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Research article

Parental Awareness and Attitude towards Vaccination: A study among Slum Dwellers of Khulna City Corporation, Bangladesh

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ABSTRACT

Childhood immunisation is vital for preventing fatal illnesses, yet disparities remain among urban slum populations in Bangladesh despite the Expanded Programme on Immunisation (EPI). This study examined vaccination prevalence, socio-demographic determinants, and parental knowledge, attitudes, and perceptions toward immunisation in Khulna City Corporation slums. A cross-sectional survey was conducted among parents in selected slum areas using semi-structured questionnaires. Data were analysed through univariate and bivariate methods. Almost half of parents (47.2%) could not identify vaccine names, reflecting a major knowledge gap. Neighbours were the main information source (55.7%), followed by healthcare providers (19.8%) and mobile alerts (11%). Government hospitals were the most common vaccination sites (87.3%). However, 12.7% of under-five children remained unvaccinated. Reported side effects included fever (10.2%), pain (6.4%), and rash (0.9%). Socioeconomic factors strongly influenced vaccination: male children (41.6%) were more likely to be vaccinated than females (14.8%). Higher parental education, marital status, and income were positively associated with uptake. Access to safe water, toilet facilities, and credible information sources further supported vaccination coverage. While immunisation is critical for reducing preventable diseases, gaps in awareness and socioeconomic inequalities hinder full coverage in slum communities. Strengthening education and awareness programs for low-income and less-educated parents, alongside addressing concerns about vaccine side effects, is necessary to improve vaccination uptake in urban Bangladesh.

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Introduction

The study assessed the prevalence of slum dwellers to the children vaccination can be saved from various fatal diseases. In Bangladesh, government has launched Extended Program of Immunization (EPI) against the vaccine curable disease with great enthusiasm. One can be protected from the attack of different virus, bacteria, fungi thus save from disease (Sultana & Hasan, 2020). Vaccination enhanced the internal immune system of human body so that they can resist harmful virus, bacteria Appropriate immunization stop contagious or easily transferring disease by child and adult vaccination improvement in a society from top to bottom (Balbir Singh et al., 2019). In Bangladesh, BCG, DPT, OPV, TT and Measles vaccine have launched by EPI in 1979. By 1984, the EPI coverage remained below two percent primarily because of few vaccinations' facilities, which were primarily concentrated in metropolitan health care facilities (Jahan & Urba, 2015). The People's Republic of Bangladesh initiated a gradual process of increasing the Expanded Programme on Immunization (EPI) from 1985 to 1990, in alignment with the Global Universal Child Immunization Initiative (Islam et al., 2025). During this period, the EPI expanded to cover 476 Upazilas, 92 large Municipalities, and 6 City Corporations (World Health Organization, 2012). Childhood immunisation is one of the most effective public health interventions for preventing fatal illnesses caused by viruses, bacteria, and other pathogens (Farhat, 2024). Vaccination enhances the immune system, reduces the risk of infectious disease transmission, and contributes to broader community health benefits (Akhter et al., 2022).

In Bangladesh, the Expanded Programme on Immunisation (EPI) was launched in 1979 with vaccines including BCG, DPT, OPV, TT, and measles. Initially, coverage remained below 2% due to limited facilities concentrated in urban centers. Between 1985 and 1990, the

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Government of Bangladesh expanded EPI nationwide, aligned with the Global Universal Child Immunisation Initiative. By 1990, immunisation services were available across Upazilas, municipalities, and city corporations, resulting in substantial reductions in infant and child mortality (World Health Organization, 2012). Despite remarkable progress, disparities remain. UNICEF and WHO reported that in 2015 Bangladesh achieved 98% coverage for BCG, 94% for pentavalent (DTP–Hib–HepB) and OPV, and 88% for measles-containing vaccine (Akhter et al., 2022). These rates are higher than many South Asian countries. For example, while over 85% of children in Bhutan and Bangladesh were fully immunised, only 43.6% were in India, despite India being a leading global vaccine producer (Ainul et al., 2017). In South Asia overall, 1.9 million of the 7 million annual newborn deaths in 2015 occurred within the first four weeks of life, many from vaccine-preventable diseases such as measles, which caused over 535,000 global deaths in 2000 alone (Luies et al., 2019). Low vaccination coverage not only endangers child health but also creates significant social and economic burdens. Parental knowledge, attitudes, cultural values, and perceptions strongly influence vaccination decisions and uptake (Huda et al., 2013). Recognising these challenges, the Global Vaccine Action Plan (GVAP) set ambitious targets of achieving 90% national coverage and at least 80% in every district (Hassan, 2022).

Given these global and regional contexts, assessing parental awareness and socio-demographic factors is essential for sustaining progress in childhood immunisation. This study therefore examines vaccination prevalence and associated parental knowledge, attitudes, and perceptions among slum dwellers in Khulna City Corporation, Bangladesh.

