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Prevalence and associated factors of parental refusal rates for routine immunisation: a cross-sectional study in Peshawar, Khyber Pakhtunkhwa, Pakistan-2024

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Abstract

Background Vaccine hesitancy is a serious public health problem globally, particularly in low- and middle-income countries like Pakistan. This study aims to determine the vaccination refusal rate, associated factors and perceptions of parents who refused routine immunisation within Peshawar, Khyber Pakhtunkhwa, Pakistan.

Methods A cross-sectional study conducted in July-2024, among 340 parents of children aged 0–59 months. Data was collected using a structured vaccine hesitancy Survey Tool of the Strategic Advisory Group of Experts(SAGE). Multistage stratified cluster sampling was employed to ensure a representative sample of tehsils in district Peshawar. Chi-squared tests and multivariable logistic regression were used to identify factors associated with vaccine refusal.

Results Among 340 participants, 22% ($n=74$) refused vaccines for their children. A total of 15% employed mothers refused vaccines compared to only 4.5% unemployed mothers ($p=0.004$). The highest refusal rate was in tehsil Shaheen Muslim Town where 41% of parents refused vaccination ($p=0.035$). Parents who refused were less inclined to believe that vaccines protect children from vaccine preventable diseases (77% vs. 98%, $p<0.001$) and expressed higher rates of vaccine hesitancy (47% vs. 29%, $p=0.003$). Multivariable logistic regression revealed that employed mothers were over three times more inclined to refuse vaccination (AOR: 3.11, 95% CI: 1.25, 7.67), while factors like the total depression score was not significantly associated with refusal ($p=0.13$). Barriers including distance from health facility and associated cost, (AOR: 1.82, 95% CI:1.10,3.02), and the concerns about the necessity of vaccines (AOR: 2.50, 95% CI: 1.45, 4.30) was significantly associated with vaccine refusal.

Conclusions The high immunization refusal rate in Peshawar among parents was associated with maternal employment, logistical challenges such as distance immunisation services, associated cost, vaccine hesitancy and safety of vaccines. It is recommended to deploy mobile immunisation units and outreach sessions to improve access, using targeted, evidence-based education to address vaccine safety concerns.

Keywords Vaccine, Hesitancy, Parental refusal, Routine immunisation, Pakistan

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Background

In 2019, the World Health Organisation identified vaccine hesitancy as one of the top ten global health threats [1], drawing attention to the considerable public health challenge caused by parental refusal to routine immunisation [2]. Immunisation remains key to primary health care and is recognised as an indisputable human right [3], crucial in reducing mortality rates over the past two centuries [4]. It is estimated that between 3.5 million to 5 million deaths annually, prevented due to immunisation from diseases such as diphtheria, tetanus, pertussis, influenza, and measles [3]. Furthermore, an additional 1.5 million deaths could be avoided with improved global vaccination coverage [5].

Beyond health benefits, immunisation also provides substantial economic advantages, including reduced healthcare costs, shorter hospital stays and improved quality-adjusted life years (QALYs) [6, 7]. However, vaccine hesitancy has emerged as a significant barrier to achieving optimal vaccination coverage, especially in areas with deep-rooted cultural, religious, and socio-economic influences [8–10]. An estimated 14.5 million children worldwide remained unvaccinated, often referred to as "zero-dose" children. According to WHO's 2023 report, vaccine hesitancy continues to pose a critical challenge, with global coverage of the third dose of the DTP3 vaccine at 84% and the first dose of the measles vaccine at 83%, reflecting a decline from the 2019 level of 86% [11]. Key factors contributing to vaccine refusal include illiteracy, fear of adverse effects, and religious beliefs [8–10, 12]. Moreover, the COVID-19 pandemic has strained health systems globally, leading to significant drops in vaccination coverage. Data from 2023 indicates that around 22 million children missed their first vaccine dose, due to COVID-19 pandemic compared to 19.3 million in 2019. This increase highlights ongoing challenges in restoring routine immunizations [3].

Pakistan, which ranks third globally for the most under-vaccinated children [13], also bears the third-highest burden of child mortality [14]. It is projected that through targeted immunisation efforts, the country will avert nearly two-thirds of all vaccine-preventable deaths in the Eastern Mediterranean Region between 2021 and 2030 [15]. With 17% of its population under the age of five [16], this demographic significantly contributes to the high mortality rate in the country. Alarmingly, only 3 out of the 14 vaccines in Pakistan's immunisation schedule achieved coverage of 90% or more in 2023 [17]. Pakistan's Vision 2025, part of the broader Sustainable Development Goals (SDG) agenda, aims to reduce the infant mortality rate from 74 to less than 40 per 1,000 live births by enhancing immunisation targets. Despite the long-standing presence of the Expanded Program on Immunization (EPI) since 1978 [13], challenges such as low parental awareness, literacy rates, socio-economic disparities, cultural and religious beliefs, and the rise of conspiracy theories against the vaccine, continue to fuel widespread vaccine hesitancy and reduced coverage across Pakistan [18].

In Peshawar, a district in Pakistan with the highest number ($n = 18$) of Super High-Risk Union Councils (SHRUCs) are categorised by the National and Provincial Emergency Operations Centres (NEOC and PEOCs), for Polio eradication initiative where significant challenges persist. These areas, characterised by dense and underserved population groups, exhibit low levels of immunisation [19] despite the availability of vaccines and active promotion efforts by health authorities. High refusal rates in these areas continue to hinder progress in combating vaccine-preventable diseases (VPDs) in the region.

Understanding these associated factors is key for developing targeted intervention strategies to address vaccine hesitancy and improve immunisation coverage in this high-risk district. These efforts are integral to the nation's progress towards achieving Universal Health Coverage (UHC), a commitment reinforced by Pakistan's signing of the UHC2030 Global Compact in 2018, and are aligned with the Sustainable Development Goals (SDG) 3 targets, which aim to ensure healthy lives and promote well-being for all by 2030 [20, 21]. This study aims to investigate the prevalence and associated factors of parental refusal of routine immunisation within Peshawar, Khyber Pakhtunkhwa, Pakistan.

Methods

A cross-sectional study was conducted during July-2024 in district Peshawar, Khyber Pakhtunkhwa, Pakistan. We included those parents residing in Peshawar for at least 12 months and having at least one child aged 0–59 months. Parents working in the healthcare sector were excluded to minimise bias related to professional knowledge and influence on vaccination decisions.

Sample size and sampling strategy

The sample size was calculated using OpenEpi software, based on an estimated parental refusal rate of 27.9% [22], a 95% confidence interval, a 5% margin of error, with design effect of 0.2. A non-response rate of 10% was anticipated, resulting in a final sample size of 340. A multistage stratified cluster sampling technique was employed to ensure representative sampling across the various socio-demographic strata of Peshawar. In the first stage, four tehsils (sub-districts) and 34 union councils were randomly selected with 10 households within each union council using a systematic sampling technique, where every 3rd household was included. In households with more than one eligible parent, one participant was randomly selected through a lottery method. Similarly, if one parent had more than one eligible child of 0–59 months than one child was selected through a lottery method.

