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Fear, trust, and safety perceptions as key drivers of parental acceptance of typhoid conjugate vaccine uptake among urban slum parents in Dhaka City Corporation,Bangladesh: a cross-sectional study

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Research Article

Keywords: Typhoid conjugate vaccine (TCV), Vaccine uptake, Vaccine hesitancy, Parental knowledge, Vaccine confidence, Behavioral and social drivers, Urban slums, Bangladesh

Posted Date: November 1st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10953147/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Typhoid fever is a public health concern in Bangladesh; among children younger than 15 years old, it contributes to two-thirds of the fatality rate. Studies show that the burden of typhoid fever is substantially higher in densely populated low-income urban settlements (slums). To address this situation, the Government of Bangladesh conducted nationwide typhoid conjugate vaccine (TCV) campaigns in October and November 2025. This study aimed to evaluate the role of parental knowledge, trust, and the relationship between immunization status and social or personal perspectives to strengthen routine immunization in the urban slum population in Dhaka city.

Methods

This cross-sectional study was conducted among slum dwellers, parents, and caregivers of children aged nine months to fourteen years in two city corporations of Dhaka using a structured questionnaire. The questionnaire consisted of two sections: demographic information, awareness, parental attitude, vaccination status, and Vaccine Attitude Scale (VAS). Bivariate and multivariate logistic regression analyses were conducted to investigate the relationship.

Results

A total of 446 parents/caregivers participated in the study. Among these participants, 69% of the children were vaccinated. Most participants believed that the TCV was safe (91%). Approximately 36% of parents expressed fear about the vaccine, with 33% fearing the side effects. In the 14-item VAS, 53% of the parents had a low score, between 0 and < 31. Participants with a low VAS score (< 31) were significantly more likely to have their children vaccinated than those with high scores. Comprehensive parental knowledge was significantly associated with higher odds of TCV uptake (aOR = 3.36; 95%CI: 1.25-9.00). Participants with the belief that the vaccine was safe (aOR = 17.3; 95% CI: 1.89-159.86) and trust in the campaign information (aOR = 15.49; 95% CI: 1.85–29.47) were significantly more likely to vaccinate their children.

Conclusions

Despite relatively high TCV uptake, fears and concerns related to vaccination remained important barriers among the parents and caregivers. To enhance both TCV acceptance and coverage among the underserved urban population, we need to focus on strengthening vaccine confidence through targeted risk communication and improving trust in vaccine campaigns.

1. Introduction

Typhoid and paratyphoid fever, commonly known as enteric fever caused by Gram-negative bacteria: *Salmonella enterica* serovar *Typhi (S. Typhi) and S. enterica* serovar *Paratyphi (S. paratyphi).* Typhoid fever is an invasive bacterial disease that spreads through water or food contaminated by human feces. Symptoms start with prolonged high-grade fever (103–104°F) associated with headache, cough, extreme fatigue, constipation, loss of appetite, and diarrhea (1), potentially leading to severe toxemia and multi-organ complications if untreated. Globally, it is one of the major public

health concerns, with an estimated more than 6 million cases of typhoid and more than 71,000 typhoid-related deaths reported in 2023 worldwide (2).

Bangladesh stands within the top five countries globally for the burden of enteric fever, with one of the highest typhoid incidence rates in the world, and is identified as a typhoid-endemic country, with more than 300 cases per 100,000 individuals per year. According to the Global Burden of Disease study, 7,998 deaths were reported in 2021. Another surveillance study in Dhaka found 1,135 cases of typhoid per 100,000 people and highlighted that children aged 5–9 years were identified at the highest rate. Bangladesh is the second-highest country in terms of mortality and Disability-Adjusted Life Years (DALYs) related to typhoid fever. Children are disproportionately affected, contributing to a high number of hospitalizations and increased health system costs. Children aged between two and four are identified as the most vulnerable group in typhoid-endemic countries such as India, Bangladesh, Nepal, and Pakistan.

Antibiotics are widely used in typhoid fever treatment. The growing prevalence of antimicrobial-resistant *S. Typhi* strains further complicates treatment and limits the effectiveness of existing antibiotics. Furthermore, treatment may not prevent chronic carriage, which in turn perpetuates disease transmission. People in low-resource environments have less access to healthcare services and face the high cost of antibiotics, which delays treatment and increases the risk of severe disease outcomes such as intestinal hemorrhage and neurological complications. Therefore, preventive measures are more urgent. In response, the World Health Organization (WHO) recommends the programmatic use of typhoid conjugate vaccines (TCVs), particularly in countries with a high burden of disease and/or high levels of antimicrobial resistance. More than 150 million children have been vaccinated in TCV campaigns since November 2019. Nine countries, including Bangladesh, have TCV in routine immunization.

To address this public health challenge, the Government of Bangladesh launched a nationwide TCV campaign on October 12, 2025, under the Expanded Program on Immunization (EPI). The campaign aimed to reach approximately 50 million children aged 9 months to younger than 14 years and was implemented in two phases: a 10-day school and madrasa-based vaccination drive, followed by an 8-day campaign at designated EPI centers. Registration for the campaign began on August 1, 2025, through the official portal (vaxepi.gov.bd), where participants were required to provide a 17-digit birth registration number to receive a digital vaccine card.

New vaccine introduction and uptake face significant obstacles, particularly in the post-pandemic environment, which has seen increasing parental refusal rates. Especially in the slum population, significant gaps in child immunization are reported by studies; coverage in these regions (e.g., 67% in 2016) is behind the national average (82%). Low awareness, restricted access to services, frequent migration, and fear of adverse effects are among the main obstacles mentioned by mothers and caregivers. Further, in slum populations, vaccine acceptance is shown to be closely linked to household perceptions, attitudes, and awareness. Parental attitudes about childhood vaccination are dynamic and can be plotted on a continuum ranging from complete acceptance of all vaccines to staunch refusal.

Therefore, this study aimed to assess and evaluate parental and caregivers' perspectives to enhance routine immunization coverage among urban slum populations in Dhaka city corporations by using the Vaccine Attitude Scale (VAS). The goal was to highlight the association between immunization status, social or personal perspective, and the role of communication.

2. Materials and methods

2.1. Study design and setting

A cross-sectional survey was conducted among the parents and caregivers of children aged nine months to fourteen years who resided in the slums of Dhaka's North and South city corporations. Dhaka has approximately 3,300 to 5,000 slums accommodating 4.4 to 6.46 million people. In Dhaka North City Corporation (DNCC), Gabtoli City Colony Slum (Ward 9) and Kallanpur Pora Slum (Ward 11); in Dhaka South City Corporation (DSCC), Sylheti Bazar Slum (Ward 55) and Nilachal Slum (Ward 57) were selected purposively from the list of the city corporations' under-resourced urban slum communities. The vaccination campaign ran from October 12 to November 13, 2025. This study was carried out by ideSHi immediately after the TCV campaign (15th to 30th November).