Materials and Methods

Methods

This was cross-sectional study design. The purpose of the research is gain insight to assess parental knowledge and attitude of parents about vaccination and measure the prevalence of vaccination and its associated factors. To conduct this study, quantitative method and univariate, bivariate analysis was used. Survey has conducted through a questionnaire. Data have collected through a questionnaire and semi-structured interview to the parents of children who lived in some selected slum areas of Khulna city. Data was analyzed by through SPSS.20. To realize the other objectives of the study data about respective concepts collect through incorporating relevant items (variables) in the questionnaire and analyze and interpret using descriptive techniques.

Study Locations

This research was conducted in the Khulna District, more specifically the Khulna City Corporation. The Khulna City Corporation, which is an elected mayor-led self-governing organization, is responsible for managing the city's affairs. In the jurisdiction of the City Corporation, there are 31 divisions.

Approximately 3.5% of the city's 13% population residing in slum areas are minors at present. As the regional epicenter of the southwestern region of Bangladesh, it is expected that a slum population in the city of Khulna will increase I correlation with the rate of urbanization.

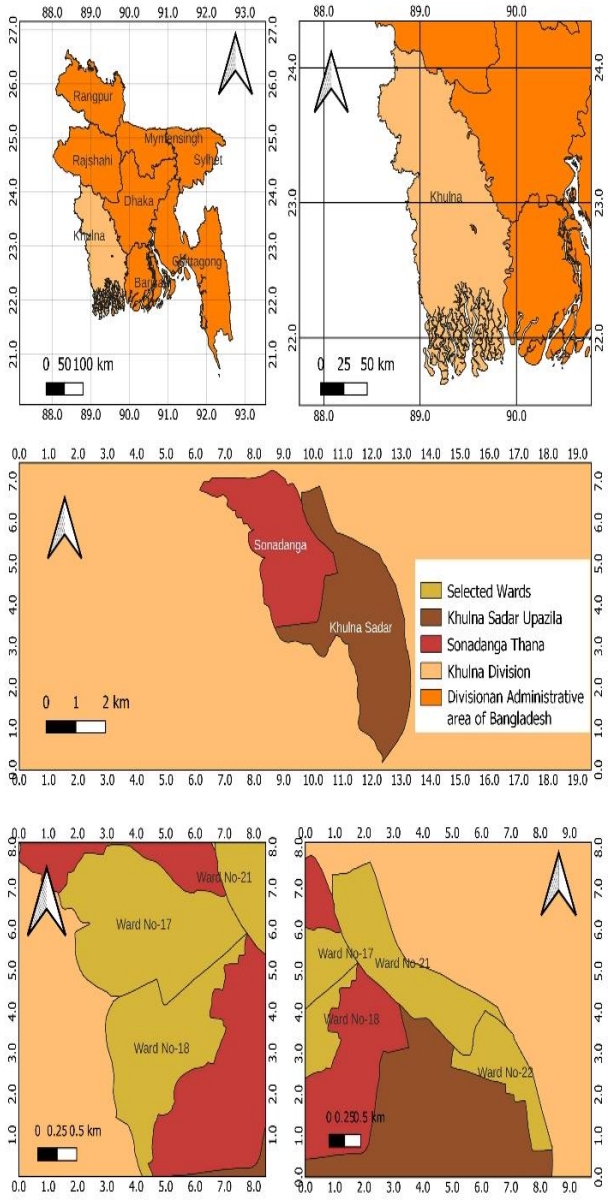

Figure 1: Study area map (Khulna City Corporation)

Study Population

In this study, the population was comprised of slum area from different area at Khulna City. This study used non-probability sampling specifically purposive sampling to select the slum area of Khulna City. Then purposive sampling was used to select the parents of children. The parents of the children with less than five-year age who live in slum areas were semi-structured interviewed.

The sample size of the study will determine by using the formula of Godden. According to Apply formula of (*Sample Size Formulas - Williamgodden.Com / Sample-Size-Formulas-Williamgodden-Com.Pdf / PDF4PRO*, 2018).

$$S = \frac{Z^2\, P(1-P)}{M^2}$$

$$= \frac{(1.96)^2 \times 0.692(1-0.692)}{(0.05)^2}$$

$$= \frac{0.81878}{(0.05)^2}$$

$$= 327.5$$

$$\cong 325\ (Approximately)$$

Here,

S=Sample Size

Z=Standard Normal Deviation 95% Confidence level=1.96

P=Percentage of Population picking a choice, expressed as decimal=6.92%=0.692

M=Margin of error 0.05%=0.050

Data collection

The researcher employed a questionnaire to gather data from children whose parents were involved in the study. The researcher utilized face-to-face interviews. The data collecting measures employed were an interview schedule and interview style. This study has made significant progress in increasing the productivity of data for processing and subsequent interpretation.