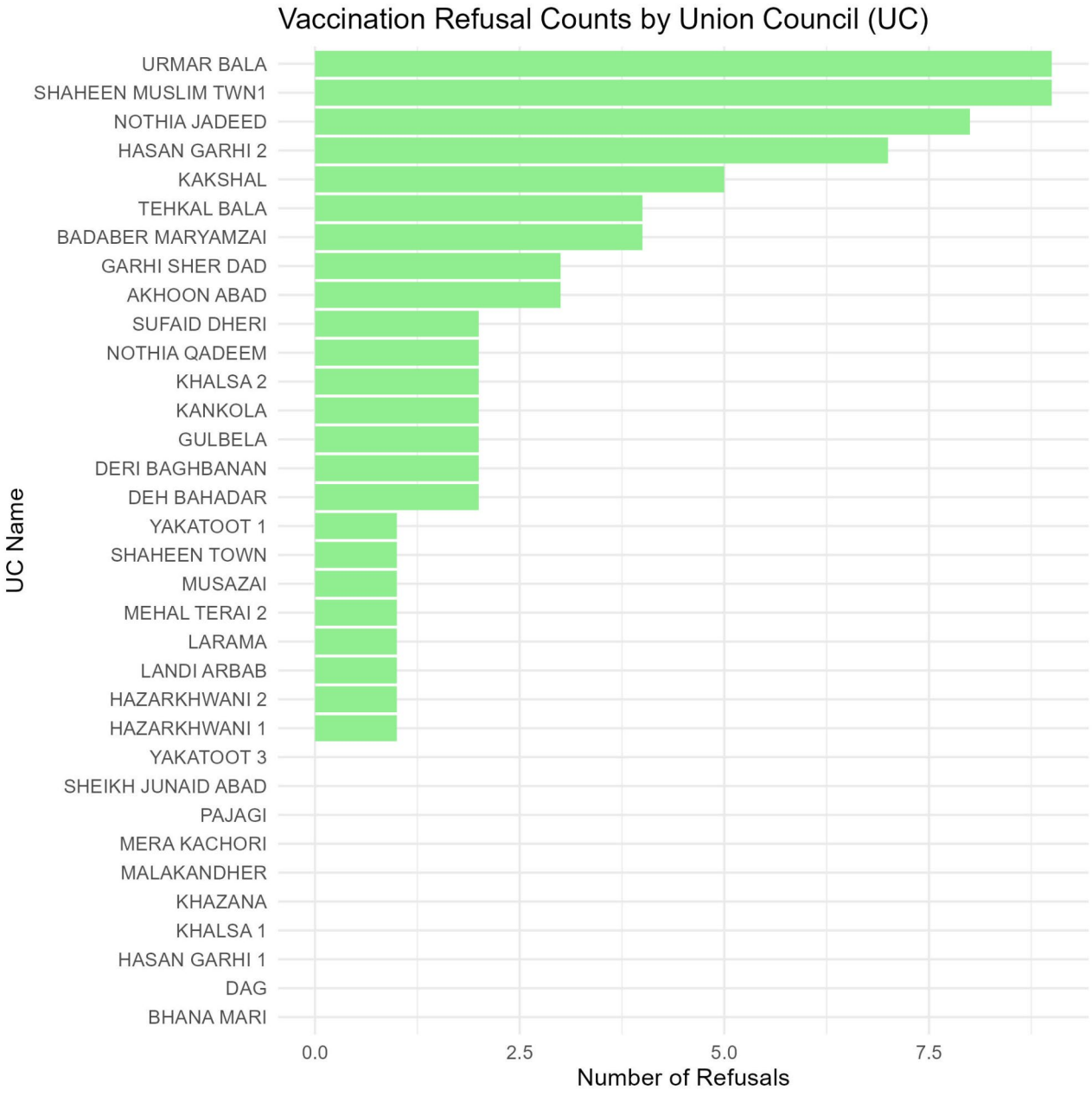

Fig. 1 Bar plot 1 vaccination refusal counts by union council

Data collection tool and ethical approval

Ethical approval for the study was granted by the Research Review Board (RRB) of the Associate Dean Research, Khyber College of Dentistry, Peshawar Pakistan*(No.: 147/RRB/KCD)*. Data was collected using a structured questionnaire of the SAGE Working Group on Vaccine Hesitancy Survey Tool [22]. It includes sections on demographic characteristics, attitudes towards immunisation, and potential barriers to vaccination. The survey also incorporated the Patient Health Questionnaire-9 (PHQ-9) for assessing depression, and the Household Food Insecurity Access Scale (HFIAS).

Depressive symptoms among participants were assessed using the PHQ-9 [23]. The PHQ-9 consists of nine items, each scored from 0 (not at all) to 3 (nearly every day), resulting in a total possible score ranging from 0 to 27. We categorised the total PHQ-9 scores into five levels of depression severity based on established cut-offs: minimal depression (scores 0–4), mild depression (scores 5–9), moderate depression (scores 10–14), moderately severe depression (scores 15–19), and severe depression (scores 20–27). Household food insecurity was measured using the HFIAS developed by the Food and Nutrition Technical Assistance (FANTA) project [24]. The

Table 1 Summary statistics of participant demographics

CHARACTERISTIC	*N* = 340[1]
TEHSIL NAME	
City	100 (29.41)
Saddar	40 (11.76)
Shah Alam	70 (20.59)
Shaheen Muslim Town	130 (38.24)
Have you ever refused a vaccination for your children	74 (21.76)
CHILD'S GENDER	
Female	152 (44.71)
Male	188 (55.29)
Child's age in months	27.19 ± 16.13
Mother's age years	29.74 ± 6.10
Mother to read and write	154 (45.29)
MOTHER'S EDUCATION	
Completed or some higher education	43 (12.65)
Completed or some primary education	51 (15.00)
Completed or some secondary education	61 (17.94)
No education	185 (54.41)
Mother s employment status	23 (6.76)
Mother owns a mobile phone	119 (35.00)
Father is involved in caring	324 (95.29)
Father's age years	35.87 ± 7.44
Father to read and write	239 (70.29)
FATHER'S EDUCATION	
Completed or some higher education	93 (27.35)
Completed or some primary education	60 (17.65)
Completed or some secondary education	86 (25.29)
No education	101 (29.71)
FATHER S EMPLOYMENT	
Employed	247 (72.65)
Unemployed	93 (27.35)
Father owns a mobile phone	325 (95.59)
NUMBER OF CHILDREN LIVING IN THE HOUSE	
1	131 (38.53)
2	109 (32.06)
3	54 (15.88)
4	25 (7.35)
5	9 (2.65)
6	6 (1.76)
7	4 (1.18)
9	2 (0.59)
Family monthly income level	50,214.71 ± 74,573.58
Landline present in home	39 (11.47)
Family owns a radio	34 (10.00)
Family owns a television	195 (57.35)
Family owns a refrigerator	293 (86.18)
Does family own an electric or gas stove	289 (85.00)
Family owns a car	58 (17.06)
NUMBER OF AMENITIES FACILITIES	
0	14 (4.12)
1	35 (10.29)
2	92 (27.06)
3	127 (37.35)
4	51 (15.00)