2.2. Study population

This study targeted parents or caregivers who had at least one child between nine months and fourteen years of age (eligible to receive the free dose of TCV during the nationwide campaign) and resided in the selected urban slum areas for at least 6 months and were willing to participate in the study. Participants provided written consent before being included in the survey.

2.3. Assessment of exposure to TCV vaccination

To limit recall biases, the survey was conducted immediately after the nationwide TCV campaign. Data on vaccination status were considered positive if the child had the vaccine completion registration card and it was verified by the vaccination campaign registries.

2.4. Sampling technique and sample size calculation

The required sample size was calculated using the single population proportion formula, assuming a 95% confidence level, a 5% margin of error, and an anticipated TCV uptake of 80%, based on findings from previous studies. A design effect (DEFF) of 1.5 was applied to account for the clustering effect of the sampling design, and an additional 10% was added to compensate for potential non-response. Based on these assumptions, the minimum required sample size was estimated to be 410 households.

A multistage cluster sampling technique was employed to select the study participants. Initially, four urban slum communities in Dhaka were selected as the primary sampling clusters based on predefined geographic and administrative boundaries. A complete household sampling frame with at least one eligible child aged 9 months to 14 years for each cluster was prepared using the household listings from the Expanded Programme on Immunization (EPI), with support from local field staff.

In the second stage, households within each cluster were selected using simple random sampling (SRS). Household identification numbers were used as the sampling frame, and eligible households were selected using a computer-generated random number sequence in R statistical software. Approximately equal numbers of households were allocated to each cluster. If a selected household declined to participate or did not meet the eligibility criteria, another eligible household was randomly selected from the same cluster.

A well-trained team of volunteers, with the help of local community leaders, reached the randomly selected households to conduct the survey. After the identification of the household, eligibility to participate in the survey was assessed, and written informed consent was obtained before the interview. Data were collected through face-to-face interviews. If a selected household refused to participate, the next household was approached. One parent or caregiver per household was approached for the interview (depending on who was present in the household at the time of the survey). If the parent or caregiver was unable to give the interview at that time, they were approached at another suitable time to conduct the interview. Each interview lasted approximately twenty minutes.

A total of 446 households were successfully enrolled and included in the final analysis, exceeding the minimum required sample size and thereby increasing the precision of the study estimates.

2.5. Ethical considerations

Participation was entirely voluntary. Participants had the right to terminate their participation in the study at any time without any negative consequences. In addition, both verbal and written consent were obtained prior to the survey. The Institutional Review Board (IRB) of the Institute for Developing Science and Health Initiatives (ideSHi), with reference number IRB-PNR-25003, approved ethical approval for the study.

2.6. Survey development

A well-structured questionnaire was developed to conduct the survey efficiently. The survey material consisted of two sections in total. The first section included five sub-sections: (1) demographic information; (2) knowledge of typhoid as a disease and TCV (4 items); (3) parental attitude towards TCV (5 items); (4) awareness of the TCV vaccination campaign (5 items); and (7) TCV vaccination status (1 item). Another section included the Vaccine Attitude Scale (VAS)-related items, which has two sub-sections: vaccine perceptions and concerns (10 items) and attitudes towards disease salience and community benefit (4 items).

Initially, the survey was carried out randomly among ten participants using a draft questionnaire and tested through cognitive debriefing methodology for the wording and comprehensiveness of the questionnaire. According to respondents' understanding of the questions and suggestions, the research committee modified the final version of the questionnaire. The questionnaire was translated into Bengali, and the interviews were conducted in Bengali. During the data cleaning, missing information about demographic variables like 'residence,' 'vaccination status,' or 'knowledge' towards TCV vaccination was considered incomplete data and excluded from the final dataset.

2.7. Data quality and Statistical analysis

A verified Parental Vaccine Attitude Scale (VAS) was applied to evaluate the parental acceptability of the TCV vaccination (3). The VAS is a combination of 14 Likert items, each with 5 responses ranging from strongly agree to strongly disagree (sum of scores ranges from 14–70) (Additional file: Supplementary file 1). This scale consists of two subdomains: vaccine perceptions and concerns (10 items) and disease salience and community benefits (4 items). The total possible sum of scores on the 10-item subscale ranged from 10 to 50, and on the 4-item subscale, it ranged from 4 to 20. Eight Likert-scale items from the total are structured in the opposite direction; hence, reverse coding of these items was performed to calculate the total sum of scores for VAS. Cutoff values for the total scores of the VAS scale and subscales were obtained by plotting the scores against the vaccination status of children and observing the pattern (Additional file: Supplementary file 2).

We used Cronbach's alpha for the 14 items of the VAS about typhoid and TCV. The value of Cronbach's alpha was 0.749, which means that these questions are reliable or have high internal consistency. The Hosmer–Lemeshow goodness-of-fit test indicated that the model fit the data adequately ($p = 0.40$).

In order to ensure the quality of the data, random site observations of interviews and follow-ups were conducted in 10% of the recruited households. The data were transmitted daily to the central data management unit at ideSHi, Dhaka.

For statistical analysis, for knowledge-based questions from the first section of the tool (typhoid and TCV vaccination), the percentage of knowledge was divided into the following three groups: poor (< 50%), moderate (50–70%), and high level (> 75%). A low level means the participant answered only one question correctly, while a moderate

level means the participant answered two questions correctly, and a high level means the participant answered all three questions correctly (Additional file: Supplementary file 3).

Inferential analysis was implemented depending on the nature of the variables. Bivariate and multivariate logistic regression analyses were conducted to investigate the relationship between demographic, knowledge, and attitude factors and the willingness to receive a supplemental dose of TCV.

In order to ascertain the determinants of typhoid vaccination status, multivariable logistic regression was conducted to obtain the association between the vaccination status of their children and the parental knowledge related to typhoid disease, awareness of the TCV campaign, vaccine-related perceptions and concerns, attitudes towards disease salience, and community benefits of the parents. Logistic regression was used to assess the association between scores on VAS subscales and vaccination status of the children.

Data analysis was performed using STATA version 15.0, considering p-values < 0.05 as statistically significant based on two-sided p-values.

3. Results

A total of 446 participants agreed to respond among 452 eligible households, a participation rate of 98.6%. The mean age of the participants and the number of children were 30.13 ± 7.76 and 1.87 ± 0.89, respectively. Among the participants, 91.70% (409) were women and 8.30% (37) were men. The majority of participants, 58.52% (261), were aged between 18 and 30 years. Overall, 69.28% (309) of parents or caregivers had accepted TCV for their children during the nationwide campaign (Table 1).

