Original Article

Prevalence of Vaccine Hesitancy, Refusal and Delay Among Parents in Riyadh and Al Madinah, Saudi Arabia: A Cross-Sectional Study

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ABSTRACT

Background: The efforts and gains in reducing vaccine-preventable infectious diseases through vaccine uptake are jeopardized by a change in how people view sickness and by growing vaccine safety concerns.

Aim: To assess the prevalence of vaccine hesitancy, refusal and delay among parents in Riyadh and Al Madinah, Saudi Arabia.

Methods: A cross-sectional study was conducted in Riyadh and Al Madinah, including 1294 participants (parents or caregivers of children) after the onset of the COVID-19 pandemic. Participants were recruited by convenience sampling and interviewed by telephone. Chi-square and Fisher–Freeman–Halton exact tests were used to identify factors associated with vaccine safety perception and vaccine refusal; $P < 0.05$ was considered statistically significant.

Results: The prevalence of vaccination refusal was 6.7% (4.6% hesitancy-related), while the prevalence of vaccination delay was 44.3%, and 32.6% reported a delay due to the COVID-19 pandemic. Among those who delayed, 37.3% considered vaccination not important. The influenza vaccine had the highest rates of hesitation (4.9%) and refusal (1.6%). Maternal education ($P = 0.010$) was significantly associated with the perception of vaccine safety. The respondent's relationship to the child was the only factor nominally associated with vaccine refusal ($P = 0.041$); neither association remained significant after correction for multiple comparisons.

Conclusion: This study showed a low prevalence of vaccine refusal but a high prevalence of vaccination delay. These findings suggest a positive attitude towards vaccination but highlight the need to promote timely vaccination and to improve access to vaccination services.

Keyword: Vaccine refusal; Prevalence; vaccine hesitancy; vaccination delay; childhood immunization; cross-sectional study.

Introduction

Vaccination against vaccine-preventable diseases (VPDs) is a highly effective and cost-saving intervention for reducing morbidity and mortality [1].

The World Health Organization (WHO) states that immunization is a cost-effective intervention that currently prevents 2–3 million deaths annually [2].

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In 1979, the Kingdom of Saudi Arabia (KSA) implemented the Expanded Program on Immunization (EPI). This program has succeeded in improving the coverage of primary vaccines to more than 95% by 2011 [3] and measles immunization coverage (first and second doses) to 95% and 96%, respectively, in 2019, and to 98% for both doses in 2022 [4]. Despite the regional target of measles elimination by 2020, KSA had not been verified as measles-free by 2022 [4]. Despite vaccines successfully controlling diseases and reducing mortality, many parents still delay or refuse to vaccinate their children. The WHO Strategic Advisory Group of Experts (SAGE) defines vaccine hesitancy as "a delay in acceptance or refusal of vaccines despite the availability of vaccination services" [5]. Vaccine hesitancy is a global concern, as it is prevalent in many developing and developed countries [6]. According to a study done in Italy, the prevalence of vaccine hesitancy was found to be 34.7% among Italian parents [7]. Vaccine hesitancy can be explained by concerns raised by parents, decision-makers, and the media regarding the safety of the recommended immunizations. These concerns relate to misleading debates about vaccines and autism, vaccine components, and the number of doses given at a single clinic visit or during the first years of life [8]. Moreover, the rapid development of the internet and social media has made it easier to disseminate confusing information about vaccines from non-medical sources and biased medical opinions [2,9]. Vaccine hesitancy is attributed to a wide range of factors, including delayed consultations, worries about the safety of vaccines, and side effects of vaccines that necessitated doctor visits [10]. Moreover, non-medical causes such as religion, culture, and philosophy may be associated with low vaccine uptake in various communities [11]. In KSA, reported prevalences of parental vaccine hesitancy have varied widely, from approximately 3% to more than 70% [12,13]. Most Saudi studies have measured hesitancy with attitude scales in single cities or in hospital- or clinic-based samples [14–17], and fewer have reported the behavioural outcomes of refusal and delay. The COVID-19 pandemic disrupted routine childhood immunization in KSA [18], and hesitancy and delay have continued to be reported after the pandemic [19,20]. Data on the prevalence of, and reasons for, self-reported refusal and delay therefore remain limited. This study aimed to estimate the prevalence of self-reported refusal and delay of childhood vaccines, and their reasons, among parents/caregivers in Riyadh and Al Madinah, Saudi Arabia; to describe their perceptions of vaccine safety, vaccine-specific hesitancy and contextual influences; and to examine the sociodemographic factors associated with perceived vaccine safety and with refusal.