Table 1 (continued)

CHARACTERISTIC	*N* = 340[1]
5	17 (5.00)
6	3 (0.88)
7	1 (0.29)
PARENTAL BELIEF AND BARRIERS ASSOCIATED WITH VACCINE REFUSAL	
Do you believe that vaccines can protect children from serious diseases	318 (93.53)
Do you think that most parents like you have their children vaccinated with all the recommended vaccines	315 (92.65)
Have you ever been reluctant or hesitant to get a vaccination for your children	111 (32.65)
Has distance timing of clinic time needed to get to clinic or wait at the clinic and or costs in getting to clinic prevented you from getting your children immunised	136 (40.00)
Are there other pressures in your life that prevent you from getting your children immunised on time	66 (19.41)
Are there any reasons you can think of why children should not be vaccinated	81 (23.82)
Do you think that it is difficult for some ethnic or religious groups in your community region to get vaccinations for their children	110 (32.35)
Have you ever received or heard negative information about vaccinations	176 (51.76)
Do leaders religious or political leaders teachers health care workers in your community support vaccinations for infants and children	287 (84.41)
PARENTAL ATTITUDES TOWARDS CHILDHOOD VACCINATION: LIKERT SCALE RESPONSES	
CHILDHOOD VACCINES ARE IMPORTANT FOR MY CHILD S HEALTH	
Agree	94 (27.65)
Disagree	7 (2.06)
Neither agree neither disagree	12 (3.53)
Strongly agree	227 (66.76)
CHILDHOOD VACCINES ARE EFFECTIVE	
Agree	137 (40.29)
Disagree	25 (7.35)
Neither agree neither disagree	26 (7.65)
Strongly agree	150 (44.12)
Strongly disagree	2 (0.59)
HAVING MY CHILD VACCINATED IS IMPORTANT FOR THE HEALTH OF OTHERS IN MY COMMUNITY	
Agree	159 (46.76)
Disagree	10 (2.94)
Neither agree neither disagree	31 (9.12)
Strongly agree	140 (41.18)
ALL CHILDHOOD VACCINES OFFERED BY THE GOVERNMENT PROGRAM IN MY COMMUNITY ARE BENEFICIAL	
Agree	158 (46.47)
Disagree	4 (1.18)
Neither agree neither disagree	29 (8.53)
Strongly agree	149 (43.82)
DO NEW VACCINES CARRY MORE RISKS THAN OLDER VACCINES	
Agree	90 (26.47)
Disagree	47 (13.82)
Neither agree neither disagree	137 (40.29)
Strongly agree	46 (13.53)
Strongly disagree	20 (5.88)
THE INFORMATION I RECEIVE ABOUT VACCINES FROM THE VACCINE PROGRAM IS RELIABLE AND TRUSTWORTHY	
Agree	166 (48.82)
Disagree	13 (3.82)
Neither agree neither disagree	30 (8.82)
Strongly agree	130 (38.24)
Strongly disagree	1 (0.29)
GETTING VACCINES IS A GOOD WAY TO PROTECT MY CHILD CHILDREN FROM DISEASE	
Agree	162 (47.65)
Disagree	3 (0.88)
Neither agree neither disagree	21 (6.18)

Table 1 (continued)

CHARACTERISTIC	*N* = 340[1]
Strongly agree	154 (45.29)
GENERALLY, I DO WHAT MY DOCTOR OR HEALTH CARE PROVIDER RECOMMENDS ABOUT VACCINES FOR MY CHILD/CHILDREN	
Agree	176 (51.76)
Disagree	3 (0.88)
Neither agree neither disagree	28 (8.24)
Strongly agree	133 (39.12)
I AM CONCERNED ABOUT THE SERIOUS ADVERSE EFFECTS OF VACCINES	
Agree	131 (38.53)
Disagree	41 (12.06)
Neither agree neither disagree	92 (27.06)
Strongly agree	57 (16.76)
Strongly disagree	19 (5.59)
MY CHILD CHILDREN DOES OR DO NOT NEED VACCINES FOR DISEASES THAT ARE NOT COMMON ANYMORE	
Agree	104 (30.59)
Disagree	72 (21.18)
Neither agree neither disagree	95 (27.94)
Strongly agree	53 (15.59)
Strongly disagree	16 (4.71)
Total depression score	4.91 ± 4.00

[1] n (%); Mean ± SD

HFIAS comprises nine questions assessing households' experiences with food access over the past 30 days, with responses scored to reflect the frequency of occurrence: 0 for never, 1 for rarely, 2 for sometimes, and 3 for often. The total HFIAS scores range from 0 to 27. We categorised households into four levels of food insecurity based on their total scores: food secure (scores 0–1), mildly food insecure (scores 2–7), moderately food insecure (scores 8–14), and severely food insecure (scores 15–27).

Data collection procedures and quality assurance

Trained surveyors conducted face-to-face interviews with participants, administering the online structured questionnaire by visiting participants at doorsteps. To maintain data quality, several measures were implemented during the data collection process. A field supervisor conducted random checks and provided feedback to interviewers to ensure data accuracy at the end of the day designated place. Data entry was completed using online Google Forms.

Data analysis

The data were analysed using R/R studio 4.3.2. Continuous variables, such as food insecurity score, child's age, maternal age, and paternal age, were converted into categorical variables by dividing the range into three equal intervals. The relationships between parental refusal of routine immunisation and various explanatory variables, as well as responses to Likert scale survey questions, were assessed using the Chi-squared test. Factors with a p-value of less than 0.05 were further analysed using a logistic regression model to identify predictors of vaccination refusal. Multivariable logistic regression was employed to calculate adjusted odds ratios (OR) for potential confounders, with statistical significance set at a p-value of less than 0.05.

Results

A total of 340 participants were included, with 78% (n = 266) reporting no refusals of vaccination for their children and 22% (n = 74) refusing vaccination. The Fig. 1 shows that Union councils(UCs) Urmar Bala and Shaheen Muslim Town (SMT1) had the highest refusal counts with 8 refusals each. Table 1 illustrates the summary statistics of all participants. The majority of the children were male (55.29%), with an average age of 27.2 months (SD = 16.1). Mothers were generally able to read and write (45.29%), though 54.41% had no formal education only 6.76% were employed. Most mothers (35%) and nearly all fathers (95.59%) owned a mobile phone. Most respondents believed that vaccines could protect children from serious diseases (93.53%), and 84.41% mentioned that community leaders support vaccinations. However, 32.7% had experienced vaccine hesitancy, and 40% quoted those logistical challenges such as barriers to immunisation. Concerns about serious adverse effects of vaccines were noted by 38.53% of participants, while 30.59% believed their children did not need vaccines for diseases that are no longer common. The average total depression score among respondents was 4.9 (SD = 4.0).