The TCV uptake distribution among children in Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) is shown in Fig. 1. Children dwelling in DNCC had a higher vaccination uptake (84%) than those in DSCC (54%), reflecting that the two city corporations' TCV coverage differed. (Table 1) (Fig. 1)

Nearly all participants were biological parents (98.2%), with very few primary caregivers or others. Participants were equally distributed between Dhaka North City Corporation (50.0%) and Dhaka South City Corporation (50.0%). In terms of vaccination status, 30.7% of the children remained unvaccinated, while 69.3% of the children were vaccinated during the nationwide TCV campaign. The vaccination cards of the children were checked by the interviewers for vaccination status data.

98.0% of participants were aware of the EPI-led vaccine immunization program, and a significant percentage (87.4%) had heard of TCV. The most common source of information was NGOs (60.5%), followed by mass media (28.3%) and friends/relatives (8.1%), while healthcare providers contributed minimally (1.8%). Most participants (91.5%) believed that the vaccine is safe. However, 36.6% reported having fears regarding vaccination; many of the participants had fears of side effects (33.2%), followed by fear due to misinformation or rumors (8.3%) and fear of infertility (6.1%). Despite these hesitations, most of the participants (66.6%) strongly recommended the vaccine, while 17.3% of the participants said they would recommend it only when asked. The majority of the participants (88.6%) said they would consult a doctor if the vaccination dose was missed, demonstrating confidence in official healthcare services, although the major source of information was not healthcare providers (1.8%) (Table 2).

Despite exposure to the TCV campaign among parents whose children remained unvaccinated, the most commonly reported concern was fear that the vaccine might not be effective for their children. Concerns about infertility or reproductive problems and fear that the vaccine was new and not fully tested followed this. A substantial proportion of parents also reported that they had fear related to misinformation or rumors, where concerns about side effects

such as fever, pain, or other health issues were comparatively less frequent. Overall, the findings suggest that for TCV uptake among unvaccinated children, concerns about vaccine effectiveness, safety, and reproductive health were important barriers (Fig. 2).

The VAS item responses indicated that parents generally held positive views about childhood vaccination. Most of the participants did not believe in common vaccine misconceptions. The majority (64%) of the participants disagreed or strongly disagreed that children get more vaccines than necessary, while just 14% agreed or strongly agreed. The idea that healthy children do not need vaccines was rejected by nearly all the parents (96%), and 95% did not agree with the idea that vaccines cause more harm than good. Similarly, about 95% of participants did not support the belief that developing natural immunity by getting sick is better than vaccination for immunity (Table 3).

Regarding parental autonomy, more than half of the participants (68%) opposed the idea of selectively choosing vaccines for their child, though a significant minority (21%) favored this perspective. There were disagreements on vaccination schedules; about 59% of the participants disagreed with giving multiple injectable vaccines during one visit, whereas 28% were in favor of this practice. Vaccine-related safety concerns persisted among a subset of parents. Concern that the child might experience a serious side effect was agreed or strongly agreed upon by approximately 32% of the participants, whereas 63% disagreed or strongly disagreed.

Strong positive attitudes toward vaccination were captured by the data. Most of the participants agreed that adhering to the recommended vaccination schedule is beneficial for children (94%). Approximately 98% of the respondents recognized the severity of vaccine-preventable diseases, and they acknowledged the fact that the broader public health benefits of vaccinating the child include reducing disease transmission within the community (99%).

Positive attitudes were additionally observed regarding social responsibility. The majority of the participants (98%) agreed that refusal to vaccinate could harm the community. Regarding punitive effects, however, attitudes were more split: about 35% of the participants agreed and strongly agreed that there should be monetary penalties for non-vaccination, whereas 40% disagreed and strongly disagreed. Finally, half of the respondents (50%) responded positively, with a willingness to actively support vaccination efforts by expressing interest in becoming community advocates if provided with appropriate training.

To identify factors associated with TCV uptake among children of participating parents or caregivers, a bivariate analysis was conducted. Statistically significant associations with vaccination status were demonstrated by the variables of multiple knowledge, perception, and campaign-related factors (Table 4).

The knowledge of parents about TCV was significantly linked with vaccine uptake ($p < 0.001$). Parents who had good knowledge (score more than 75) had a much higher coverage of vaccination, with 81.9% being vaccinated, compared to only 30.9% of children with parents who had poor knowledge (score less than 50). Similarly, vaccination uptake among parents who had moderate knowledge (score between 50–75) was quite low at 28.8%. This implies that having better knowledge, awareness, and understanding of the matter is strongly associated with improved vaccination behavior and approach.

There was no significant correlation between the gender of the parents and their vaccine uptake ($p = 0.327$). The coverage for vaccination among the children was slightly higher in the case of female parents or caregivers (69.9%) than among male parents (62.2%). However, this difference does not imply a significant statistical difference.

A much lower TCV uptake was related to fear and concern about immunization ($p < 0.001$). Approximately 47.2% of the parents who reported fear about the vaccine ultimately vaccinated their children, compared to 82.0% of the parents who had not reported any fear of the vaccine. This implies that vaccine and vaccination-related fears could be

significant obstacles to vaccine uptake. Moreover, vaccine uptake was also significantly associated with awareness of the TCV campaign ($p = 0.001$). Here, we could see that only 14.3% of parents who had not previously heard of the campaign had vaccinated their children, whereas 70.2% of the parents who had heard about the vaccination campaign had vaccinated their children. This data greatly emphasizes the importance of campaign visibility and dissemination in terms of promoting vaccination. Moreover, trust in the information provided by the campaign was also highly associated with vaccination uptake ($p < 0.001$). Almost 76.2% of the parents who trusted the campaign information vaccinated their children, compared to only 2.4% of the parents who lacked trust in the TCV vaccination-related campaign information. This implies and highlights the important role of credibility and confidence in public health communication strategies to gain higher vaccine acceptance and uptake.

Moreover, there was a significant relation ($p < 0.001$) between vaccination uptake and the motivation of the parents attained by the messages conveyed through the campaign and community engagement programs to get their children vaccinated. Among the parents who had reported being motivated by the campaign messages, 77.6% vaccinated their children. On the other hand, the parents who had reported a lack of motivation did not vaccinate their children at all. This implies a direct relationship between the effectiveness of the motivational messages and community engagement programs of the TCV campaign in terms of promoting vaccines.

In summary, the bivariate analysis indicated that TCV uptake was heavily influenced by the knowledge of parents, concerns regarding vaccine safety, fears of different vaccines, campaign awareness, trust in campaign information, and campaign-related motivation.

After adjusting for potential confounding variables, a multivariable logistic regression analysis was performed to identify independent predictors of TCV uptake among children (Table 5).