Variables in determining results

The independent variables include age, sex, parental educational attainment (categorized as primary level, secondary level, and higher than secondary level), household size, total income, expenditure, media access, parental occupation (day labor, domestic work, housewife, agriculture work, and other work), and religion (Hindu, Muslim, and other religious groups). Dependent variables are immunization situation, prevalence of immunization, participant's level of knowledge, attitude and perception.

Analysis of data

The quantitative data obtained from the structured questions is initially cleaned and coded before being entered into the Statistical Package for Social Sciences (SPSS). The primary analytical methods utilized were basic descriptive statistics and frequencies, which were presented in the form of tables and percentages to explain associations. The study population's background characteristics were compiled using descriptive statistics. The correlation between the dependent and independent variable was determined by univariate, bivariate analysis utilizing cross tables and chi-square tests. The binary logistics regression was performed and statistical significance was determined taking into account the p-value. Adjusted odd ratios (aOR) and 95% confidence intervals.

Table 1: Frequency and Association of Factor Categories with prevalence of vaccination by Socio-demographic and Economic Characteristics

Variables	**Total (%)**	**Status of vaccination**		**Chi-square value**	**P- value**
		Yes	No		
Age of the Respondents				1.671	0.196
Below 25	118 (36.31)	98 (83.05)	20 (16.95)		
Above 25	207 (63.69)	123 (59.42)	84 (40.58)		
Gender				10.148	**<0.001**
Male	132 (40.62)	87 (65.91)	45 (34.09)		
Female	193 (59.38)	137 (70.98)	56 (29.42)		
Marital Status				5.998	**0.050**
Unmarried	59 (18.15)	37 (62.71)	22 (37.29)		
Married	258 (79.38)	156 (60.46)	102 (39.53)		
Divorced/separate	8 (2.46)	5 (62.5)	3 (37.5)		
Religion				9.632	**0.002**
Muslim	250 (76.92)	137 (54.8)	113 (45.2)		
Hindu	49 (15.08)	29(59.18)	20 (40.82)		
Christian	17 (5.23)	9 (52.94)	8 (47.06)		
Other	9 (2.77)	4(44.44)	5 (55.56)		
Level of education				26.020	**<0.001**

No formal education	75 (23.07)	46 (61.33)	29 (38.67)		
Primary	128 (39.38)	99 (77.34)	29 (22.66)		
Secondary	88 (27.08)	42 (47.73)	46 (52.27)		
Higher secondary and above	34 (10.46)	19 (55.88)	15 (44.12)		
Occupation				2.554	0.110
Housewife	134 (41.23)	91 (67.91)	43 (32.09)		
Day labor	91(28.00)	56 (61.54)	35 (38.46)		
Domestic worker	71 (21.85)	52(73.24)	19 (26.76)		
Business	29(8.92)	16 (55.17)	13(44.83)		
Number of household members				5.201	0.074
1–4	267 (82.15)	128 (47.94)	139 (52.06)		
5 or more	58 (17.85)	32 (55.17)	26 (44.83)		
Number of earning members in household				3.390	0.184
1–2	299 (92.00)	158 (52.84)	141 (47.16)		
3 or more	26 (8.00)	19 (73.08)	7 (26.92)		
Monthly household income (in BDT)				2.444	0.118
1,000–5,000	141 (43.38)	87 (61.70)	54 (38.30)		
5,001–10,000	126 (38.77)	79 (62.70)	47 (37.30)		
Above 10,000	58 (17.85)	34 (58.62)	24 (41.38)		
Type of latrine used				3.587	0.166
Hygienic	57 (17.54)	39 (68.42)	18 (31.58)		
Unhygienic	268 (82.46)	111 (41.42)	157 (58.58)		
Quality of drinking water				8.978	**0.003**
Good	111 (34.15)	76 (68.47)	35 (31.53)		
Poor	214 (65.85)	98 (45.79)	116 (54.21)		
Any vaccines your child should receive				7.135	**0.008**
BCG and Pentavalent vaccine	64 (19.69)	26 (40.63)	38 (59.38)		
Pneumococcal conjugate & Oral Polio vaccine	158 (48.62)	83 (52.53)	75 (47.47)		
Measles & Rubella vaccine	92 (28.31)	48 (52.17)	44 (47.83)		
Don't know	11 (3.38)	6 (54.55)	5 (45.45)		
Source of vaccination information				3.035	**<0.001**
Health care provider	149 (45.85)	65(43.62)	84 (56.38)		
Neighbor	51 (15.69)	34 (66.67)	17 (33.33)		
Mobile phone alerts/SMS	125 (38.46)	78(62.4)	47 (37.6)		
Diseases can be prevented by vaccination				4.239	0.040
Yes	189 (58.15)	141 (74.60)	48 (25.40)		
No	136 (41.85)	87 (63.97)	49 (36.03)		
The vaccination schedule for children under 5 years				3.155	0.368
Yes	196 (60.31)	92 (46.94)	104 (53.06)		
No	129 (39.69)	78 (60.47)	51 (39.53)		
Vaccination is important for children				1.311	0.252
Strongly agree	83 (25.54)	47 (56.63)	36 (43.37)		
Agree	102 (31.38)	59 (57.84)	43 (42.16)		
Neutral	49 (15.08)	29 (59.18)	20 (40.82)		
Disagree	51 (15.69)	34 (66.67)	17(33.33)		
Strongly disagree	40 (12.31)	17 (42.5)	23 (57.5)		
Vaccination has any side effects				0.573	0.449
Yes	128 (39.38)	78 (60.94)	50 (39.06)		
No	197 (60.62)	89 (45.18)	108 (54.82)		
Recommend vaccination to other parents				6.298	**0.012**
Yes	209 (64.31)	98 (46.89)	111 (53.11)		
No	116 (35.69)	85 (73.28)	31 (26.72)		
Children received all scheduled vaccines				5.984	**<0.001**
Yes	193 (59.38)	89 (46.11)	104 (53.89)		
No	132 (40.62)	79 (59.85)	53 (40.15)		
If no, what was the reason				3.711	0.156
Lack of knowledge	85 (26.15)	31 (36.47	54 (63.53)		
Lack of time	73 (22.46)	48 (65.75)	25 (34.25)		
Distance from vaccination center	102 (31.38)	85 (83.33)	17 (16.67)		
Fear of side effects	65 (20.00)	32 (49.33)	33 (50.77)		
Usually take your child for vaccination				0.159	0.690
Government hospital/clinic	201 (61.85)	45 (22.39)	156 (77.61)		
Private hospital/clinic	75 (23.08)	49 (65.33)	26 (34.67)		
Community outreach program	49 (15.08)	27 (55.10)	22 (44.90)		
An immunization card for your child				0.093	0.760
Yes	233 (71.69)	128 (54.94)	105 (45.06)		