Table 2 presents the association of parental refusal with other demographic factors. Refusal rates were significantly associated with different Tehsils in Peshawar (p = 0.035), with the highest refusal observed in SMT (41%). Mothers who refused vaccination were more likely

Table 2 Demographic characteristics of participants by immunisation refusal status

CHARACTERISTIC	No, $N=266$[1]	Yes, $N=74$[1]	p-value[2]
TEHSIL NAME			
City	78 (29%)	22 (30%)	0.035
Saddar	26 (9.8%)	14 (19%)	
Shah Alam	62 (23%)	8 (11%)	
Shaheen Muslim Town	100 (38%)	30 (41%)	
CHILD'S GENDER			
Female	120 (45%)	32 (43%)	0.8
Male	146 (55%)	42 (57%)	
Child's age in months	27 (13, 41)	24 (11, 37)	0.3
Mother's age years	28.0 (25.0, 35.0)	28.5(25.0, 32.8)	>0.9
Mother to read and write	117 (44%)	37 (50%)	0.4
MOTHER'S EDUCATION			
Completed or some higher education	33 (12%)	10 (14%)	0.6
Completed or some primary education	41 (15%)	10 (14%)	
Completed or some secondary education	44 (17%)	17 (23%)	
No education	148 (56%)	37 (50%)	
Mother's employment status	12 (4.5%)	11 (15%)	0.004
Mother owns a mobile phone	92 (35%)	27 (36%)	0.8
Father is involved in caring	256 (96%)	68 (92%)	0.13
Father's age years	35 (30, 40)	35 (30, 42)	>0.9
Father to read and write	188 (71%)	51 (69%)	0.8
FATHER'S EDUCATION			
Completed or some higher education	70 (26%)	23 (31%)	0.7
Completed or some primary education	50 (19%)	10 (14%)	
Completed or some secondary education	67 (25%)	19 (26%)	
No education	79 (30%)	22 (30%)	
FATHER'S EMPLOYMENT			
Employed	185 (70%)	62 (84%)	0.018
Unemployed	81 (30%)	12 (16%)	
Father owns a mobile phone	254 (95%)	71 (96%)	>0.9
NUMBER OF CHILDREN LIVING IN THE HOUSE			
1	101 (38%)	30 (41%)	0.2
2	91 (34%)	18 (24%)	
3	44 (17%)	10 (14%)	
4	15 (5.6%)	10 (14%)	
5	5 (1.9%)	4 (5.4%)	
6	5 (1.9%)	1 (1.4%)	
7	3 (1.1%)	1 (1.4%)	
9	2 (0.8%)	0 (0%)	
Family monthly income level	35,000 (20,000, 55,000)	40,000 (20,000, 67,500)	0.2
Landline present in home	25 (9.4%)	14 (19%)	0.037
Family owns a radio	25 (9.4%)	9 (12%)	0.5
Family owns a television	155 (58%)	40 (54%)	0.6
Family owns a refrigerator	226 (85%)	67 (91%)	0.3
Does family own an electric or gas stove	227 (85%)	62 (84%)	0.7
Total depression score	5.0 (1.0, 8.0)	4.0 (1.0, 6.0)	0.062

[1]n (%); Median (IQR)

[2]Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates); Fisher's exact test; Welch Two Sample t-test

to be employed (15% vs. 4.5%, $p=0.004$). Similarly, fathers of children who refused vaccination were also employed (84% vs.70%, $p=0.018$). The presence of a landline in the home was significantly associated with refusal (19% vs. 9.4%, $p=0.037$). No significant differences were found in parental education, family income, or ownership of household items like a television or refrigerator. The total depression score was slightly lower in the refusal group,

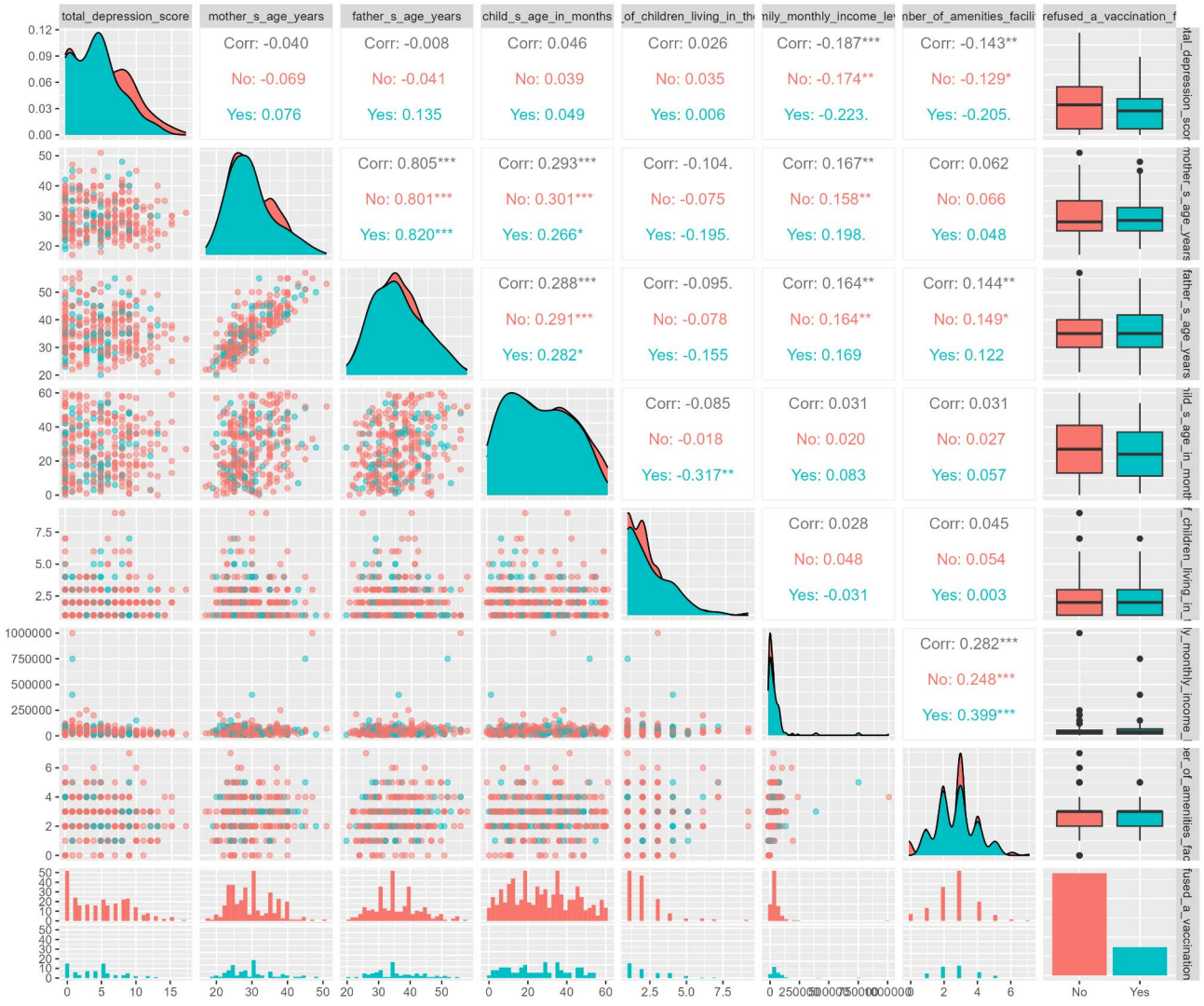

Fig. 2 Correlation of depression score of the participants with other cofactors

though this was not statistically significant (median 4.0 vs. 5.0, $p = 0.062$).

