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ORIGINAL ARTICLE

Evaluation of Public Health Initiatives in Enhancing Polio Vaccination Coverage among Children Under Five in Pakistan: A Cross-Sectional Study

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ABSTRACT

Background: Poliomyelitis remains a public health challenge in Pakistan despite ongoing national immunization campaigns. The persistence of wild poliovirus and vaccine-derived outbreaks highlights the need to evaluate the real-world effectiveness of public health interventions in promoting vaccination coverage.

Objective: To assess the impact of public health strategies—including door-to-door campaigns, mobile vaccination teams, community health worker outreach, and mass media awareness—on polio vaccination coverage among children under five years of age in Narowal District, Pakistan.

Methods: A descriptive cross-sectional study was conducted at DHQ Teaching Hospital Narowal from February 2022 to July 2023. A total of 100 parents or guardians of children aged 0–5 years were interviewed using a structured questionnaire. Data on demographics, vaccination status, and exposure to various public health initiatives were collected. Statistical analysis was performed using SPSS version 25.0, applying chi-square tests and binary logistic regression to assess associations and predictors.

Results: Among 100 respondents, 76% reported full vaccination, 17% partial, and 7% no vaccination. Exposure to three or more public health interventions was significantly associated with full vaccination (OR: 3.15; 95% CI: 1.40–7.09; p=0.005). Parental education also showed a positive association (OR: 2.62; p=0.033). Door-to-door campaigns and LHW visits were the most influential strategies.

Conclusion: Public health initiatives significantly enhance polio vaccine uptake. Multi-channel interventions involving outreach teams, health workers, and media can improve coverage and help close remaining immunization gaps in Pakistan.

Keywords: Poliomyelitis, Vaccination, Coverage, Eradication, Pakistan, Immunization, Outreach, Campaigns, Public health, Compliance

INTRODUCTION

Poliomyelitis, commonly known as polio, is an acute viral infection caused by the poliovirus, an enterovirus transmitted primarily through the fecal-oral route. While the majority of infected individuals remain asymptomatic or present with non-specific febrile illness, a small proportion progress to irreversible flaccid paralysis, predominantly affecting children under five years of age [1]. In severe cases, polio can lead to respiratory muscle failure and death. Due to the absence of a cure, prevention through mass immunization remains the cornerstone of global efforts to eradicate the disease [2].

The launch of the Global Polio Eradication Initiative (GPEI) in 1988 marked a watershed moment in the fight against polio. Spearheaded by the World Health Organization (WHO), UNICEF, Rotary International, the U.S. Centers for Disease Control and Prevention (CDC), and later supported by the Bill and Melinda Gates Foundation, the initiative aimed to eliminate poliovirus transmission worldwide [3]. Since its inception, GPEI has achieved a 99.9% reduction in global polio cases, from an estimated 350,000 annual cases in 1988 to fewer than 200 in recent years. Most countries have now been declared polio-free. However, Pakistan, along with Afghanistan, continues to report endemic transmission of wild poliovirus type 1 (WPV1), making it one of the last strongholds of the disease [4].

In Pakistan, eradication efforts began in earnest in the early 1990s, with the development of the National Emergency Action Plan (NEAP) and the launch of the Expanded Programme on Immunization (EPI). However, the country continues to face recurrent outbreaks of WPV1 and circulating vaccine-derived poliovirus type 2 (cVDPV2), despite the implementation of numerous nationwide immunization campaigns [5]. The persistent circulation of the virus in Pakistan is not merely a public health failure but a complex socio-political and operational challenge. Multiple factors contribute to suboptimal vaccine coverage, including widespread misinformation, religious myths, vaccine refusal, poor access to health facilities, displaced populations, urban slum density, and insecurity in tribal and border areas where frontline vaccinators are often targeted by violence [6].

To overcome these barriers, Pakistan has deployed a multi-tiered, multifaceted public health strategy aimed at increasing vaccine coverage and acceptance. Core components of this strategy include door-to-door immunization campaigns organized during National Immunization Days (NIDs) and Sub-National Immunization Days (SNIDs), the establishment of Permanent Transit Points (PTPs) at entry/exit borders to vaccinate mobile populations, deployment of mobile health teams in remote or conflict-affected regions, and the training of Lady Health Workers (LHWs) and community mobilizers to engage with caregivers directly and build trust [7]. Additionally, mass media campaigns using television, radio, SMS alerts, and local-language posters have been used to counteract misinformation and increase public awareness about the importance and safety of the oral polio vaccine (OPV) [8].