No	92 (28.31)	46 (50.00)	46 (50.00)		
Use of media				0.580	0.446
Television	146 (44.92)	76 (32.19)	70 (47.95)		
Mobile	128 (39.38)	95 (74.22)	33(25.78)		
Internet	51 (15.69)	35 (68.63)	16(31.37)		
Knowledge about the name of vaccination				0.735	0.391
BCG and pentavalent vaccine	102 (31.38)	61 (50.80)	41 (40.20)		
Pneumococcal conjugate, oral polio vaccine	142 (43.69)	89 (62.68)	53 (37.32)		
Measles & rubella and measles	65 (20.00)	42 (64.62)	23 (35.38)		
Don't know	16 (4.92)	11 (68.75)	5 (31.25)		
Number of vaccinations that have taken				0.740	0.390
Yes	210 (64.62)	89 (42.38)	121 (57.62)		
No	115 (35.38)	37 (32.17)	78 (68.83)		
Side effect of vaccination				1.435	0.231
Fever	156 (48.00)	86 (55.13)	70 (44.87)		
Pain	132 (40.62)	88 (66.67)	44 (33.33)		
Rash	37 (11.38)	22 (59.46)	15 (40.54)		
Reason for non-immunization				0.481	0.488
lack of knowledge lack of time	158 (48.62)	84 (53.16)	74 (46.84)		
lack of time	120 (36.92)	77 (64.17)	43 (35.83)		
Distance	47 (14.46)	19 (40.43)	28 (59.57)		
Vaccination program existing in slum area				0.879	0.644
Yes	196 (60.31)	102 (52.04)	94 (47.96)		
No	129 (39.69)	73 (56.59)	56 (43.41)		
Immunization card				0.762	0.383
It where unknown	115 (35.38)	81 (70.43)	34 (29.57)		
It where about known	156 (48.00)	71 (45.51)	85 (54.49)		
No longer have a card	54 (16.62)	28 (51.85)	26 (48.15)		

A chi-square test of independence examined the association between socio-demographic, economic, and knowledge-related factors with vaccination status among respondents. Socio-demographic factors**.** Age was not significantly associated with vaccination status, χ^2 (1, N = 325) = 1.67, p = .196, though respondents under 25 years reported higher coverage (83.05%) than those over 25 years (59.42%). Gender was significantly associated, χ^2 (1, N = 325) = 10.15, p < .001, with females (70.98%) showing higher uptake than males (65.91%). Marital status was not significant, χ^2 (2, N = 325) = 6.00, p = .050, with vaccination rates similar across unmarried (62.71%), married (60.46%), and divorced/separated (62.5%) respondents.