We analysed the depression score of the participants with other cofactors as well. The total depression score shown in the correlation Fig. 2 showed varying degrees of correlation with several factors. A significant negative correlation was observed between the total depression score and family monthly income level (Corr: -0.187, $p < 0.001$), suggesting that higher income levels were associated with lower depression scores. Similarly, there was a significant negative correlation with the number of amenities/facilities (Corr: -0.143, $p < 0.01$), indicating that access to more amenities was linked to lower depression scores. Interestingly, the correlation between total depression score and parental ages was minimal, with mother's age (Corr: -0.040, $p > 0.05$) and father's age (Corr: -0.008, $p > 0.05$) showing weak negative correlations that were not statistically significant. Also, we looked at the total depression score by analysing the refusal rate among different union councils. In union council Sufaid Dheri, the depression score was much higher among refusal (see Fig. 3).

Table 3 presents parental beliefs and barriers associated with vaccine refusal. Our results showed that parents who refused vaccination for their children were significantly less likely to believe, that vaccines protect children from serious diseases (77% vs. 98%, $p < 0.001$) and less likely to think, that most parents vaccinate their children with all recommended vaccines (78% vs. 97%, $p < 0.001$). Vaccine hesitancy was higher among those who refused vaccination (47% vs. 29%, $p = 0.003$). Practical barriers, such as distance and cost, were also more commonly reported by those who refused vaccines (51% vs. 37%, $p = 0.031$), and they were more likely to quote other life pressures as reasons for delayed immunisation (30% vs. 17%, $p = 0.019$). Additionally, the refusal group was more

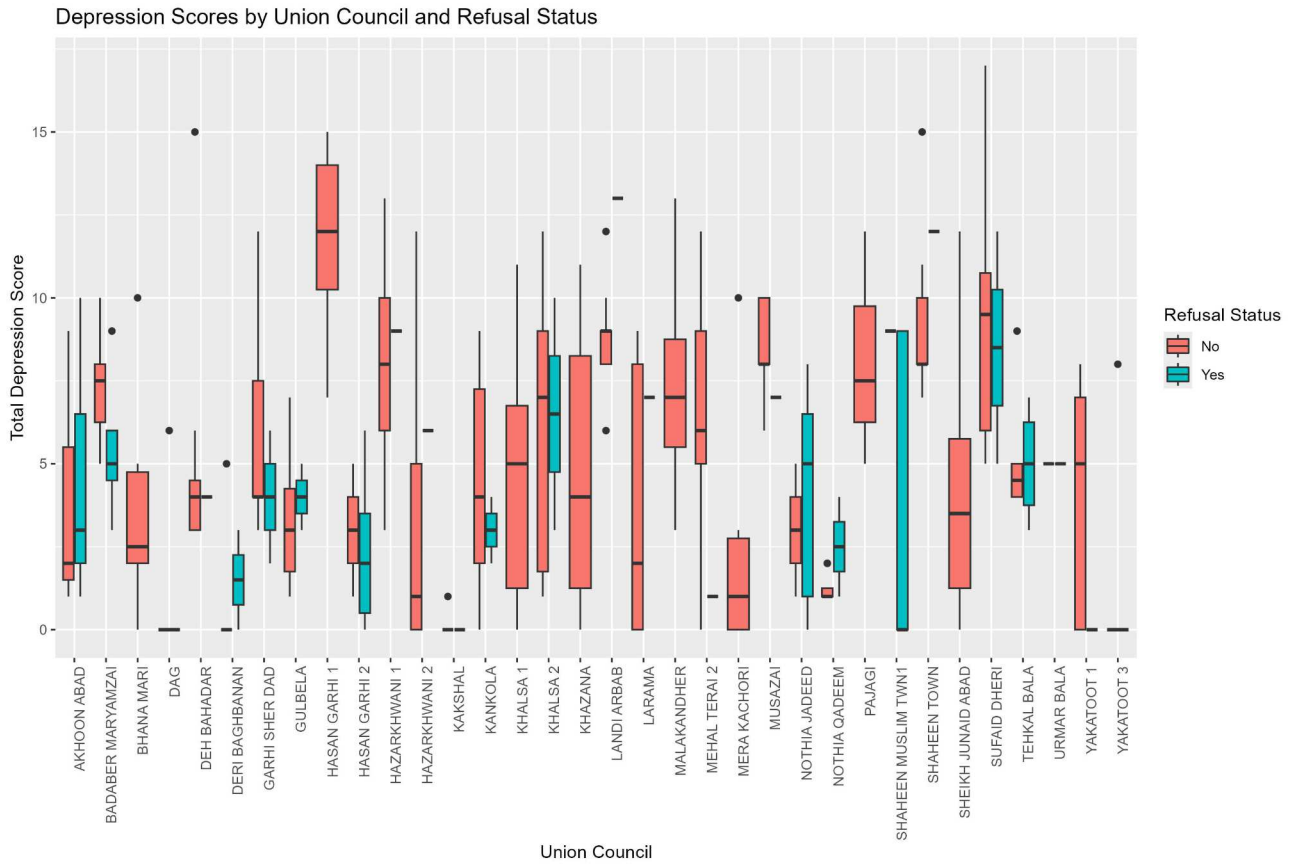

Fig. 3 Box plot of depression score by union council and refusal status

likely to express concerns about the necessity of vaccines (43% vs. 18%, $p < 0.001$) and to perceive difficulties in vaccine access for certain ethnic or religious groups (47% vs. 28%, $p = 0.003$). However, there was no significant difference in hearing negative information about vaccinations or in the perceived support for vaccines from community leaders ($p > 0.05$).

Table 4 presents the distribution of parental attitudes towards childhood vaccination based on Likert scale responses, comparing parents who refused vaccination with those who did not. The analysis revealed significant differences between the two groups. A smaller proportion of parents who refused vaccination strongly agreed that childhood vaccines are important for their child's health (54% vs. 70%, $p < 0.001$) and effective (45% vs. 44%, $p = 0.010$). There was also greater concern about the risks associated with new vaccines, with a higher percentage of parents in the refusal group agreeing or strongly agreeing that new vaccines carry more risks than older ones (58% vs. 43%, $p = 0.006$). Trust in vaccine information was lower among parents who refused vaccination, with fewer agreeing that the information they receive is reliable and trustworthy (36% vs. 52%, $p = 0.017$).