Methods

Study design and setting. A cross-sectional study in Riyadh and Al Madinah included 1294 participants and was conducted after the onset of the COVID-19 pandemic. Riyadh (central region) and Al Madinah (western region) were selected to include parents from two regions of the country. Participants and sampling. The target population was parents and other caregivers responsible for the vaccination of at least one child. Parents or caregivers aged 18 years or older who agreed to participate were eligible, and incomplete interviews were excluded. Respondents were asked to answer with reference to their youngest child. Participants were recruited by convenience sampling. Using the most conservative expected prevalence of 50%, a 95% confidence level and a 5% margin of error, the minimum required sample size was 385 participants; the final sample of 1294 participants exceeded this requirement. Data collection. Data were collected via telephone interviews after obtaining verbal consent and ensuring confidentiality. Interviews were conducted in Arabic by members of the research team, who were trained to administer the questionnaire in a standardized manner. The culturally adapted questionnaire, based on WHO guidance and the literature, was reviewed by experts. Additionally, a pilot study involving 60 participants was conducted prior to data collection. The questionnaire comprised: (1) demographic data: age, educational level, occupation, marital status, geographical location, and nationality; and (2) assessment of individual and group influences. This section comprised three questions on previous adverse reactions, natural immunity and the need for vaccination. Each question was answered “yes”, “no” or “I’m not sure”.

1. Assessment of vaccination-specific issues: In this section, participants answered eight questions assessing their beliefs regarding vaccine safety. They indicated whether they had ever delayed or completely refused to vaccinate their children, specifying the vaccines, durations, and causes. Additionally, the questions evaluated parents’/caregivers’ beliefs about vaccine side effects (harmful, not harmful, or do not know).

2. Assessment of contextual influences: Parents answered six questions regarding background vaccination influences. These covered information

sources, media and celebrity influences, logistical barriers and trust in vaccine producers. Operational definitions. Refusal was defined as a positive answer to the question "Have you ever not accepted a vaccination for your child?". Hesitancy-related refusal was defined as not vaccinating because the parent considered vaccination not important, whereas not vaccinating because of vaccine unavailability or illness was classified as a missed or deferred vaccination. Delay was defined as a parent-reported postponement of any scheduled childhood vaccine beyond its due date in the national immunization schedule, of any duration. Vaccine hesitancy as a construct was not measured with a validated scale. Ethics approval and consent to participate: The study was approved by the Institutional Review Board of Princess Nourah bint Abdulrahman University, Riyadh (IRB Log No. 20-0124; KACST IRB registration No. HAP-01-R-059; category: exempt). Verbal informed consent was obtained at the start of each telephone interview and recorded by the interviewer on the data-collection form. No personal identifiers were recorded.

Statistical analysis

Data were analyzed using SPSS version 23 (IBM Corp., Armonk, NY, USA). Prevalence estimates are presented with 95% confidence intervals (CIs) calculated by the Wilson score method. Associations were assessed using the chi-square test and, because of sparse cells, the Fisher–Freeman–Halton exact test; Yates' continuity correction is also reported for 2 × 2 tables. Linear trends across ordered educational categories were examined with the Cochran–Armitage test. Crude odds ratios (ORs) with 95% CIs were calculated relative to a reference category. Participants who answered "I'm not sure" to the vaccine-safety question (n = 60) were excluded from the analysis of perceived safety. To account for multiple testing (16 comparisons), P values were adjusted using the Benjamini–Hochberg false discovery rate procedure. There were no missing values for the variables analyzed. Exact two-sided P values are reported; $P < 0.05$ was considered significant.

Results

Most participants were mothers (74.5%) (Table 1). Nearly all were married (98.5%) and, in 95.6% of families, both parents were Saudi. Parents'/caregivers' perceptions of childhood vaccination are summarized (Figure 1). While 91.0% considered vaccines safe and 81.8% believed that they remain necessary even when diseases are no longer prevalent, 13.8% thought that vaccines have harmful side effects. However, 4.4% considered vaccines unsafe and a further 4.6% were unsure, and 13.5% did not trust pharmaceutical companies to provide safe and effective vaccines, with another 16.9% unsure. Overall, 87 participants (6.7%; 95% CI 5.5–8.2) reported having previously not accepted a vaccination for their child (Figure 2). However, 27 of them gave vaccine unavailability (n = 5) or the child's illness (n = 22) as the reason; refusal for a hesitancy-related reason was therefore reported by 60 participants (4.6%; 95% CI 3.6–5.9). Overall, 573 participants (44.3%; 95% CI 41.6–47.0), nearly one in two, reported having previously delayed vaccinating their child (Figure 2). Among the 573 participants who reported a delay, the main cause was thinking that vaccination was not important (37.3%), followed by vaccine unavailability (32.3%) and child sickness (30.4%). In a separate question, 422 participants (32.6%) reported delaying their child's vaccination because of the COVID-19 pandemic. Participants' rates of hesitancy and refusal toward specific vaccines are shown (Figure 3). The influenza vaccine had the highest rates of hesitancy (4.9%) and refusal (1.6%). The main sources of information about vaccination were healthcare providers (60.7%), family and friends (13.0%), social media (12.9%), medical experience (personal medical knowledge or experience) (8.5%), and books (4.9%) (Table 2). External factors influencing vaccination attitudes are presented (Table 2). Reports on websites or social media made 9.6% of parents reconsider vaccinating their child. Media reports of parents claiming to have lost a child to a vaccine-preventable disease were believed by 429 participants (33.2%) and influenced the vaccination decisions of 14.5% of all participants. Finally, 17.8% reported that logistical barriers, such as distance and waiting time, had prevented vaccination. Factors associated with perceptions of vaccine safety are shown (Table 3). Maternal educational level was significantly associated with these perceptions (Fisher–Freeman–Halton exact P = 0.010); the association was not linear (Cochran–Armitage trend P = 0.541), with the highest proportion considering vaccines unsafe among mothers with primary or intermediate education (15.0%; OR 4.29). Parental nationality was not significantly associated with perceived safety (exact P = 0.065). No other factor was significantly associated. After Benjamini–Hochberg correction for multiple comparisons, the association with maternal education was no longer significant (q = 0.164). Factors associated with participants' decision to refuse vaccinating their children are shown (Table 4). The respondent's relationship to the child was