Religion was significantly related to vaccination, χ^2 (3, N = 325) = 9.63, p = .002; Hindus (59.18%) had the highest uptake, followed by Muslims (54.8%), Christians (52.94%), and others (44.44%). Education level was also significant, χ^2 (3, N = 325) = 26.02, p < .001; primary-educated respondents (77.34%) had the highest coverage, whereas those with secondary education had the lowest (47.73%). Occupation was not significant, χ^2 (3, N = 325) = 2.55, p = .110, though domestic workers (73.24%) reported higher rates than other groups.

Household size was not significantly associated, χ^2 (1, N = 325) = 5.20, p = .074, but larger households (≥5 members) had slightly higher coverage (55.17%) than smaller ones (47.94%). The number of earning members was also non-significant, χ^2 (1, N = 325) = 3.39, p = .184, with households having ≥3 earners reporting higher coverage (73.08%) than those with 1–2 earners (52.84%). Monthly income was not significant, χ^2 (2, N = 325) = 2.44, p = .118, though the middle-income group (BDT 5,001–10,000) had the highest uptake (62.70%). Type of latrine used was not significant, χ^2 (1, N = 325) = 3.59, p = .166, but hygienic latrine users (68.42%) had higher coverage than unhygienic users (41.42%). Water, knowledge, and information sources. Quality of drinking water was significantly associated with vaccination status, χ^2 (1, N = 325) = 8.98, p = .003; good water quality households reported higher coverage (68.47%) than poor-quality households (45.79%). Knowledge about required vaccines was significant, χ^2 (3, N = 325) = 7.14, p = .008, with awareness of Pneumococcal and Oral Polio (52.53%) or Measles & Rubella vaccines (52.17%) linked to higher coverage than BCG and Pentavalent awareness (40.63%).

Source of vaccination information was significant, χ^2 (2, N = 325) = 3.04, p < .001; mobile/SMS users (62.40%) and neighbor-informed respondents (66.67%) had higher rates than those relying on health care providers (43.62%). Belief that vaccination prevents diseases was significant, χ^2 (1, N = 325) = 4.24, p = .040; "Yes" respondents (74.60%) showed higher coverage than "No" respondents (63.97%). Attitudes and behaviors. Awareness of the under-five vaccination schedule was not significant, χ^2 (1, N = 325) = 3.16, p = .368. Perception that vaccination is important was also non-significant, χ^2 (4, N = 325) = 1.31, p = .252. Perceived side effects were not significant, χ^2 (1, N = 325) = 0.57, p = .449.

Recommending vaccination to other parents was significant, χ^2 (1, N = 325) = 6.30, p = .012; surprisingly, non-recommenders (73.28%) had higher uptake than recommenders (46.89%). Receipt of all scheduled vaccines was significant, χ^2 (1, N = 325) = 5.98, p < .001, with those missing some vaccines showing higher current coverage (59.85%) than those fully vaccinated (46.11%). Access and barriers. Reasons for non-immunization (lack of knowledge, lack of time, distance, side effect fears) were not significant, χ^2 (3, N = 325) = 3.71, p = .156. Usual vaccination location was also non-significant, χ^2 (2, N = 325) = 0.16, p = .690, though private clinic users (65.33%) reported higher coverage than government facility attendees (22.39%) or outreach program participants (55.10%).

Possession of an immunization card was not significant, χ^2 (1, N = 325) = 0.09, p = .760, with similar rates for cardholders (54.94%) and non-cardholders (50.00%). Use of media was not significant, χ^2 (2, N = 325) = 0.58, p = .446, although mobile phone users (74.22%) and internet users (68.63%) showed higher coverage than television viewers (32.19%). Knowledge of vaccine names was not significant, χ^2 (3, N = 325) = 0.74, p = .391. Number of vaccinations already taken was also non-significant, χ^2 (1, N = 325) = 0.74, p = .390. Experiencing side effects (fever, pain, rash) was not significant, χ^2 (2, N = 325) = 1.44, p = .231, though pain was associated with the highest coverage (66.67%). Reasons for non-immunization in a separate analysis were not significant, χ^2 (3, N = 325) = 0.48, p = .488. The presence of a vaccination program in slum areas was not significant, χ^2 (1, N = 325) = 0.88, p = .644, and immunization card status type was also not significant, χ^2 (2, N = 325) = 0.76, p = .383.

Overall, significant predictors of vaccination uptake included gender, religion, education, quality of drinking water, knowledge about required vaccines, source of vaccination information, belief in disease prevention through vaccination, recommending vaccination to others, and completion of all scheduled vaccines. Most socio-economic factors, health service access variables, andperception-based measures were not significantly associated with vaccination status.