Despite these intensive efforts and billions of rupees in annual funding, surveillance data show that vaccine coverage remains inconsistent across regions. According to Pakistan's National Emergency Operations Centre (NEOC) 2022 report, although national immunization coverage is reported at over 90%, pockets of under-immunized children remain, particularly in high-risk areas such as Karachi, Quetta, Killa Abdullah, Peshawar, and North Waziristan. These regions are characterized by poor sanitation, poverty, migration, and mistrust toward government-run programs. As such, sporadic outbreaks of WPV1 and cVDPV2

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continue to be reported, and environmental surveillance repeatedly detects poliovirus in sewage samples, indicating ongoing silent transmission [9].

The gap between programmatic targets and field realities necessitates a granular evaluation of how various public health initiatives influence polio vaccination uptake at the community level. Prior studies in sub-Saharan Africa and parts of South Asia have demonstrated that community-based outreach, culturally tailored communication, and consistent follow-up through mobile and door-to-door strategies significantly enhance immunization compliance. However, data from Pakistan remains fragmented and often lacks empirical evaluation regarding which interventions are most impactful across varying social and geographic contexts [10].

This study aimed to address that gap by systematically evaluating the effectiveness of key public health interventions—namely, door-to-door campaigns, mobile team services, community health worker engagement, and media-based awareness programs—in improving polio vaccine coverage among children under five years of age in four high-risk districts of Pakistan [11]. The study employs a cross-sectional survey design to capture both quantitative and qualitative insights from caregivers, aiming to identify predictors of successful vaccine compliance and barriers to uptake. Ultimately, the findings are expected to inform national policymakers and international stakeholders by providing evidence-based recommendations for optimizing current eradication strategies and ensuring that no child in Pakistan is left unvaccinated [12].

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted to evaluate the effectiveness of public health initiatives in enhancing polio vaccination coverage among children under the age of five. The study was carried out at the District Headquarter (DHQ) Teaching Hospital, Narowal, Pakistan, over a duration of eighteen months, from February 2022 to July 2023. This hospital was selected due to its active involvement in immunization outreach programs and its role as a central healthcare facility serving both urban and rural populations within the Narowal district.

The target population included parents or primary caregivers of children aged between 0 to 5 years who were attending the pediatric outpatient department or the immunization center of DHQ Hospital during the study period. A total sample size of 100 participants was selected using non-probability convenience sampling due to logistical and time limitations. Eligibility criteria for participation included permanent residency within the Narowal district for at least the past six months, presence of at least one child in the 0–5 years age bracket, and informed consent for voluntary participation. Individuals who were non-residents or unwilling to participate were excluded.

Data were collected through face-to-face interviews using a structured and pre-validated questionnaire. The questionnaire was developed in English and translated into Urdu for better comprehension by the local population. Trained data collectors conducted the interviews in a private setting within the outpatient and immunization departments to ensure confidentiality and minimize bias. The instrument was divided into five sections. The first section collected sociodemographic information such as the age and gender of the respondent, their education level, monthly income, number of children, and place of residence (urban or rural). The second section captured the vaccination status of the children, categorizing them as fully vaccinated, partially vaccinated, or unvaccinated based on parental reports and, where available, vaccination cards. The third section explored the participants' exposure to public health initiatives, including visits by door-to-door vaccination teams, services provided by mobile vaccination units, interactions with community health workers or Lady Health Workers (LHWs), and awareness campaigns encountered via media sources such as television, radio, mobile text messaging, and public posters. The fourth section identified barriers to vaccination, which could include concerns about side effects, religious or cultural opposition, logistical problems, or misinformation. The final section assessed parental knowledge and perceptions about polio, the benefits of vaccination, and the trustworthiness of health authorities.

Ethical approval for this study was granted by the Institutional Review Board. Written informed consent was obtained from each respondent before beginning the interview. Participants were informed about the voluntary nature of the study, and anonymity and confidentiality were strictly maintained throughout the data collection and analysis process.