Parental knowledge about TCV vaccination was considerably associated with vaccine uptake. Parents with adequate information about typhoid and TCV were three times more likely to vaccinate their children compared to those with insufficient knowledge (aOR = 3.36, 95% CI: 1.25–9.00, $p = 0.01$). However, moderate knowledge was not significantly linked with vaccination uptake in the adjusted model. Perceived vaccination safety appeared as one of the strongest predictors of vaccine uptake. Parents who believed the vaccination was safe were significantly more likely to vaccinate their children than those who did not believe in vaccine safety (aOR = 17.36, 95% CI: 1.89-159.86, $p = 0.01$).

Lower vaccination uptake was independently correlated with vaccine-related fear. Parents who expressed concerns about the vaccine were less likely to have their children vaccinated than those who did not have such concerns *(aOR = 0.42, 95% CI: 0.25–0.72, $p < 0.001$)*. While initial analysis indicated that awareness of the vaccination campaign was significantly associated with vaccination, this relationship lost statistical significance after adjustment *(aOR = 3.42, 95% CI: 0.14–81.12, $p = 0.44$)*. Likewise, parental gender was not associated with vaccine uptake.

In the multivariable model, trust in campaign information continued to be a significant predictor. Compared to parents who did not trust the campaign material, those who did were approximately 15 times more likely to vaccinate their children (aOR = 15.49, 95% CI: 1.85–129.47, $p = 0.01$).

Logistic regression analysis was applied to further examine the relationship between children's immunization status and parental VAS scores (Table 6).

Parents with moderate-to-high total VAS scores were significantly less likely to vaccinate their children in comparison to those with low VAS scores. The association persisted as significant after adjustment for potential confounders (aOR = 0.48, 95% CI: 0.28–0.82, $p < 0.001$).

Subscale analysis indicated that higher scores in the vaccine perceptions and concerns domain were strongly correlated with lower vaccination uptake. Parents with moderate-to-high scores in this domain had 57% lower odds of vaccinating their children compared to those with lower scores (aOR = 0.43, 95% CI: 0.25–0.72, p < 0.001).

Likewise, parental attitudes regarding disease salience and community benefits were strongly associated with the children's vaccination status. Parents who scored moderately to highly in this domain were much less likely to avoid vaccinating their children and more likely to ensure their children received vaccinations, compared with parents with lower scores *(aOR = 0.37, 95% CI: 0.22–0.64, p < 0.001)*.

In summary, the results suggest that parents' attitudes, perceptions of vaccine safety, concerns about vaccination, and beliefs about protecting the community were key factors influencing TCV uptake among children.

Table 1
Demographic characteristics of parents and caregivers included in the study (N = 446)

Variables		
	N = 446	
n	**(%)**	
Participants' Age		
18–30 years	261	(58.52)
31–40 years	159	(35.65)
41–50 years	19	(4.26)
> 50 years	7	(1.57)
Gender		
Female	409	(91.70)
Male	37	(8.30)
Relationship of the respondent with the child		
Parents	438	(98.21)
Primary caregivers	4	(0.89)
Others	4	(0.89)
Location-wise vaccination status of the children		
Dhaka North City Corporation vaccination status		
Vaccinated	188	(84.30)
Unvaccinated	35	(15.70)
Dhaka South City Corporation vaccination status		
Vaccinated	121	(54.26)
Unvaccinated	102	(45.74)

Table 2
Parental knowledge, awareness, attitudes, perceptions, and vaccination-related practices regarding Typhoid Conjugate Vaccine (TCV) vaccination (N = 446)

Variables	N = 446	
	n	(%)
Knowledge regarding vaccination		
Heard about the TCV vaccine		
Yes	390	(87.44)
No	56	(12.56)
Source of knowledge about the TCV vaccine		
Doctors and nurses	8	(1.79)
Friends and relatives	36	(8.07)
Mass media (e.g., TV, Radio, YouTube, Facebook)	126	(28.25)
Personal knowledge	0	0
NGOs	270	(60.54)
Others	197	(44.17)
Do not know	10	(2.24)
Heard about the TCV vaccination campaign		
Yes	437	(97.98)
No	9	(2.02)
Knowledge about eligibility for getting the vaccine		
0–8 months	2	(0.45)
9 months–14 years	357	(80.04)
More than 14 years	1	(0.22)
Do not know	86	(19.28)
Parental attitude and practice towards the TCV vaccination		
Believe in vaccine safety.		
Yes	408	(91.48)
No	38	(8.52)
Have fears about the vaccine		
Yes	163	(36.55)
No	283	(63.45)
Fears about the vaccine		
Fear of side effects (e.g., fever, pain, or other health issues)	148	(33.18)

Variables	N = 446	
	n	(%)
Knowledge regarding vaccination		
Fear of infertility or reproductive problems	27	(6.05)
Fear that the vaccine is new and not fully tested	12	(2.69)
Fear due to misinformation or rumors	37	(8.30)
Fear of injection or needles	4	(0.90)
Fear that it might conflict with religious or cultural beliefs	4	(0.90)
Fear that it may not be effective	3	(0.67)
Vaccine recommendation		
Discourage taking the vaccine	3	(0.67)
Only if they ask	77	(17.26)
Strongly recommend	297	(66.59)
No comments	69	(15.47)
Point of contact if the vaccine dose is missed		
Doctor	395	(88.57)
Nurse	39	(8.74)
Pharmacist	9	(2.02)
Family or friends	1	(0.22)
Will handle myself	2	(0.45)

Table 3
Distribution of parental responses to individual items of the Vaccine Attitudes Scale (VAS) (N = 446)

Item on VAS		
	N = 446	
	n	**(%)**
Children get more vaccinations than are actually good for them.		
Strongly agree	7	(1.57)
Agree	57	(12.78)
Neutral	98	(21.97)
Disagree	217	(48.65)
Strongly disagree	67	(15.02)
Healthy children do not need vaccinations.		
Strongly agree	3	(0.67)
Agree	12	(2.69)
Neutral	4	(0.90)
Disagree	331	(74.22)
Strongly disagree	96	(21.52)
Vaccinations do more harm than good.		
Strongly agree	2	(0.45)
Agree	9	(2.02)
Neutral	10	(2.24)
Disagree	337	(75.56)
Strongly disagree	88	(19.73)
It is better for my child to develop immunity by getting sick than to get a vaccination.		
Strongly agree	2	(0.45)
Agree	11	(2.47)
Neutral	9	(2.02)
Disagree	320	(71.75)
Strongly disagree	104	(23.32)
I should be allowed to selectively choose the vaccines that I believe my child needs.		
Strongly agree	9	(2.02)
Agree	84	(18.83)
Neutral	49	(10.99)