Table 1: Sociodemographic Characteristics of the Participants (n = 1294).

Characteristic	n	%
Relationship of the respondent to the child		
• Mother	964	74.5
• Father	326	25.2
• Other relative (grandparent or uncle)	4	0.3
City of residence		
• Riyadh	680	52.6
• Al Madinah	614	47.4
Parents' nationality		
• Both parents Saudi	1237	95.6
• One parent Saudi	33	2.6
• Both parents non-Saudi	24	1.9
Mother's educational level		
• Primary school	7	0.5
• Intermediate school	35	2.7
• High school	325	25.1
• Bachelor's degree	821	63.4
• Postgraduate (Master's or Doctorate)	106	8.2
Father's educational level		
• Primary school	6	0.5
• Intermediate school	26	2.0
• High school	319	24.7
• Bachelor's degree	748	57.8
• Postgraduate (Master's or Doctorate)	195	15.1
Mother's occupation		
• Healthcare professional	53	4.1
• Non-healthcare professional	508	39.3
• Retired	13	1.0
• Unemployed	720	55.6
Father's occupation		
• Healthcare professional	141	10.9
• Non-healthcare professional	1085	83.8
• Retired	35	2.7
• Unemployed	33	2.6
Parents' marital status		
• Married	1275	98.5
• Widowed	10	0.8
• Divorced	9	0.7
Continuous variables, mean ± SD		
• Mother's age, years	32.6 ± 6.0	

• Father's age, years	37.6 ± 7.2
• Number of children in the family	1.7 ± 1.2
• Age of the index child, years	2.3 ± 1.6

SD, standard deviation. Percentages may not total 100% because of rounding.

Table 2: Sources of Vaccine Information and Influence of External Factors on Participants' Perception and Attitude Toward Vaccination (n = 1294).

Question	N	%
What is the main source of your information about vaccines?		
• Healthcare provider	786	60.7
• Family and friends	168	13.0
• Social media	167	12.9
• Medical experience	110	8.5
• Books	63	4.9
Have reports you heard/read on websites/social media made you reconsider your choice to have your child vaccinated?		
• Yes	124	9.6
• No	1170	90.4
Do you believe the media reports by parents claiming to have lost a child to a vaccine-preventable disease?		
• Yes	429	33.2
• No	865	66.8
If the answer to the previous question is yes, does this affect your decision to vaccinate your child?		
• Yes	187	14.5
• No	242	18.7
• Not applicable	865	66.8
Would it trigger doubts about vaccinating your child if a celebrity advocated against a certain vaccine?		
• Yes	88	6.8
• No	1206	93.2
Has distance, timing of clinic, time needed to get to clinic or wait at clinic prevent you from getting your child immunized?		
• Yes	230	17.8
• No	1064	82.2

Table 3: Factors Associated with Perception of Vaccine Safety (n = 1234; "I'm not sure" responses, n = 60, excluded).