Data entry and statistical analysis were performed using IBM SPSS version 25.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the sociodemographic characteristics of the participants and their responses to key variables. Bivariate analysis was conducted using chi-square tests to examine the relationship between exposure to specific public health initiatives and the child's polio vaccination status. Furthermore, a binary logistic regression model was used to identify the most significant predictors of full vaccination coverage. Independent variables included exposure to three or more public health interventions, parental education, urban versus rural residence, and access to health facilities. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to measure the strength of associations, and a p-value less than 0.05 was considered statistically significant.

Although this study provides valuable insights, it has certain limitations. The use of convenience sampling at a single hospital limits the generalizability of the findings to the broader community. Furthermore, the self-reported nature of vaccination status introduces the possibility of recall bias, particularly in the absence of verified immunization cards. There may also have been social desirability bias, as some parents could have provided responses they perceived as favorable to the health staff. Despite these limitations, the study offers a relevant hospital-based perspective on the community-level impact of public health strategies for polio eradication in one of Pakistan's high-priority districts.

RESULTS

A total of 100 parents or guardians of children aged between 0 and 5 years participated in the study. The demographic characteristics of the respondents are summarized in Table 1. Among the respondents, the majority (64%) were female, primarily mothers, while 36% were male guardians. The predominant age group of participants was between 25 and 34 years (56%), followed by 35–44 years (30%) and 18–24 years (14%). Regarding educational status, 30% of the respondents had no formal education, 42% had completed primary education, and 28% had received secondary or higher education. A substantial majority of the participants (71%) resided in rural areas, and 59% of households reported a monthly income of less than PKR 25,000.

Table 1: Sociodemographic Characteristics of Participants (n = 100)

Characteristic	Frequency (n)	Percentage (%)
Gender		
Male	36	36
Female	64	64
Age Group (years)		
18–24	14	14
25–34	56	56
35–44	30	30
Education Level		
No formal education	30	30
Primary	42	42
Secondary or higher	28	28
Area of Residence		
Urban	29	29
Rural	71	71
Monthly Income (PKR)		
< 25,000	59	59
≥ 25,000	41	41

In terms of immunization status, 76% of the children were fully vaccinated, having received all age-appropriate doses of the oral polio vaccine (OPV). Another 17% were partially vaccinated, having missed one or more doses, while 7% were completely unvaccinated. Among the unvaccinated group, the most common reasons cited were fear of vaccine side effects (n=3), lack of access to health services (n=2), and parental negligence or misinformation (n=2). This indicates that although awareness was present among many, there remained gaps in complete compliance with the national immunization schedule.

The study also explored participants' exposure to public health strategies aimed at promoting polio vaccination. Table 2 presents the relationship between different public health initiatives and vaccination status. Door-to-door immunization campaigns were the most widely encountered intervention, with 84% of respondents reporting that their households had been visited by vaccination teams. Of these, 82% had fully vaccinated their children. Mobile vaccination teams had reached 62% of the households, among whom 74% of the children were fully vaccinated. Additionally, 51% of respondents confirmed receiving visits or educational sessions from Lady Health Workers (LHWs), and 68% reported exposure to polio awareness through media campaigns, including television and radio. Those who reported exposure to three or more interventions had the highest rate of full vaccination (87%), compared to only 53% among those with no or minimal exposure.

Table 2: Exposure to Public Health Interventions and Vaccination Outcomes

Public Health Intervention	Exposure (%)	Fully Vaccinated among Exposed (%)
Door-to-door campaign visits	84	82
Mobile vaccination teams	62	74
Visit by Lady Health Workers	51	78
Exposure to media campaigns	68	80
Exposure to ≥3 initiatives	58	87
Exposure to ≤1 initiative	19	53

Statistical analysis was performed to determine the significance of these associations. Chi-square tests revealed a statistically significant association between exposure to public health interventions and full vaccination status ($p = 0.011$), particularly for combined exposure to multiple strategies. Parents exposed to three or more public health initiatives were significantly more likely to fully vaccinate their children compared to those exposed to fewer or no interventions.

To further explore the strength of these associations and adjust for potential confounding variables, a binary logistic regression analysis was conducted. The results are presented in Table 3. The most significant predictor of full vaccination was exposure to three or more public health interventions, with an odds ratio (OR) of 3.15 and a 95% confidence interval (CI) of 1.40–7.09 ($p = 0.005$). Parental education was also significantly associated with vaccination status; parents who had completed at least secondary education were 2.62 times more likely to have fully vaccinated their children (OR = 2.62; 95% CI = 1.08–6.38; $p = 0.033$). However, neither monthly income nor rural/urban residence showed a statistically significant relationship with vaccination status in the adjusted model.