Disagree	260	(58.30)
Strongly disagree	44	(9.87)
It is better for my child to receive two injectable vaccines in one visit rather than one injectable vaccine in two visits.		
Strongly agree	85	(19.06)
Agree	42	(9.42)
Neutral	57	(12.78)
Disagree	225	(50.45)
Strongly disagree	37	(8.30)
I am concerned my child might have a serious side effect from vaccination.		
Strongly agree	7	(1.57)
Agree	136	(30.49)
Neutral	24	(5.38)
Disagree	224	(50.22)
Strongly disagree	55	(12.33)
Following the vaccination schedule is a good idea for my child.		
Strongly agree	166	(37.22)
Agree	255	(57.17)
Neutral	15	(3.36)
Disagree	9	(2.02)
Strongly disagree	1	(0.22)
Parents who do not vaccinate their children should be penalized with a monetary fine.		
Strongly agree	32	(7.17)
Agree	125	(28.03)
Neutral	107	(23.99)
Disagree	127	(28.48)
Strongly disagree	55	(12.33)
I would like to be a volunteer advocate for vaccination in my community if I am trained.		
Strongly agree	45	(10.09)
Agree	178	(39.91)
Neutral	68	(15.25)
Disagree	132	(29.60)
Strongly disagree	23	(5.16)

I believe many of the illnesses that vaccines prevent are severe.		
Strongly agree	128	(28.70)
Agree	310	(69.51)
Neutral	4	(0.90)
Disagree	4	(0.90)
Strongly disagree	0	0
When I see a child or a picture of a child with polio, diphtheria, pertussis (whooping cough), tetanus, hepatitis B, pneumonia, meningitis, or measles, I am reminded of the need for vaccination.		
Strongly agree	147	(32.96)
Agree	294	(65.92)
Neutral	3	(0.67)
Disagree	2	(0.45)
Strongly disagree	0	0
When my child is vaccinated, it benefits my entire community by reducing the spread of disease.		
Strongly agree	139	(31.17)
Agree	302	(67.71)
Neutral	3	(0.67)
Disagree	2	(0.45)
Strongly disagree	0	0
When a parent refuses to vaccinate a child, it harms the entire community through the risk of disease.		
Strongly agree	128	(28.70)
Agree	311	(69.73)
Neutral	5	(1.12)
Disagree	2	(0.45)
Strongly disagree	0	0

Table 4
Bivariate analysis of factors associated with Typhoid conjugate vaccine (TCV) uptake among parents of children in Dhaka North and Dhaka South City Corporations (N = 446)

Variable	Vaccinated n (%)	Unvaccinated n (%)	p-value
Knowledge level			
Poor (score > 50)	13 (30.95)	29 (69.05)	0.000*
Moderate (score 50–75)	19 (28.79)	47 (71.21)	
Good (score < 75)	277 (81.95)	61 (18.05)	
Gender			
Female	286 (69.93)	123 (30.07)	0.327
Male	23 (62.16)	14 (37.84)	
Believe the vaccine is safe.			
Yes	308 (75.49)	100 (24.51)	0.000*
No	1 (2.63)	37 (97.37)	
Have fears about the vaccine.			
Yes	77 (47.24)	86 (53.76)	0.000*
No	232 (81.98)	51 (18.02)	
Heard about the campaign			
Yes	308 (70.16)	131 (29.84)	0.001*
No	1 (14.29)	6 (85.71)	
Trust in the campaign information			
Yes	308 (76.24)	96 (23.76)	0.000*
No	1 (2.38)	41 (97.62)	
The campaign motivated people to get the vaccine.			
Yes	309 (77.64)	89 (22.36)	0.000*
No	0	48 (100.00)	

Table 5
Multivariable logistic regression analysis of factors associated with TCV uptake among parents of children in Dhaka North and Dhaka South City Corporations (N = 446)

		Vaccination status		Bivariate logistic regression			Multivariate logistic regression		
Variable	Category	Vaccinated n (%)	Unvaccinated n (%)	cOR	(95% CI)	p-value	aOR	(95% CI)	p-value
Knowledge level	Poor (ref.)	13 (30.95)	29 (69.05)	1.00	-	-	-	-	-
	Moderate	19 (28.79)	47 (71.21)	0.90	0.39–2.10	0.81	-	-	-
	Good	277 (81.95)	61 (18.05)	10.13	4.98–20.61	**0.00***	3.36	1.25-9.00	**0.01***
Gender	Female (ref.)	286 (69.93)	123 (30.07)	1.00	-	-	-	-	-
	Male	23 (62.16)	14 (37.84)	0.70	0.35–1.41	0.33	-	-	-
Belief vaccines are safe	No (ref.)	1 (2.63)	37 (97.37)	1.00	-	-	1.00	-	-
	Yes	308 (75.49)	100 (24.51)	113.96	15.44-841.25	**0.00***	17.36	1.89-159.86	**0.01***
Have fears about the vaccine	No (ref.)	232 (81.98)	51 (18.02)	1.00	-	-	1.00	-	-
	Yes	77 (47.24)	86 (53.76)	0.20	0.13–0.30	**0.00***	0.42	0.25–0.72	**0.00***
Heard about the campaign	No (ref.)	1 (14.29)	6 (85.71)	1.00	-	-	1.00	-	-
	Yes	308 (70.16)	131 (29.84)	14.11	1.68-118.33	**0.01***	3.42	0.14–81.12	0.44
Trust in the campaign information	No (ref.)	1 (2.38)	41 (97.62)	1.00	-	-	1.00	-	-
	Yes	308 (76.24)	96 (23.76)	131.54	17.86-968.97	**0.00***	15.49	1.85-129.47	**0.01***

Table 6
Association of the immunization status of children in Dhaka North and Dhaka South City Corporations with parental VAS score (N = 446)

Scale	**N (%)**	**cOR**	**(95% CI)**	**p-value**	**aOR**	**(95% CI)**	**p-value**
Total VAS							
Low (< 31) (ref.)	213 (47.76)	1.00	-	-	1.00	-	-
Moderate to high (31–70)	233 (52.24)	0.51	0.34–0.78	**0.00***	0.48	0.28–0.82	**0.00***

Scale	N (%)	cOR	(95% CI)	p-value	aOR	(95% CI)	p-value
Vaccine Perceptions & Concerns							
Low (< 23) (ref.)	165 (37.00)	1.00	-	-	1.00	-	-
Moderate to high (23–50)	281 (63.00)	0.63	0.41–0.98	**0.04***	0.43	0.25–0.72	**0.00***
Attitude towards disease salience and community benefit scale							
Low (< 7) (ref.)	151 (33.86)	1.00	-	-	1.00	-	-
Moderate to high (7–20)	295 (66.14)	0.39	0.24–0.62	**0.00***	0.37	0.22–0.64	**0.00***

4. Discussion

This study assessed parental knowledge, attitudes, and acceptance of TCV among children in urban slum communities of Dhaka and examined the sociodemographic, cognitive, and attitudinal correlates of vaccination status. The findings offer a nuanced picture: overall awareness and vaccine confidence were high, uptake was substantial, and yet clear structural and psychological gaps persisted that limited full coverage.