Factor	Do you believe vaccines are safe for your child/children?		Crude OR (95% CI)	*P*‡	*q*†
	Yes	No			
Relationship of the household respondent to the child?				0.443	0.644
Father (n = 317)	305 (96.2%)	12 (3.8%)	1 (ref.)		
Mother (n = 913)	868 (95.1%)	45 (4.9%)	1.32 (0.69–2.52)		
Educational status of the mother?				**0.010**	0.164
Primary and intermediate school (n = 40)	34 (85%)	6 (15%)	4.29 (1.68–10.97)		
High school (n = 307)	295 (96.1%)	12 (3.9%)	0.99 (0.50–1.95)		
Higher education (Bachelor's degree) (n = 784)	753 (96%)	31 (4%)	1 (ref.)		
Postgraduate Education (Master – Doctoral) (n = 103)	95 (92.2%)	8 (7.8%)	2.05 (0.91–4.58)		
Educational status of the father?				0.741	0.840
Primary and intermediate school (n = 30)	28 (93.3%)	2 (6.7%)	1.58 (0.36–6.92)		
High school (n = 304)	290 (95.4%)	14 (4.6%)	1.07 (0.56–2.03)		
Higher education (Bachelor's degree) (n = 715)	684 (95.7%)	31 (4.3%)	1 (ref.)		
Postgraduate Education (Master – Doctoral) (n = 185)	175 (94.6%)	10 (5.4%)	1.26 (0.61–2.62)		
Mothers' job				0.302	0.538
Health care professional (n = 52)	50 (96.2%)	2 (3.8%)	0.87 (0.20–3.84)		
Non health care professional (n = 480)	459 (95.6%)	21 (4.4%)	1 (ref.)		
Retired (n = 13)	11 (84.6%)	2 (15.4%)	3.97 (0.83–19.08)		
Unemployed (n = 689)	657 (95.4%)	32 (4.6%)	1.06 (0.61–1.87)		
Fathers' job				0.840	0.840
Health care professional (n = 137)	133 (97.1%)	4 (2.9%)	0.58 (0.21–1.63)		
Non health care professional (n = 1034)	983 (95.1%)	51 (4.9%)	1 (ref.)		
Retired (n = 31)	30 (96.8%)	1 (3.2%)	0.64 (0.09–4.81)		

Unemployed (n = 32)	31 (96.9%)	1 (3.1%)	0.62 (0.08–4.65)		
Marital status				0.397	0.635
Married (n = 1215)	1159 (95.4%)	56 (4.6%)	1 (ref.)		
Widowed (n = 10)	10 (100%)	0 (0%)	NE		
Divorced (n = 9)	8 (88.9%)	1 (11.1%)	2.59 (0.32–21.04)		
Geographical location				0.788	0.840
Riyadh (n = 650)	621 (95.5%)	29 (4.5%)	1 (ref.)		
Madinah (n = 584)	556 (95.2%)	28 (4.8%)	1.08 (0.63–1.84)		
What is the parent/caregiver nationality?				0.065	0.208
Both parents Saudi (n = 1179)	1126 (95.5%)	53 (4.5%)	1 (ref.)		
One parent Saudi (n = 31)	27 (87.1%)	4 (12.9%)	3.15 (1.06–9.32)		
Both parents non-Saudi (n = 24)	24 (100%)	0 (0%)	NE		

OR, odds ratio of answering "No" (vaccines not safe) relative to the reference category (ref.); CI, confidence interval; NE, not estimable because of a zero cell. ‡*P* values from the Fisher–Freeman–Halton exact test (two-sided); Yates-corrected *P* values for the 2 × 2 tables were 0.497 (relationship to the child) and 0.887 (geographical location). †Benjamini–Hochberg adjusted *P* values across the 16 comparisons in Tables 3 and 4. Cochran–Armitage trend test: maternal education $P = 0.541$; paternal education $P = 0.958$. Four respondents who were neither the mother nor the father are not shown under relationship to the child. Bold, $P < 0.05$.

Table 4: Factors Associated with Participants' Decision to Refuse Vaccinating Their Children (n = 1294).

Factor	Have you ever not accepted a vaccination for your child?		Crude OR (95% CI)	*P*‡	*q*†
	Yes	No			
Relationship of the household respondent to the child?				**0.041**	0.208
Father (n = 326)	14 (4.3%)	312 (95.7%)	1 (ref.)		
Mother (n = 964)	73 (7.6%)	891 (92.4%)	1.83 (1.02–3.28)		
Educational status of the mother?				0.092	0.245
Primary and intermediate school (n = 42)	5 (11.9%)	37 (88.1%)	2.13 (0.80–5.66)		
High school (n = 325)	21 (6.5%)	304 (93.5%)	1.09 (0.64–1.85)		
Higher education (Bachelor's degree) (n = 821)	49 (6%)	772 (94%)	1 (ref.)		
Postgraduate Education (Master–Doctoral) (n = 106)	12 (11.3%)	94 (88.7%)	2.01 (1.03–3.92)		
Educational status of the father?				0.054	0.208