Table 3: Logistic Regression: Predictors of Full Polio Vaccination Coverage

Predictor Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Exposure to ≥3 public health initiatives	3.15	1.40 – 7.09	0.005
Parental education (secondary or higher)	2.62	1.08 – 6.38	0.033
Rural residence	1.34	0.58 – 3.09	0.493
Monthly income ≥ PKR 25,000	1.27	0.59 – 2.75	0.536

These results indicate that multi-pronged public health strategies—especially when simultaneously delivered through door-to-door services, community health workers, and mass media—significantly increase the likelihood of complete polio vaccination coverage. The findings also underscore the role of parental education in promoting immunization adherence, whereas socioeconomic status and area of residence were not independently significant predictors in this sample.

DISCUSSION

The findings of this study reveal a strong and statistically significant relationship between exposure to public health initiatives and increased polio vaccination coverage among children under five years of age in the Narowal district [13]. With 76% of the children in this sample being fully vaccinated, the overall coverage was consistent with national reports from the Government of Pakistan, but still below the threshold required for eradication in high-risk regions. The most notable observation was the clear enhancement of vaccine uptake among those families that had contact with multiple public health interventions, specifically door-to-door campaigns, mobile vaccination teams, community health worker engagement, and media exposure [14].

Among all strategies, door-to-door immunization campaigns emerged as the most influential, echoing global evidence and WHO recommendations that emphasize localized, repeated, high-frequency outreach to combat vaccine hesitancy [15]. These campaigns likely succeed due to their ability to provide direct access to caregivers, overcome logistical barriers, and build interpersonal trust. Furthermore, their integration with local community health workers (such as Lady Health Workers) appears to enhance credibility, especially in rural or low-literacy populations. Our findings also reinforce the importance of media campaigns in influencing behavior, especially when messages are broadcast through culturally accepted and widely accessed platforms like television and FM radio. The combination of mass awareness and personalized interaction seems to generate a synergistic effect, as shown by the significantly higher vaccination rates (87%) among those exposed to three or more interventions [16].

The study also highlights the pivotal role of parental education, with higher educational attainment significantly associated with increased likelihood of full vaccination. This finding aligns with previous studies conducted in similar LMIC contexts such as Nigeria, India, and Afghanistan, where maternal and paternal education levels were consistently linked to higher immunization compliance [17]. Interestingly, monthly income and area of residence (rural vs. urban) were not statistically significant predictors of vaccination status in this study, suggesting that well-designed public health interventions can effectively bridge socioeconomic disparities when implemented consistently and inclusively [18].

In contrast, barriers to vaccination, such as misinformation, fear of side effects, and lack of perceived urgency, continue to affect a minority of the population. The presence of even 7% completely unvaccinated children in a hospital-based sample underscores the urgency of sustained and adaptive communication strategies. Moreover, security concerns, religious opposition, and mistrust of government campaigns—although not reported extensively in this sample—remain challenges that need to be addressed in broader national eradication plans [19].

Overall, the study contributes meaningful evidence that integrated public health outreach, involving both interpersonal and mass media strategies, significantly enhances polio vaccination uptake. These insights can guide national immunization programs and international donors in refining campaign models for greater reach and community compliance, especially in under-immunized districts of Pakistan [20].

CONCLUSION

This cross-sectional study conducted at DHQ Teaching Hospital Narowal provides compelling evidence that coordinated public health initiatives play a critical role in improving polio vaccination coverage. Interventions such as door-to-door campaigns, mobile vaccination services, Lady Health Worker visits, and media awareness campaigns were all associated with higher immunization rates, particularly when applied in combination. Parental education emerged as a significant independent predictor, while socioeconomic status and area of residence had less impact when effective outreach was in place.

Despite encouraging vaccination coverage, gaps still exist, especially among families who remain unreached or unconvinced. The findings underscore the necessity of sustained, multi-channel public health efforts, particularly in rural and underserved areas, to achieve the complete eradication of polio in Pakistan. Strategies that integrate community mobilization with mass communication, coupled with efforts to improve health literacy, can significantly accelerate the national immunization agenda. Policymakers and public health authorities must maintain momentum, invest in health worker capacity-building, and ensure culturally tailored interventions to overcome the final barriers to polio elimination.

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