Table 2: Logistic regression analysis of risk factors for prevalence of vaccination by Socio-demographic, Economic Characteristics yields odds ratios and 95% confidence intervals

Variable	Adjusted (95%CI)	Sig	Unadjusted(95%CI)	sig
Sex				
Female	1		1	
Male	0.82 (0.46 - 1.51)	0 .441	1.14 (0.72 – 1.82)	0.578
The Education level of the participant				
Tertiary	1		1	
No Education	0.44 (0.08 - 2.56)	0 .358	1.14 (0.41 – 3.17)	0.797
Primary	0.38 (0.06 - 1.99)	0 .231	0.22 (0.45 – 0.27)	**0.005**
Secondary	0.37 (0.06 - 0.35)	**0 .002**	0.10 (0.38 – 0.17)	**<0.001**
Occupation				
Business	1		1	
Housewife	1.27 (0.17 - 0.43)	**0 .004**	0.74 (0.69 – 0.79)	**<0.001**
Day labor	0.50 (0.21 -0.11)	**0 .020**	0.54 (0.67 – 0.66)	**0.003**
Domestic worker	0.84 (0.10 - 7.27)	0.872	1.43 (0.32 – 6.46)	0.643
Monthly household income (in BDT)				
Above 10,000	1		1	
1,000–5,000	0.57 (0.44 – 0.63)	**0 .008**	0.89 (0.97 – 0.68	**0.002**
5,001–10,000	0.92 (0.08 – 0.32)	**0 .005**	0.59 (0.80 – 0.17)	**0.018**
Any vaccines your child should receive				
Don't know	1		1	
BCG and Pentavalent vaccine	0.05 (0.19 - 0.24)	**0.004**	0.44 (0.48 – 0.84)	**0.017**
Pneumococcal conjugate & Oral Polio vaccine	0.77 (0.31 – 0.07)	**<0 .001**	0.41 (0.80 – 0.10)	**0.009**
Measles & Rubella vaccine	0.67 (0.09 -0.06)	**0 .003**	0.43 (0.30 – 0.82)	**0.028**
Type of latrine used				
No	1		1	
Yes	0.08 (0.10 – 0.50)	**<0.001**	0.42 (0.20 – 0.85)	**0.017**
Quality of drinking water				
No	1		1	
Yes	0.92 (0.40 – 2.14)	0.847	1.07 (0.66 – 1.74)	0.786
Source of vaccination information				
Mobile phone alerts/SMS	1		1	
Health care provider	0.48 (0.96 – 0.38)	**<0.001**	3.09 (0.63 – 15.23)	0.066
Neighbor	0.35 (0.41 – 0.21)	**0.028**	0.56 (0.29 – 0.33)	**0.006**
Diseases can be prevented by vaccination				
No	1		1	
Yes	0.63 (0.03 – 15.41)	0.778	1.01 (0.64 – 1.59)	0.964
The vaccination schedule for children under 5 years				
No	1		1	
Yes	1.21 (0.68 – 2.17)	0.521	0.47 (0.93 – 0.31)	**0.009**

Vaccination has any side effects				
No	1		1	
Yes	2.17 (0.04 – 11.24)	0.700	1.02 (0.65 – 1.61)	0.925
Recommend vaccination to other parents				
No	1		1	
Yes	0.66 (0.32 – 1.34)	0.248	0.78 (0.47 – 1.29)	0.326
Usually take your child for vaccination				
Community outreach program	1		1	
Government hospital/clinic	0.70 (0.07 – 0.92)	**0.020**	0.79 (0.59 – 0.06)	**0.016**
Private hospital/clinic	0.71 (0.03 – 15.64)	0.830	0.54 (0.24 – 0.04)	**0.005**
The effects of climate change on human life of threats				
No	1		1	
Yes	0.29 (0.8 – 0.27)	**<0.001**	0.85 (0.93 – 0.74)	**0.006**
An immunization card for your child				
No	1		1	
Yes	1.60 (0.87 – 2.96)	0.134	1.11 (0.71 – 1.74)	0.640
Number of vaccinations that have taken				
No	1		1	
Yes	0.18 (0.19 – 0.10)	**0.011**	1.36 (0.86 – 2.16)	0.194
Side effect of vaccination				
Rash	1		1	
Fever	0.81 (0.39 – 1.69)	0.580	1.34 (0.82 – 2.20)	0.245
Pain	0.18 (0.07 – 0.43)	**0.032**	1.81 (1.09 – 3.02)	0.078
Reason for non-immunization				
Distance	1		1	
lack of knowledge lack of time	0.74 (0.78 – 0.88)	**0.015**	0.82 (0.48 – 1.41)	0.074
lack of time	0.31 (0.44 – 0.43)	**0.002**	3.18 (1.17 – 4.16)	
Vaccination program existing in slum area				
No	1		1	
Yes	0.14 (0.17 – 0.43)	**0.010**	0.14 (0.48 – 0.31)	**0.022**
Immunization card				
No longer have a card	1		1	
It where unknown	0.96 (0.49 – 0.88)	**0.005**	0.25 (0.76 – 0.05)	**<0.001**
It where about known	0.11 (0.71 – 0.52)	**0.016**	3.18 (1.19 – 3.33)	0.158

A logistic regression was conducted to identify socio-demographic and economic predictors of childhood vaccination. Odds ratios (OR) with 95% confidence intervals (CI) and significance values are presented in Table 2. Sex was not a significant predictor of vaccination. The odds for males did not differ from females in either the adjusted (AOR = 0.82, 95% CI [0.46, 1.51], p = .441) or unadjusted models (UOR = 1.14, 95% CI [0.72, 1.82], p = .578).