Primary and intermediate school (n = 32)	3 (9.4%)	29 (90.6%)	1.38 (0.41–4.70)		
High school (n = 319)	13 (4.1%)	306 (95.9%)	0.57 (0.31–1.06)		
Higher education (Bachelor's degree) (n = 748)	52 (7%)	696 (93%)	1 (ref.)		
Postgraduate Education (Master–Doctoral) (n = 195)	19 (9.7%)	176 (90.3%)	1.44 (0.83–2.51)		
Mothers' job				0.129	0.294
Health care professional (n = 53)	2 (3.8%)	51 (96.2%)	0.51 (0.12–2.20)		
Non health care professional (n = 508)	36 (7.1%)	472 (92.9%)	1 (ref.)		
Retired (n = 13)	3 (23.1%)	10 (76.9%)	3.93 (1.04–14.93)		
Unemployed (n = 720)	46 (6.4%)	674 (93.6%)	0.89 (0.57–1.41)		
Fathers' job				0.737	0.840
Health care professional (n = 141)	11 (7.8%)	130 (92.2%)	1.19 (0.62–2.30)		
Non health care professional (n = 1085)	72 (6.6%)	1013 (93.4%)	1 (ref.)		
Retired (n = 35)	3 (8.6%)	32 (91.4%)	1.32 (0.39–4.41)		
Unemployed (n = 33)	1 (3%)	32 (97%)	0.44 (0.06–3.26)		
Marital status				0.543	0.724
Married (n = 1275)	86 (6.7%)	1189 (93.3%)	1 (ref.)		
Widowed (n = 10)	0 (0%)	10 (100%)	NE		
Divorced (n = 9)	1 (11.1%)	8 (88.9%)	1.73 (0.21–13.98)		
Geographical location				0.267	0.534
Riyadh (n = 680)	51 (7.5%)	629 (92.5%)	1 (ref.)		
Madinah (n = 614)	36 (5.9%)	578 (94.1%)	0.77 (0.49–1.19)		
What is the parent/caregiver nationality?				0.052	0.208
Both parents Saudi (n = 1237)	79 (6.4%)	1158 (93.6%)	1 (ref.)		
One of the parent Saudi (n = 33)	4 (12.1%)	29 (87.9%)	2.02 (0.69–5.89)		
Both parents non-Saudi (n = 24)	4 (16.7%)	20 (83.3%)	2.93 (0.98–8.78)		

OR, odds ratio of refusal relative to the reference category (ref.); CI, confidence interval; NE, not estimable because of a zero cell. ‡*P* values from the Fisher–Freeman–Halton exact test (two-sided); Yates-corrected *P* values for the 2 × 2 tables were 0.056 (relationship to the child) and 0.288 (geographical location). †Benjamini–Hochberg adjusted *P* values across the 16 comparisons in Tables 3 and 4. Cochran–Armitage trend test: maternal education $P = 0.812$; paternal education $P = 0.042$. Four respondents who were neither the mother nor the father (none refused) are not shown under relationship to the child. Bold, $P < 0.05$.