Of the 452 eligible households approached, 446 participants agreed to be interviewed, yielding a response rate of 98.6%. Such a high participation rate strengthens confidence in the representativeness of the sample and reduces the likelihood of substantial non-response bias. Consistent with the sociocultural context of Bangladesh, the majority of respondents were mothers (91.7%), a pattern that reflects prevailing caregiving norms in which women retain primary responsibility for children's health-related decisions, while men are more frequently engaged in employment outside the home during daytime hours. Nearly seven in ten children (69.3%) had received TCV at the time of the survey, a coverage level that, while encouraging, still leaves roughly one-third of eligible children unvaccinated and underscores the need for continued programmatic attention (4–7).

A particularly notable finding was the marked geographic disparity in uptake between the two administrative zones of the capital. Vaccination coverage in Dhaka North City Corporation approached 84%, compared with only 54% in Dhaka South City Corporation, despite near-equal representation of both areas in the sample. Such within-city variation is not uncommon in large-scale immunization campaigns implemented across densely populated and unevenly resourced urban settings, and it more plausibly reflects differences in campaign intensity, staffing, or outreach coordination between zones than any underlying difference in parental willingness to vaccinate (5, 6, 8). This disparity illustrates a broader methodological point: aggregate, city-wide, or national coverage estimates can obscure meaningful sub-district inequities that warrant targeted investigation and resource allocation.

Awareness of TCV in this population was high, with 87% of respondents reporting prior knowledge of the vaccine. This figure compares favorably with a study conducted in an outbreak setting in Pakistan, where only 54.2% of participants demonstrated awareness of TCV, suggesting that dissemination of vaccine-related information may have been more effective in the present setting, possibly owing to the scale and visibility of the national campaign (1). Notably, non-governmental organizations were identified as the principal source of information (60.5%), followed by mass media (28.3%), while healthcare providers accounted for only 1.8% of reported exposure. The prominent role of community-based organizations in disseminating vaccine information is consistent with evidence from other low- and middle-income settings, where such organizations often possess stronger trust and grassroots access than formal health

infrastructure (5, 6). Nevertheless, the limited involvement of healthcare providers in information delivery is a finding of some concern, given that healthcare professionals are consistently identified as among the most trusted sources of vaccine-related guidance. Their minimal presence in the information pipeline observed here likely represents an underused opportunity rather than a neutral finding, and future campaigns may benefit from deliberately integrating provider-led communication alongside community-based outreach (4, 5, 9, 10).

With respect to knowledge, the majority of respondents (80%) correctly identified the eligible age range for TCV vaccination (9 months to 14 years), indicating a reasonably sound understanding of vaccination guidelines among caregivers in this population. This level of accurate knowledge is broadly consistent with findings from other low- and middle-income settings, where direct exposure to vaccination campaigns has been shown to enhance general awareness of immunization schedules and eligibility criteria (11). Attitudes toward vaccination were, on the whole, favorable: 91.5% of respondents perceived TCV as safe, and 85% reported that they would strongly recommend vaccination to others. These proportions are comparable to, and in some respects exceed, those reported in the Pakistani cohort, in which 78–80% of respondents considered the vaccine safe and effective, and 92% expressed strong willingness to recommend it (12).

Despite this generally favorable orientation, more than one-third of respondents (36.6%) reported some degree of concern regarding vaccination, most commonly fear of side effects (33.2%), followed by concerns rooted in misinformation or rumor, and, less frequently, fear of infertility. This coexistence of high overall confidence alongside persistent, specific concerns is not contradictory; rather, it reflects a well-documented pattern in the vaccine hesitancy literature, wherein safety confidence and safety concern operate as distinct dimensions capable of coexisting within the same population and even within the same individual (13–16). The World Health Organization has similarly identified diminished confidence in vaccine safety and the circulation of misinformation as two of the principal global drivers of vaccine hesitancy (16, 17). Reassuringly, most respondents (88.6%) indicated that they would consult a physician in the event of a missed vaccine dose, demonstrating substantial residual trust in formal healthcare services notwithstanding the limited role that healthcare providers played in initial information dissemination. This apparent divergence between low provider-initiated outreach and high provider-directed trust further reinforces the case for more deliberate integration of healthcare professionals into campaign communication strategies.

An important secondary observation concerned parents who had been exposed to the campaign but had nonetheless not vaccinated their children. Among this subgroup, the predominant concern was not fear of harm but doubt regarding vaccine efficacy. This distinction carries meaningful implications for campaign design, as it suggests that messaging efforts may have more successfully addressed safety concerns than concerns regarding effectiveness. Given the substantial trial-based evidence supporting the protective efficacy of TCV, this represents a communication gap that could plausibly be addressed through more explicit messaging emphasizing demonstrated vaccine performance (18–20).

Findings from the VAS further corroborated the generally positive orientation toward immunization observed in this population. The majority of respondents rejected common misconceptions, including the beliefs that children receive more vaccines than necessary, that healthy children do not require vaccination, and that naturally acquired immunity is preferable to vaccine-induced protection. Strong agreement was similarly observed for statements affirming the importance of adherence to recommended vaccination schedules and recognition of the severity of vaccine-preventable disease. Respondents also demonstrated marked awareness of the broader community-level benefits of vaccination, consistent with an understanding of herd protection. These patterns align with previous research linking positive attitudes toward vaccine safety and collective protection to higher rates of vaccine acceptance (18, 21, 22). Nonetheless, a subset of respondents continued to express concern regarding potential side effects and

demonstrated variability in attitudes toward selective vaccination and willingness to serve as vaccination advocates, indicating that a degree of residual hesitancy persists even within an overall supportive population. This pattern is consistent with prior evidence identifying safety concerns and misinformation as durable barriers to vaccine uptake, even in settings characterized by generally favorable attitudes (14, 16). As the World Health Organization has emphasized, confidence in vaccine safety and trust in the broader health system remain critical, interdependent determinants of vaccine acceptance (13, 17).

