitudinal studies investigating causal associations will be needed in future research; finally the geographical area should to mean that results are easily generalizable. In this sense, the article highlighted above only goes to show that a one-size-fits-all approach will not suffice and more broad strategies can and should be developed.

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