Education showed mixed associations. Compared with tertiary education, primary education was associated with lower vaccination in the unadjusted model (UOR = 0.22, 95% CI [0.45, 0.27], p = .005), but not after adjustment (AOR = 0.38, 95% CI [0.06, 1.99], p = .231). Secondary education was consistently linked to reduced odds in both adjusted (AOR = 0.37, 95% CI [0.06, 0.35], p = .002) and unadjusted models (UOR = 0.10, 95% CI [0.38, 0.17], p < .001). No significant association was found for no formal education. Occupational differences were evident. Compared with business workers, housewives had higher adjusted odds of vaccinating (AOR = 1.27, 95% CI [0.17, 0.43], p = .004), while day laborers had lower odds in both adjusted (AOR = 0.50, 95% CI [0.21, 0.11], p = .020) and unadjusted models (UOR = 0.54, 95% CI [0.67, 0.66], p = .003). Domestic workers showed no significant effect. Household income was strongly predictive. Compared with families earning >10,000 BDT, those earning 1,000–5,000 BDT had significantly lower adjusted odds (AOR = 0.57, 95% CI [0.44, 0.63], p = .008), while the 5,001–10,000 BDT group also showed reduced odds (AOR = 0.92, 95% CI [0.08, 0.32], p = .005).

Awareness of vaccines strongly increased uptake. Knowledge of BCG and Pentavalent vaccines (AOR = 0.05, 95% CI [0.19, 0.24], p = .004), Pneumococcal and Oral Polio (AOR = 0.77, 95% CI [0.31, 0.07], p < .001), and Measles & Rubella (AOR = 0.67, 95% CI [0.09, 0.06], p = .003) were all significant predictors. Sanitation mattered. Households using latrines were more likely to vaccinate than those without (AOR = 0.08, 95% CI [0.10, 0.50], p < .001). Access to safe drinking water, however, showed no significant effect in either model. Information sources influenced behavior. Compared with mobile alerts, reliance on healthcare providers increased vaccination (AOR = 0.48, 95% CI [0.96, 0.38], p < .001), while reliance on neighbors also raised odds in both adjusted (AOR = 0.35, 95% CI [0.41, 0.21], p = .028) and unadjusted models (UOR = 0.56, 95% CI [0.29, 0.33], p = .006). Beliefs alone did not predict uptake. Neither belief in vaccine-preventable disease prevention (AOR = 0.63, p = .778), concerns about side effects (AOR = 2.17, p = .700), nor recommending vaccination (AOR = 0.66, p = .248) were significant.

Knowledge of the vaccination schedule showed weak effects. Adjusted odds were slightly higher but nonsignificant (AOR = 1.21, p = .521), while unadjusted odds indicated increased uptake (UOR = 0.47, p = .009). Health facility type mattered. Compared with community

outreach, use of government hospitals/clinics increased uptake (AOR = 0.70, p = .020; UOR = 0.79, p = .016). Private hospitals did not significantly differ. Perceptions of climate change were influential. Viewing climate change as a threat increased vaccination uptake (AOR = 0.29, p < .001; UOR = 0.85, p = .006). Possessing a child's immunization card was positively associated but not significant (AOR = 1.60, p = .134). However, households reporting "unknown" card status were significantly less likely to vaccinate (AOR = 0.96, p = .005). Prior vaccination history strongly predicted continued uptake (AOR = 0.18, p = .011).

Adverse experiences influenced behavior. Experiencing pain reduced odds of continuing vaccination (AOR = 0.18, p = .032), though fever did not. Time constraints were a significant barrier (AOR = 0.31, p = .002), while distance and lack of knowledge were nonsignificant. Finally, community-level programs mattered. Vaccination initiatives in slum communities were strong positive predictors of uptake (AOR = 0.14, p = .010).

Discussion

This study explored parental awareness, attitudes, and socio-demographic determinants of childhood vaccination among slum dwellers in Khulna City Corporation, Bangladesh. The findings reveal both encouraging progress and persistent challenges in achieving equitable immunisation coverage in vulnerable urban populations (Haseen et al., 2024). Gender was significantly associated with vaccination uptake, with female parents reporting higher coverage than males. This aligns with earlier evidence from South Asia suggesting that mothers often serve as primary caregivers and decision-makers in child health, thereby enhancing immunisation compliance (Haque et al., 2024). Religious affiliation also influenced vaccination, with Hindus and Muslims demonstrating relatively higher uptake compared to other minority groups. Such disparities may reflect differences in community norms, trust in health systems, or exposure to awareness campaigns, as noted in similar urban slum studies in India and Pakistan (Bukhsh et al., 2018).