Bivariate analysis confirmed that vaccination status was significantly associated with parental knowledge, perceived vaccine safety, vaccination-related fear, awareness of the campaign, trust in campaign information, and campaign-related motivation (all $p < 0.05$). The gradient associated with knowledge was particularly pronounced, with vaccination coverage rising from approximately 30% among caregivers with poor or moderate knowledge to nearly 82% among those with good knowledge. Trust in campaign information demonstrated an even more pronounced differential, with vaccination coverage almost absent among respondents who did not trust campaign messaging. Parental gender, by contrast, was not significantly associated with vaccination status ($p = 0.327$), indicating comparable uptake behavior between male and female caregivers once other factors were considered.

Following adjustment for potential confounders, several of these associations remained independently significant, while others attenuated—an important distinction for prioritizing intervention strategies. Adequate parental knowledge remained an independent predictor of vaccination, with well-informed caregivers approximately three times more likely to vaccinate their children (aOR = 3.36, 95% CI: 1.25–9.00, $p = 0.01$). Perceived vaccine safety emerged as the single strongest independent predictor in the model, with caregivers who believed the vaccine to be safe more than seventeen times more likely to vaccinate (aOR = 17.36, 95% CI: 1.89–159.86, $p = 0.01$), while trust in campaign information conferred approximately fifteen-fold higher odds of vaccination (aOR = 15.49, 95% CI: 1.85–129.47, $p = 0.01$). Vaccine-related fear remained independently and negatively associated with uptake (aOR = 0.42, 95% CI: 0.25–0.72, $p < 0.001$). Notably, simple awareness of the campaign, although significant in unadjusted analysis, lost statistical significance after adjustment—an observation suggesting that exposure to campaign messaging alone is insufficient to drive behavior change unless accompanied by trust and perceived credibility of the information source (10, 17, 18, 23, 24).

Analyses incorporating VAS domain scores provided additional insight into the attitudinal architecture underlying vaccination decisions. Higher scores on the vaccine perceptions and concerns subscale were independently associated with lower odds of vaccination (aOR = 0.43, 95% CI: 0.25–0.72, $p < 0.001$), whereas stronger endorsement of disease severity and community-benefit beliefs was independently associated with higher odds of vaccination (aOR = 0.37, 95% CI: 0.22–0.64, $p < 0.001$). These findings closely parallel those reported by Batool and colleagues using the same instrument in Pakistan, and are consistent with broader behavioral evidence indicating that perceived collective benefit and disease threat often exert influence on vaccination decisions independent of, and sometimes exceeding, purely informational factors (12, 18, 21)

.

Collectively, these findings indicate that improving TCV coverage in Dhaka's urban slum communities will require strategies that extend beyond generalized awareness-raising. Three priorities emerge from the data. First, the substantial disparity in uptake between Dhaka North and Dhaka South points to the need for more equitable allocation of campaign resources and closer monitoring of sub-district implementation fidelity. Second, the finding that unvaccinated but campaign-aware parents were primarily concerned with vaccine efficacy, rather than safety alone, suggests that hesitancy messaging should not be treated as a uniform construct but tailored to the specific nature of parental doubt. Third, the disproportionate influence of trust and, by extension, the underutilization of healthcare

providers as an information source, suggests that more deliberate integration of clinical personnel into campaign communication may yield meaningful gains in both confidence and uptake. Taken together, these findings reinforce the view that vaccine acceptance is shaped not by any single factor but by the interaction of knowledge, safety perception, trust, and social values, and that future interventions should be designed accordingly.

When interpreting the findings in this study, several limitations should be considered. First, the study was conducted across two city corporations in Dhaka where only four slums were selected. Consequently, the diverse socioeconomic and cultural characteristics of all urban slum communities in Bangladesh may not be fully represented by the findings. Second, the study population was restricted to the households of urban slums and did not include the entire urban population. Therefore, the findings may not represent the non-slum urban residents or rural populations, where access to health services, health-seeking behaviors, and determinants of vaccine uptake may vary. Third, as the data were collected primarily during regular working hours, the proportion of fathers participating in the survey was relatively low, as many fathers were not at the residence. This may not have captured both paternal perspectives regarding childhood vaccination decisions. Notwithstanding these limitations, the study highlights the valuable evidence on the knowledge, attitudes, and factors influencing the TCV uptake among one of the most underserved and high-risk populations in Bangladesh. The use of a relatively large sample size, a structured questionnaire, and multivariable regression analysis has strengthened the validity of the findings and demonstrates important insights to inform future immunization strategies and public health interventions.

5. Conclusion

This study found that TCV uptake among children living in slum settings was relatively high; however, a considerable proportion of children remained unvaccinated. Parental knowledge, perceived vaccine safety, and trust in campaign information were significant positive determinants of vaccine uptake, while fear and vaccine-related concerns negatively influenced vaccination behavior. Although parents generally demonstrated favorable attitudes toward childhood vaccination, persistent concerns regarding side effects and vaccine safety continued to affect uptake decisions.

The findings further highlight that parental attitudes and perceptions are multidimensional and extend beyond simple awareness of vaccination. Trust-building, addressing misconceptions, and strengthening risk communication may play a critical role in improving vaccine acceptance. Community-based awareness programs and culturally appropriate communication strategies involving healthcare providers and trusted community actors could help reduce hesitancy and improve vaccination coverage.

Overall, these findings underscore the importance of strengthening public health messaging and behavioral interventions to enhance vaccine confidence and ensure equitable vaccine uptake among underserved populations in urban slum settings.

Abbreviations

Dhaka South City Corporation (DSCC)

Dhaka North City Corporation (DNCC)

Disability-Adjusted Life Years (DALYs)

Expanded Program on Immunization (EPI)

Typhoid Conjugate Vaccine (TCV)

Vaccine Attitude Scale (VAS)

World Health Organization (WHO)

Declarations

Declarations

7.1. Acknowledgement:

We would like to thank our participants for their time and effort in data collection. We further want to express our gratitude to EPI Bangladesh, Dhaka South City Corporation (DSCC), and Dhaka North City Corporation (DNCC) for their support in field-level management.

7.2. Ethics approval and consent to participate.

This study was conducted according to the ethical principles for research involving human participants. The Institute for developing Science and Health initiatives (ideSHi)'s Institutional Review Board (IRB), Dhaka, Bangladesh [Reference no. IRB-PNR-25003] ethically approved this study. Informed written consent was obtained from all participants prior to data collection. During the process, participants were informed about the purpose and procedures of the study and their right to withdraw from the study at any time without any negative consequences.

7.3. Human Ethics and Consent to Participate declarations

All experimental protocols involving human participants were approved by the Institutional Review Board (IRB) of the Institute for Developing Science and Health Initiatives (ideSHi), Dhaka, Bangladesh (Reference no. IRB-PNR-25003), and all methods were carried out in accordance with relevant guidelines and regulations. Written informed consent was obtained from all participants prior to data collection.

7.4. Clinical trial number

Not applicable.

7.5. Consent for publication

Not applicable.

7.7. Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The authors declare no competing interests.