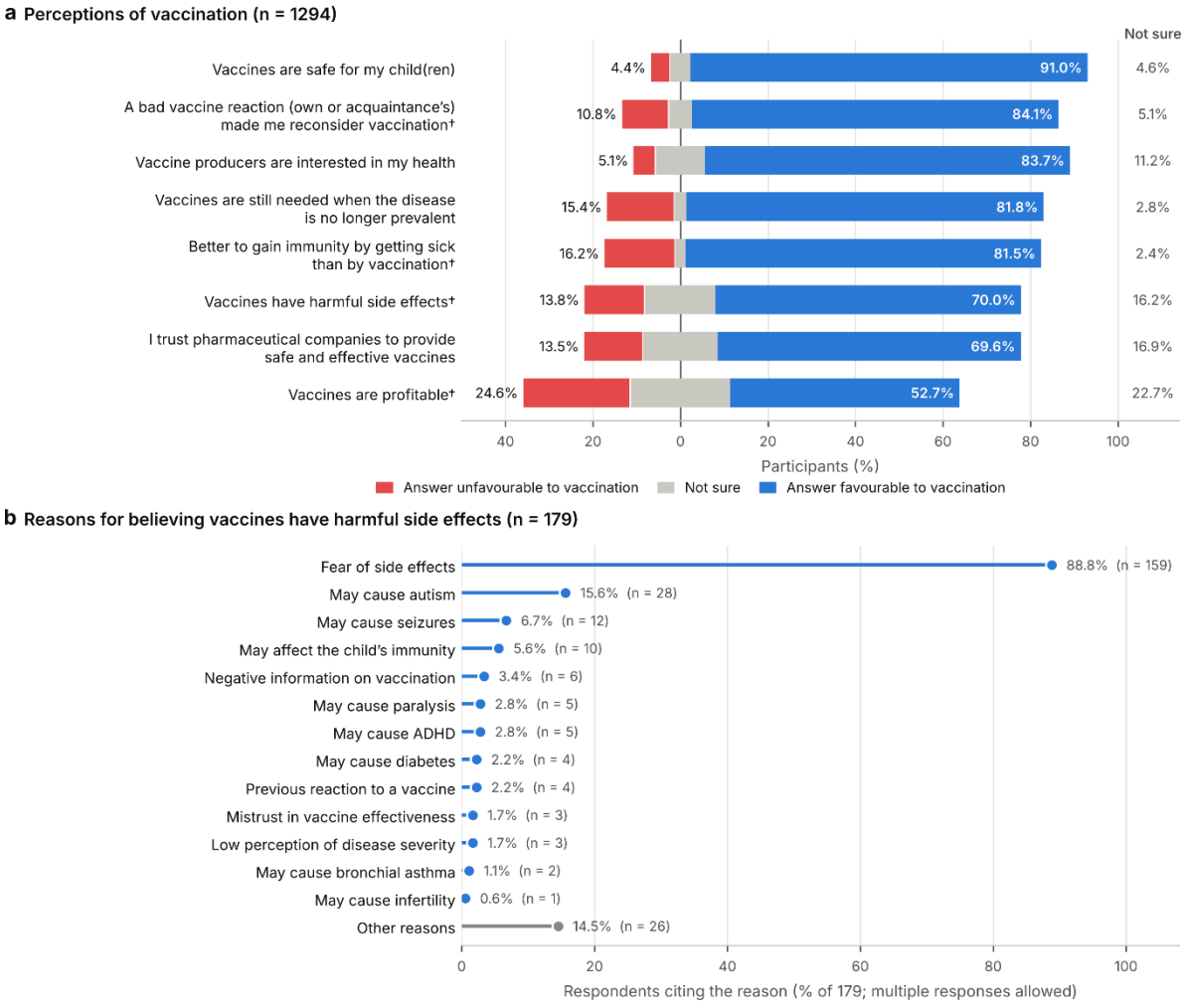


Figure 1: Parents' perceptions of childhood vaccination (n = 1294). (a) Proportions of answers favourable to vaccination, "not sure" and unfavourable to vaccination for each perception item; for items marked †, answering "yes" was classified as unfavourable. (b) Reasons given by the 179 participants who believed that vaccines have harmful side effects; more than one reason could be given, and percentages are of the 179 respondents.