The results of the multivariable logistic regression analysis are summarised in Table 5. The analysis examined various factors associated with parental refusal of vaccination for their children. The probability of being vaccine refusal were significantly higher among mothers who were employed, with an odds ratio (AOR) of 3.11 (95% CI: 1.25, 7.67; $p = 0.015$), indicating that employed mothers were over three times more likely to refuse vaccination compared to those who were not employed. However, no significant association was found with the father's employment status (AOR: 0.58, 95% CI: 0.26, 1.20; $p = 0.15$). Regarding the tehsil of residence, the analysis did not reveal any significant differences in the likelihood of vaccine refusal across different tehsils, with Saddar area having an AOR of 2.01 (95% CI: 0.82, 4.88), SHAH ALAM an AOR of 0.59 (95% CI: 0.22, 1.47), and SMT an AOR of 0.95 (95% CI: 0.49, 1.85) when compared to the City reference group ($p = 0.15$). The presence of a landline in the home was also not significantly associated with vaccine refusal (OR: 1.30, 95% CI: 0.56, 2.86; $p = 0.5$). Additionally, the total depression score did not show a significant relationship with vaccine refusal, with an OR of 0.95 (95% CI: 0.88, 1.02; $p = 0.13$).

Table 3 Parental belief and barriers associated with vaccine refusal

CHARACTERISTIC	No, $N=266$[1]	Yes, $N=74$[1]	*p*-value[2]
Do you believe that vaccines can protect children from serious diseases	261 (98%)	57 (77%)	<0.001
Do you think that most parents like you have their children vaccinated with all the recommended vaccines	257 (97%)	58 (78%)	<0.001
Have you ever been reluctant or hesitant to get a vaccination for your children	76 (29%)	35 (47%)	0.003
Has distance timing of clinic time needed to get to clinic or wait at the clinic and or costs in getting to clinic prevented you from getting your children immunized	98 (37%)	38 (51%)	0.031
Are there other pressures in your life that prevent you from getting your children immunized on time	44 (17%)	22 (30%)	0.019
Are there any reasons you can think of why children should not be vaccinated	49 (18%)	32 (43%)	<0.001
Do you think that it is difficult for some ethnic or religious groups in your community region to get vaccinations for their children	75 (28%)	35 (47%)	0.003
Have you ever received or heard negative information about vaccinations	140 (53%)	36 (49%)	0.6
Do leaders religious or political leaders teachers health care workers in your community support vaccinations for infants and children	223 (84%)	64 (86%)	0.7
Do you believe that vaccines can protect children from serious diseases	261 (98%)	57 (77%)	<0.001
Do you think that most parents like you have their children vaccinated with all the recommended vaccines	257 (97%)	58 (78%)	<0.001
Have you ever been reluctant or hesitant to get a vaccination for your children	76 (29%)	35 (47%)	0.003
Has distance timing of clinic time needed to get to clinic or wait at the clinic and or costs in getting to clinic prevented you from getting your children immunized	98 (37%)	38 (51%)	0.031
Are there other pressures in your life that prevent you from getting your children immunized on time	44 (17%)	22 (30%)	0.019
Are there any reasons you can think of why children should not be vaccinated	49 (18%)	32 (43%)	<0.001
Do you think that it is difficult for some ethnic or religious groups in your community region to get vaccinations for their children	75 (28%)	35 (47%)	0.003
Have you ever received or heard negative information about vaccinations	140 (53%)	36 (49%)	0.6
Do leaders religious or political leaders teachers health care workers in your community support vaccinations for infants and children	223 (84%)	64 (86%)	0.7

[1]n (%)

[2]Fisher's exact test

The Fig. 4 demonstrates the distribution of total food security scores among participants who reported having refused a vaccination for their children compared to those who did not. The median food security score appears similarly low in both groups, indicating a general trend of food insecurity among participants. However, the group that did not refuse vaccination shows a wider interquartile range (IQR) and more variability in their food security scores. Additionally, this group displays a greater number of high-value outliers, suggesting that a subset of participants enjoys better food security. By contrast, the group that refused vaccination has a more concentrated distribution of lower food security scores, potentially indicating that food insecurity may contribute to the decision to refuse vaccination.

Discussion

Our study identified a high rate of parental refusal for routine immunisation, with several key factors driving vaccine hesitancy, including maternal employment, distance to immunisation services and associated costs, parental beliefs and concern. Parents who refused vaccines were less likely to believe in their protective benefits and exhibited higher rates of vaccine hesitancy, with more prevalent concerns about the necessity and safety of vaccines.

The 22% refusal rate observed in our study is consistent with other studies in Pakistan and similar contexts. For instance, a survey in the district Bannu, Khyber Pakhtunkhwa of Pakistan reported that 27.9% of parents refused vaccinations [22]. Likewise, in India,, a study showed that although 73.2% of caregivers believed vaccines protect children from serious diseases, 26.8% expressed hesitancy [25]. These findings are in line with a global review estimating the cumulative prevalence of parental vaccine hesitancy for children aged 0–6 years at 21.1% [26]. The alignment of our findings with studies from regions such as India and Sub-Saharan Africa demonstrates that vaccine hesitancy is a global phenomenon influenced by similar socio-economic and cultural factors. These results emphasize the need for globally coordinated efforts under frameworks such as WHO's Immunisation Agenda 2030 to address hesitancy in underserved populations. Enhanced funding and technical support for region-specific interventions can improve vaccination coverage worldwide.

Our findings also revealed significant variation in refusal rates across different tehsils in Peshawar, with the highest refusal recorded at 41% in tehsil Shaheen Muslim Town(SMT), with total of 18 Super-High Risk Union Councils (SHRUCs) categorised by the National and Provincial Emergency Operations Centres in Pakistan for