7.9. Authors' Contributions and Acknowledgements

RR, KA, and FQ conceived the idea and developed the protocol. AK, DTG, RR, and SK collected the data and managed field operations. KA, ASM, and YM analyzed and interpreted the data. KA, ASM, YM, and RR performed the write-up of

the manuscript. FQ and RR reviewed the manuscript for intellectual content critically. The final version of the manuscript was reviewed and approved by all authors.

7.8. Funding

This research was funded by PATH International, grant number UOM.585894-01739980-CRT.

Author Contribution

RR, KA, and FQ conceived the idea and developed the protocol. AK, DTG, RR, and SK collected the data and managed field operations. KA, ASM, and YM analyzed and interpreted the data. KA, ASM, YM, and RR performed the write-up of the manuscript. FQ and RR reviewed the manuscript for intellectual content critically. The final version of the manuscript was reviewed and approved by all authors.

Acknowledgement

We would like to thank our participants for their time and effort in data collection. We further want to express our gratitude to EPI Bangladesh, Dhaka South City Corporation (DSCC), and Dhaka North City Corporation (DNCC) for their support at the field-level management.

Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to participants' privacy protection but are available from the corresponding author on reasonable request.

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Figures

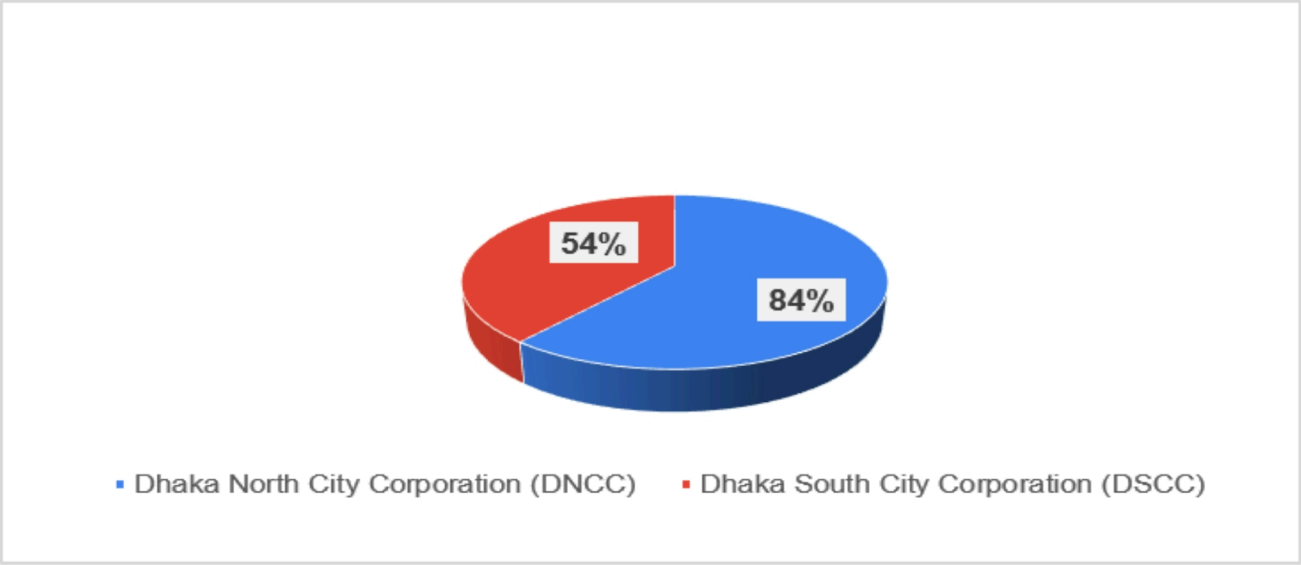


Figure 1

Distribution of Typhoid Conjugate Vaccine (TCV) uptake among children in Dhaka North and Dhaka South city corporations.

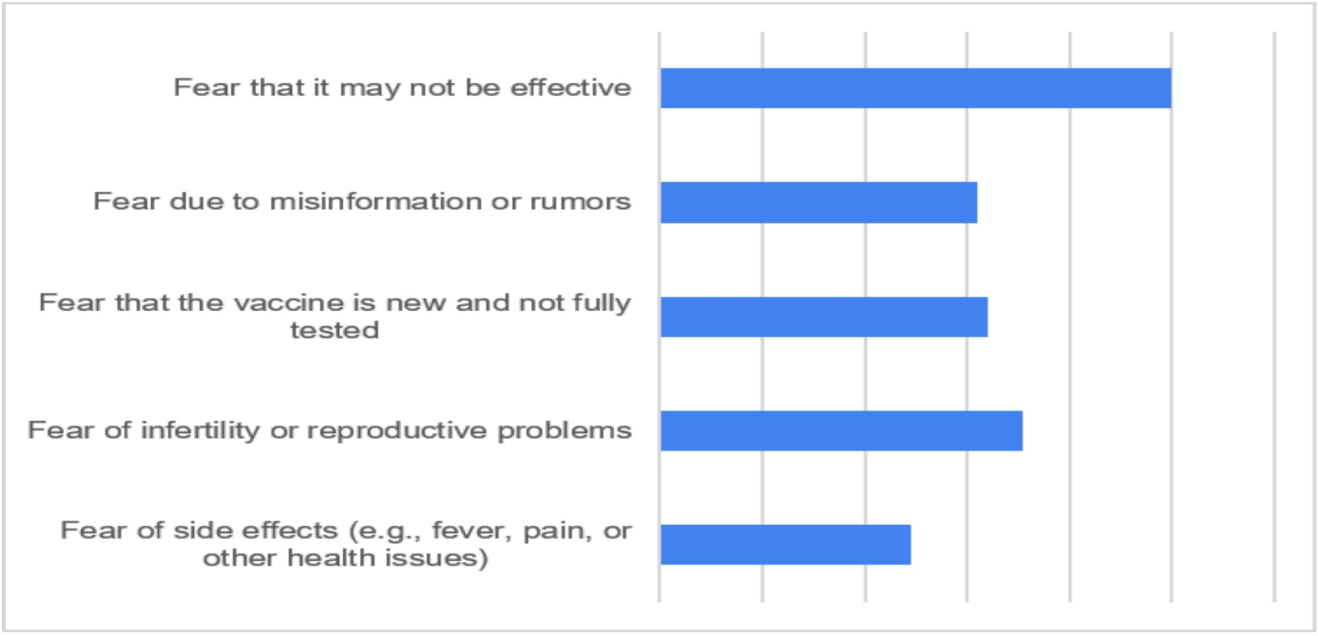


Figure 2

Common vaccine-related fears among parents who remained unvaccinated despite exposure to the TCV campaign

Supplementary Files

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