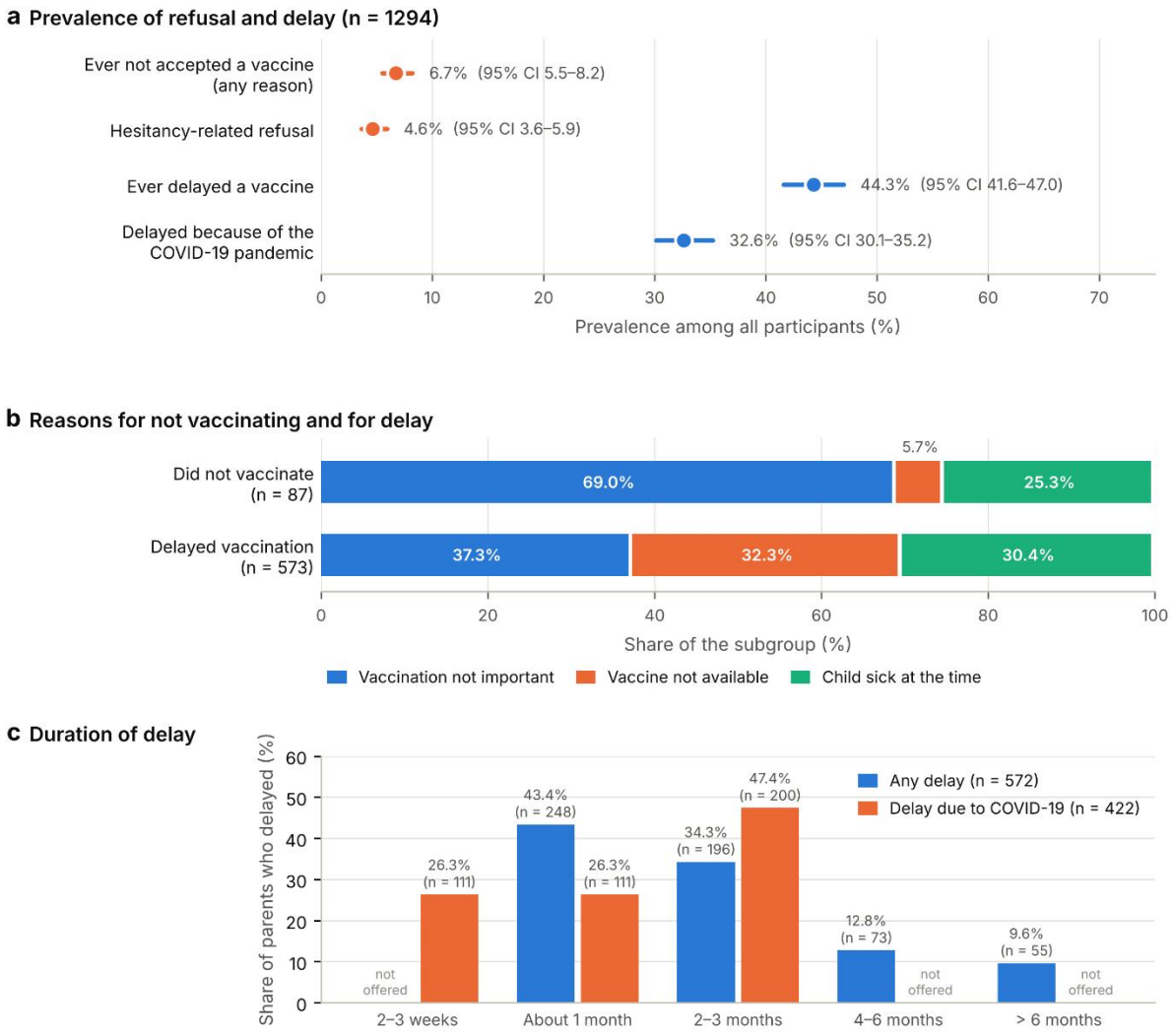


Figure 2: Refusal and delay of childhood vaccination. (a) Prevalence among all 1294 participants with 95% confidence intervals (Wilson method); hesitancy-related refusal excludes missed doses due to vaccine unavailability or the child's illness. (b) Reasons for not vaccinating (n = 87) and for delaying vaccination (n = 573; single response). (c) Duration of delay for the general delay question (n = 572) and for delay due to the COVID-19 pandemic (n = 422), which was asked separately with different response categories.

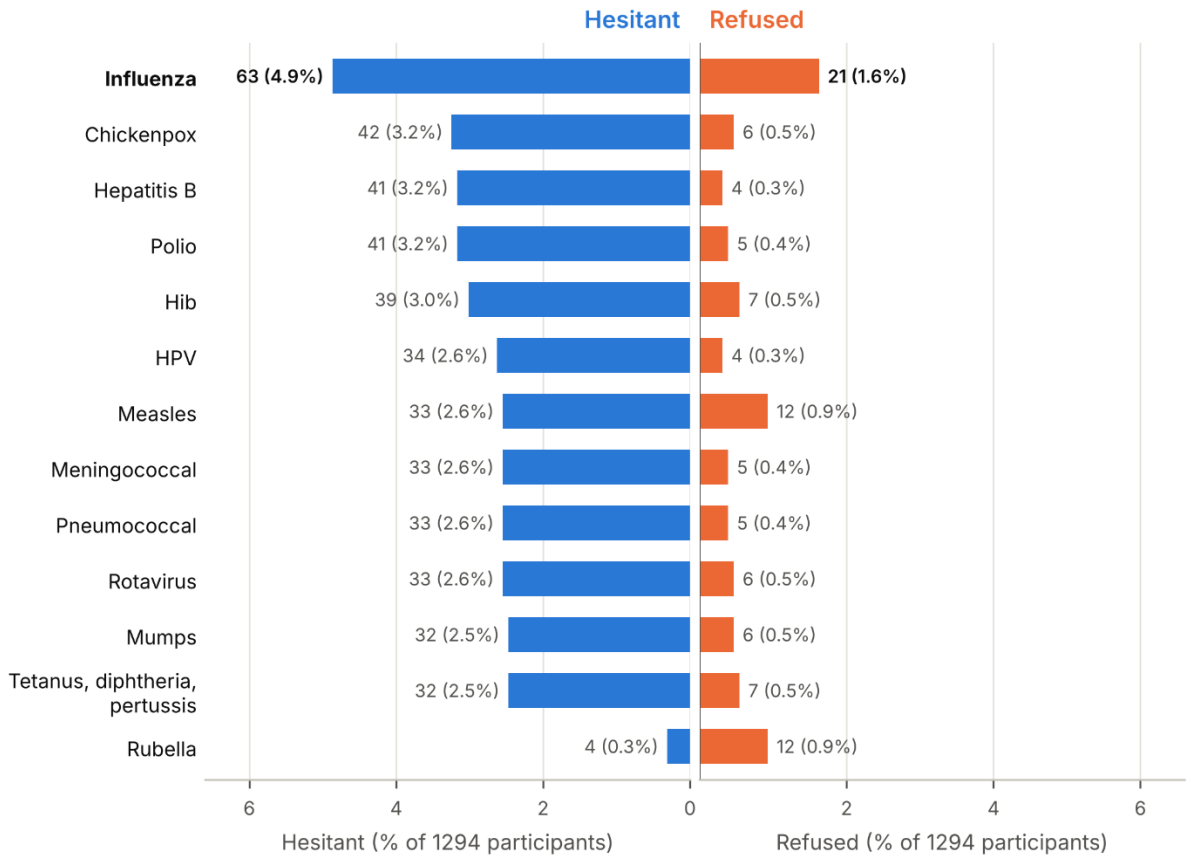


Figure 3: Hesitancy and refusal toward specific vaccines among all 1294 participants. "Hesitant" refers to parents who reported hesitating about giving the vaccine and "refused" to those who reported not giving it; labels show n (%). Hib, Haemophilus influenzae type b; HPV, human papillomavirus.

nominally associated with refusal (Fisher's exact P = 0.041; Yates-corrected P = 0.056), with refusal reported by 7.6% of mothers compared with 4.3% of fathers (OR 1.83, 95% CI 1.02–3.28); this association did not remain significant after correction for multiple comparisons (q = 0.208). No other factor was significantly associated with refusal.