Table 4 Parental attitudes towards childhood vaccination: likert scale responses

CHARACTERISTIC	No, $N=266$[1]	Yes, $N=74$[1]	*p*-value[2]
CHILDHOOD VACCINES ARE IMPORTANT FOR MY CHILD S HEALTH			<0.001
Agree	75 (28%)	19 (26%)	
Disagree	3 (1.1%)	4 (5.4%)	
Neither Agree neither disagree	1 (0.4%)	11 (15%)	
Strongly Agree	187 (70%)	40 (54%)	
CHILDHOOD VACCINES ARE EFFECTIVE			0.01
Agree	116 (44%)	21 (28%)	
Disagree	16 (6.0%)	9 (12%)	
Neither Agree neither disagree	15 (5.6%)	11 (15%)	
Strongly Agree	117 (44%)	33 (45%)	
Strongly disagree	2 (0.8%)	0 (0%)	
HAVING MY CHILD VACCINATED IS IMPORTANT FOR THE HEALTH OF OTHERS IN MY COMMUNITY			0.012
Agree	133 (50%)	26 (35%)	
Disagree	5 (1.9%)	5 (6.8%)	
Neither Agree neither disagree	20 (7.5%)	11 (15%)	
Strongly Agree	108 (41%)	32 (43%)	
ALL CHILDHOOD VACCINES OFFERED BY THE GOVERNMENT PROGRAM IN MY COMMUNITY ARE BENEFICIAL			<0.001
Agree	140 (53%)	18 (24%)	
Disagree	0 (0%)	4 (5.4%)	
Neither Agree neither disagree	12 (4.5%)	17 (23%)	
Strongly Agree	114 (43%)	35 (47%)	
DO NEW VACCINES CARRY MORE RISKS THAN OLDER VACCINES			0.006
Agree	72 (27%)	18 (24%)	
Disagree	43 (16%)	4 (5.4%)	
Neither Agree neither disagree	109 (41%)	28 (38%)	
Strongly Agree	31 (12%)	15 (20%)	
Strongly disagree	11 (4.1%)	9 (12%)	
THE INFORMATION I RECEIVE ABOUT VACCINES FROM THE VACCINE PROGRAM IS RELIABLE AND TRUSTWORTHY			0.017
Agree	139 (52%)	27 (36%)	
Disagree	8 (3.0%)	5 (6.8%)	
Neither Agree neither disagree	18 (6.8%)	12 (16%)	
Strongly Agree	100 (38%)	30 (41%)	
Strongly disagree	1 (0.4%)	0 (0%)	
GETTING VACCINES IS A GOOD WAY TO PROTECT MY CHILD CHILDREN FROM DISEASE			<0.001
Agree	137 (52%)	25 (34%)	
Disagree	0 (0%)	3 (4.1%)	
Neither Agree neither disagree	5 (1.9%)	16 (22%)	
Strongly Agree	124 (47%)	30 (41%)	
GENERALLY, I DO WHAT MY DOCTOR OR HEALTH CARE PROVIDER RECOMMENDS ABOUT VACCINES FOR MY CHILD CHILDREN			<0.001
Agree	150 (56%)	26 (35%)	
Disagree	1 (0.4%)	2 (2.7%)	
Neither Agree neither disagree	15 (5.6%)	13 (18%)	
Strongly Agree	100 (38%)	33 (45%)	
I AM CONCERNED ABOUT THE SERIOUS ADVERSE EFFECTS OF VACCINES			0.003
Agree	102 (38%)	29 (39%)	
Disagree	38 (14%)	3 (4.1%)	
Neither Agree neither disagree	75 (28%)	17 (23%)	
Strongly Agree	42 (16%)	15 (20%)	
Strongly disagree	9 (3.4%)	10 (14%)	
MY CHILD CHILDREN DOESOR DO NOT NEED VACCINES FOR DISEASES THAT ARE NOT COMMON ANYMORE			

Table 4 (continued)

CHARACTERISTIC	No, $N=266$[1]	Yes, $N=74$[1]	*p*-value[2]
Agree	81 (30%)	23 (31%)	< 0.001
Disagree	64 (24%)	8 (11%)	
Neither Agree neither disagree	80 (30%)	15 (20%)	
Strongly Agree	35 (13%)	18 (24%)	
Strongly disagree	6 (2.3%)	10 (14%)	

[1]n (%)

[2]Fisher's exact test

Table 5 Multivariable logistic regression of factors associated with parental refusal of vaccination

Characteristic	OR[1]	95% CI[1]	*p*-value
TEHSIL NAME			
City	—	—	0.15
Saddar	2.01	0.82, 4.88	
Shah Alam	0.59	0.22, 1.47	
Shaheen Muslim Town	0.95	0.49, 1.85	
MOTHER'S EMPLOYMENT STATUS			
No	—	—	0.015
Yes	3.11	1.25, 7.67	
FATHER'S EMPLOYMENT			
Employed	—	—	0.15
Unemployed	0.58	0.26, 1.20	
LANDLINE PRESENT IN HOME			
No	—	—	0.5
Yes	1.3	0.56, 2.86	
TOTAL DEPRESSION SCORE	0.95	0.88, 1.02	0.13

[1]OR = Odds Ratio, CI = Confidence Interval

Polio eradication initiative due to high vaccine hesitancy and high risks of Polio virus [19]. Other studies similarly show that districts with SHRUCs have lower overall full immunisation coverage, with rates of 66% in 2018 and 76.5% in 2021, both below the national average [27]. In SHRUCs, socio-cultural factors such as mistrust of government programs, deeply rooted traditional beliefs, and susceptibility to misinformation often compound logistical challenges. For instance, religious interpretations that associate vaccines with foreign agendas have been reported in both Pakistan and other conservative LMICs, such as Afghanistan and Nigeria, where polio eradication efforts have faced resistance [28]. Global health strategies must integrate culturally sensitive approaches to counteract these challenges effectively.

Notably, 38.5% of parents in our study reported fear of adverse effects as a primary reason for vaccine refusal. Previous research indicates that the quality of information or misinformation about potential adverse events significantly influences vaccination coverages [29]. This fear is particularly prominent in conservative and low-literacy communities where vaccine hesitancy is more widespread [30]. Additionally, 40% of parents reported logistical challenges, such as distance to healthcare centres, as barriers to vaccination. This is consistent with findings from urban slums in Karachi, Pakistan, where 39.6% of respondents identified similar issues [31]. Other studies in Pakistan have also noted that long distances to vaccination centres serve as a major impediment to immunisation [32, 33]. In our study, logistical challenges were reported by 51% of parents who refused vaccines, a statistically significant association. This findings aligns with another cross-sectional study in Pakistan, which identified a 40.6% rate of vaccine refusal associated with logistical barriers [22]. These supporting evidences across different studies suggest that the lack of accessible healthcare infrastructure, continues to be a major barrier to vaccination efforts in Pakistan. This pattern is not unique to Pakistan but reflects broader global trends in LMICs, where logistical challenges and economic barriers frequently limit access to healthcare services. Studies in Sub-Saharan Africa and Southeast Asia similarly report maternal employment and associated time constraints as significant barriers to routine immunisation. These shared experiences underscore the importance of tailoring global strategies to address local socio-economic realities [34].

Our results also showed that 84% of parents believe community leaders support vaccinations, reflecting the significant role of social influence on health behaviours. This aligns with existing research suggesting that active community involvement, especially through leveraging support from both religious and non-religious influencers, enhances vaccine acceptance [35]. Pakistan's National Immunisation Policy of 2022 outlines strategies to further involve community and religious leaders, philanthropists, and local influencers in supporting vaccination efforts. The policy emphasizes the importance of interpersonal communication to encourage families to complete immunisation schedules [36].

Contrary to previous research, our study found no significant link between parental education and vaccine refusal. This finding is contrary to previous research in Pakistan, which has consistently pointed to low parental education as a major factor in vaccine hesitancy. For instance, women with no education were significantly more likely to have children who received no polio