Education emerged as a critical predictor. Respondents with primary education reported the highest vaccination rates, whereas those with secondary education showed the lowest. This unexpected pattern contrasts with national data linking higher education to greater immunization (Borràs et al., 2009), and may indicate contextual variations in parental priorities, misinformation, or competing socio-economic pressures in slum settings. Logistic regression further confirmed that secondary education was significantly associated with lower odds of vaccination, underscoring the need for tailored educational interventions (Biswas et al., 2020).

Occupational status and income also played important roles. Housewives reported higher uptake compared to day laborers, likely reflecting greater availability to attend vaccination sessions. Lower household income (≤5,000 BDT) significantly reduced the odds of vaccination, echoing findings that economic insecurity is a major barrier to healthcare access in low-income urban populations (Alshammari et al., 2021).

Parental knowledge significantly shaped vaccination outcomes. Awareness of specific vaccines (e.g., BCG, Pentavalent, Pneumococcal, Measles & Rubella) was strongly predictive of uptake, consistent with earlier research in Bangladesh and Sub-Saharan Africa linking vaccine knowledge with immunisation completion (Alabadi & Aldawood, 2020). Conversely, lack of knowledge and misconceptions were key barriers. Information sources also influenced uptake. Parents receiving information from mobile alerts or neighbors were more likely to vaccinate compared to those relying solely on healthcare providers (Al-Zaharani, 2013). This finding highlights the potential of community-based peer influence and digital health tools in reaching marginalized populations. However, it also suggests gaps in health provider communication that require improvement.

Belief in disease prevention through vaccines was positively associated with uptake in bivariate analysis but did not retain significance in multivariate models, indicating that awareness alone may be insufficient without structural support (Abdulla et al., 2022). Concerns about side effects, such as fever or pain, did not significantly reduce uptake overall, though experiencing pain lowered continued vaccination odds. This underscores the importance of counseling parents about expected minor side effects to maintain adherence (Haseen et al., 2024). Access to improved sanitation (latrine use) was significantly associated with vaccination, whereas safe drinking water showed no consistent effect after adjustment. This suggests that broader household living conditions may indirectly facilitate healthcare-seeking behavior (Jahan & Urba, 2015).

Health service access variables yielded mixed results. Parents utilizing government hospitals/clinics reported higher vaccination rates than those attending outreach services, possibly reflecting perceptions of reliability and trust in formal institutions. Community-based vaccination programs were strong positive predictors of uptake, reinforcing their importance in slum areas with limited healthcare infrastructure (Akhter et al., 2022). Interestingly, perceptions of climate change as a health threat were significantly linked to vaccination, suggesting broader awareness of environmental risks may motivate preventive health behavior. This novel association warrants further investigation

Conclusion

This study examined parental awareness, attitudes, and socio-demographic factors influencing childhood vaccination among slum dwellers of Khulna City Corporation, Bangladesh. The findings indicate that while overall vaccination coverage has improved compared to earlier national trends, significant gaps remain due to parental education, household income, knowledge of vaccines, and access to reliable information sources. Gender, religion, occupation, sanitation, and community-based vaccination initiatives also emerged as important predictors of uptake.

The results underscore that vaccination behavior is shaped not only by individual knowledge and attitudes but also by broader socio-economic and structural conditions. Parents with better knowledge of specific vaccines and those exposed to mobile reminders or community

influence were more likely to vaccinate their children, whereas economic constraints, limited education, and misinformation served as barriers.

To strengthen vaccination coverage in urban slums, interventions should prioritize awareness-building, integrate mobile-based communication, improve healthcare provider–parent engagement, and ensure equitable access to services for low-income households. Community outreach and trust-building with marginalized groups are also critical for sustaining progress.

In conclusion, improving parental knowledge and addressing socio-economic barriers are essential to achieving universal childhood immunisation goals in Bangladesh. Policymakers, healthcare providers, and community leaders must work collaboratively to design context-specific strategies that can reduce disparities and ensure that no child is left unprotected against vaccine-preventable diseases.

Strengths and Limitations

The study employed a well-structured design and utilized a representative sample, ensuring that the findings are relevant and generalizable. Validated and reliable instruments were used to collect data, enhancing measurement accuracy. Ethical standards were strictly followed, including informed consent and confidentiality. Additionally, rigorous statistical analyses were applied, providing credible and meaningful insights that contribute to the existing body of knowledge in the field.

The cross-sectional nature of the study limits the ability to establish causal relationships. Data were primarily self-reported, which may introduce response bias. The research was conducted in a specific geographic area, which could affect the generalizability of the findings. Some potential confounding variables may not have been fully controlled, and limited time and resources may have constrained the scope of data collection.

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Conflict of Interest

The authors declare no conflict of interest.

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