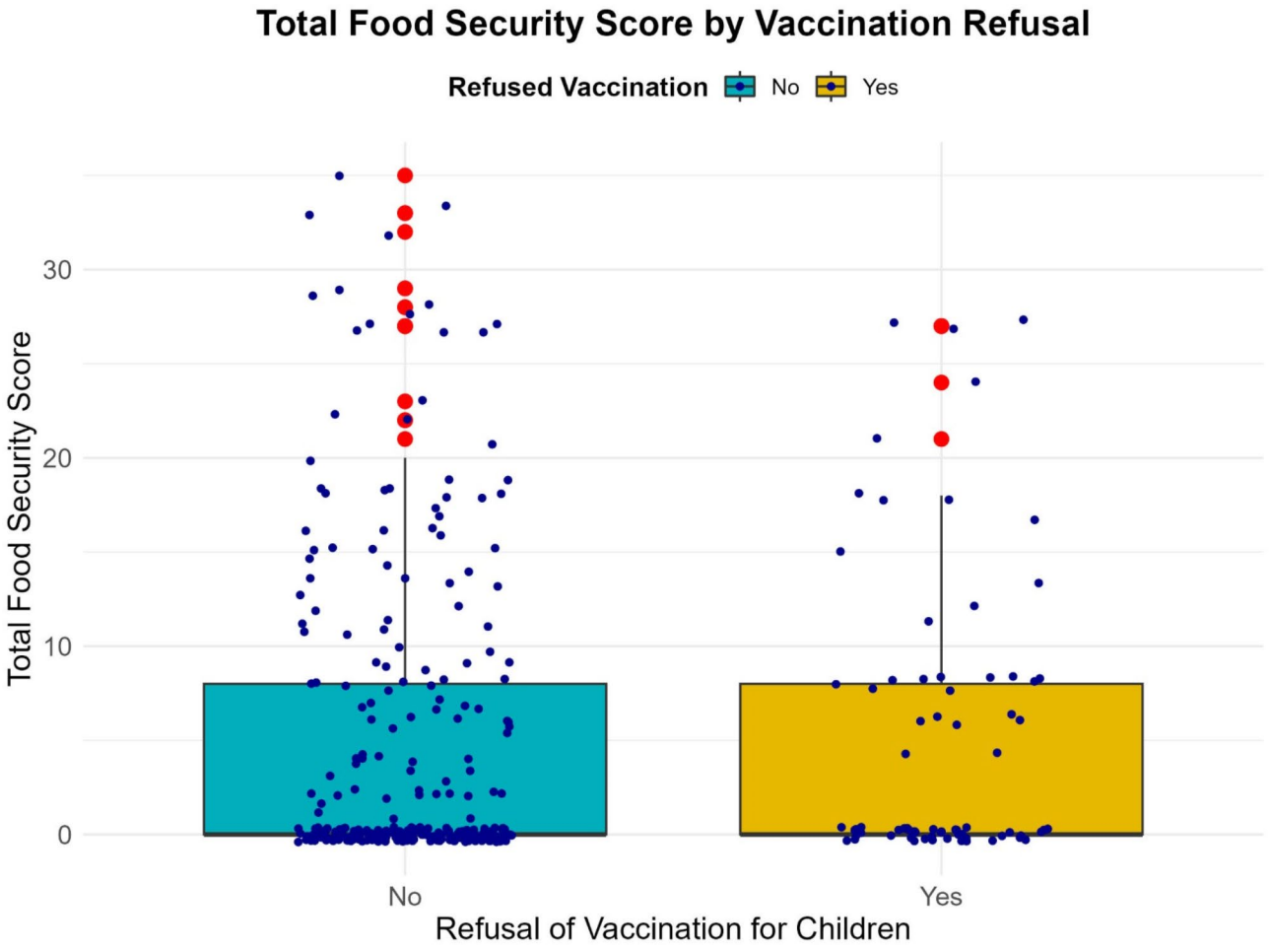

Fig. 4 Box plot of total food security scores by vaccination refusals

vaccination or incomplete vaccinations, according to a secondary analysis of the Pakistan Demographic and Health Survey (PDHS) 2012–2013 [37].

Our study findings align with existing literature on the relationship between socioeconomic factors and depression, particularly highlighting significant negative correlations between depression scores and both family income and access to household amenities. Specifically, higher family income levels and greater ownership of amenities such as refrigerators, televisions, and gas stoves were associated with lower depression scores among participants. These results support research indicating that higher socioeconomic status and better access to resources are linked to reduced rates of depression in low- and middle-income countries (LMICs) [38, 39]. However, the relatively weak correlations observed in our study suggest that other contextual factors, such as strong familial or community support systems, may lessen the impact of lower income or fewer amenities on mental health within this population [40].

Conclusions

High number of parents refused to vaccinate their children in Peshawar. Multiple reasons for refusal identified like employed mothers, distance to vaccination centres and associated cost, and worries about vaccine safety. Some parents do not trust the information they received about vaccines. These results show that we need better ways to help working parents and improve community trust in vaccines to reduce refusal rates.

Policy implications and recommendations

This study highlights critical gaps in immunization coverage in Peshawar, particularly in high-refusal areas like Shaheen Muslim Town and SHRUCs. To address these gaps, national immunization policies should focus on improving access and addressing vaccine hesitancy. Flexible vaccination services, such as extended clinic hours and mobile immunization units, can reduce logistical barriers, especially for working mothers. Additionally, workplace vaccination programs could provide convenient options for employed parents, minimizing missed opportunities for child immunization.

Educational campaigns targeting parental concerns about vaccine safety and effectiveness are essential to dispel misconceptions. Engaging community leaders, religious influencers, and healthcare professionals can build trust and foster acceptance of immunization. These strategies, combined with efforts to address logistical challenges, will not only enhance vaccine coverage but also support Pakistan's progress toward Universal Health Coverage and the elimination and control of vaccine-preventable diseases.

Study limitations

This study provides important insights into parental refusal of routine immunisation in Peshawar but has several limitations. The use of self-reported data raises the possibility of response bias, as participants may have misrepresented their beliefs or behaviours, particularly on sensitive topics like vaccine hesitancy or refusal, due to social pressures. Additionally, the study excluded healthcare workers from the sample, which limits the perspective on how provider-level factors, such as attitudes, knowledge, and communication strategies, might influence vaccine uptake.

Moreover, reliance on cross-sectional data constrains the ability to assess causal relationships between parental beliefs and vaccine refusal.

Abbreviations

WHO	World Health Organization
QALYs	Quality-Adjusted Life Years
COVID-19	Coronavirus Disease 2019
SDG	Sustainable Development Goals
EPI	Expanded Program on Immunisation
SHRUCs	Super High-Risk Union Councils
NEOC	National Emergency Operations Centre
PEOCs	Provincial Emergency Operations Centres
VPDs	Vaccine-Preventable Diseases
UHC	Universal Health Coverage
SAGE	Strategic Advisory Group of Experts
PHQ-9	Patient Health Questionnaire-9
HFIAS	Household Food Insecurity Access Scale
FANTA	Food and Nutrition Technical Assistance
UC	Union Council
SMT	Shaheen Muslim Town
AOR	Adjusted Odds Ratio
IQR	Interquartile Range
PDHS	Pakistan Demographic and Health Survey
LMICs	Low- and Middle-Income Countries
OR	Odds Ratio

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Author contributions

MH conceptualised and designed the study. MH, FA, and Z drafted the initial manuscript and critically reviewed and revised it. AP, SA, and ZH contributed to writing different sections of the manuscript. All authors read, revised, and approved the final manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval for the study was granted by the Research Review Board (RRB) of the Associate Dean Research, Khyber College of Dentistry, Peshawar Pakistan **(Notification No.: 147/RRB/KCD)**. Written informed consent was obtained from all participants, with both written and oral consent. Participants were assured of their right to withdraw from the study at any time without any consequences, and all data were kept confidential, accessible only to the primary investigator and authorised personnel.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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