Discussion

In this cross-sectional study of 1294 parents/caregivers in Riyadh and Al Madinah, self-reported refusal of childhood vaccines was uncommon (6.7%, or 4.6% when only hesitancy-related refusal was considered), whereas delay was common, affecting 44.3% of families. Few sociodemographic factors were associated with perceived vaccine safety or refusal, and none remained significant after correction for multiple testing. It is therefore recommended that healthcare workers should ensure vaccine accessibility and provide parental education. Given that the definition of vaccine hesitancy has differed among studies, it is challenging to compare the results of this study with those of similar studies, which have reported differing proportions of hesitant parents toward vaccination [5]. Scale-based estimates are not directly comparable with our self-reported outcomes. Using the WHO SAGE vaccine hesitancy survey tool, vaccine hesitancy among 500 Saudi parents at King Khalid University Hospital in Riyadh was 20% [14]. A country-wide survey in 2021 found that 6% of parents were hesitant toward routine childhood vaccination [21]. Studies reporting behavioural outcomes are more comparable with ours. In an international survey of 4029 parents, 13.7% reported vaccine hesitancy or refusal and 19.3% had not fully complied with vaccination programmes [22], compared with the 4.6–6.7% refusal observed in our study. Regarding delay, 9% of 233 parents in a recent online survey in KSA reported delaying vaccination [20]. The higher prevalence of delay in our study (44.3%) may reflect the inclusion of delays of any duration and for any reason, including the pandemic.

Regarding global findings, a Malaysian study reported a vaccine hesitancy prevalence of 11.6% [23]. The influenza vaccine showed the highest rates of hesitancy and refusal, in line with similar results from Riyadh. Although Saudi Arabia applies strict childhood immunization requirements, the influenza vaccine is a seasonal vaccine that must be repeated annually and is not among the mandatory childhood vaccines, and hesitancy toward such non-mandatory vaccines has exceeded 50% in some Saudi settings [13], which likely explains its higher hesitancy and refusal rates among parents. The proportion who considered vaccines unsafe (4.4%) is consistent with those reported in studies conducted in KSA and other Eastern Mediterranean countries, in which 2–5% of participants reported concerns about vaccine safety [10,24]. The higher proportion reporting harmful side effects (13.8%) reflects a different question: believing that vaccines can have harmful side effects does not necessarily mean that vaccines are considered unsafe overall. However, studies conducted in Canada and Australia reported that 40–52% of parents had safety concerns when vaccinating their child [25,26]. A YouTube study found that 32% of immunization videos were anti-vaccine, yet these videos received more views and higher ratings than pro-vaccine content [27]. More recent evidence links organisation on social media with public doubts about vaccine safety [28]; in KSA, negative social media content was associated with higher odds of parental vaccine hesitancy during the COVID-19 era [19]. However, in our sample, social media was the main source of vaccine information for only 12.9% of parents, so its role in the outcomes measured in this study appears limited. Maternal education was significantly associated with vaccine safety perceptions in the unadjusted analysis, but the relationship was U-shaped rather than linear: doubts were most frequent among mothers with primary or intermediate education and, to a lesser extent, among those with postgraduate education. Similarly, in a study conducted in Turkey, people with high incomes and higher educational degrees were more hesitant and more likely to refuse vaccines [29]. The apparent associations with parental nationality and with the respondent being the mother were based on small numbers or borderline P values and did not remain significant after correction for multiple comparisons, and both should be interpreted with caution. Access barriers were reported by 17.8% of parents, and vaccine unavailability accounted for almost one-third of delays. Similarly, in a post-pandemic study in Algeria, easy access to healthcare facilities was strongly associated with vaccine uptake [30]. Reducing service-related barriers may therefore reduce delays. The strengths of this study include addressing the important topic of post-COVID-19 vaccine hesitancy and using a large sample size. However, limitations include the inherent bias of the cross-sectional design and of self-reported data collected by telephone interview, which may be subject to recall and social-desirability bias; refusal

and delay were not verified against vaccination records. Convenience sampling produced a sample skewed toward mothers, parents with a bachelor's degree, mothers who were not employed, married parents and Saudi families, which limits representativeness. Analyses were unadjusted, several categories were very small, and multiple testing may have inflated type I error. Predictors of delay and the relationship between perceptions and refusal or delay were not examined and should be addressed in future studies.

Conclusion

In this sample of parents from Riyadh and Al Madinah, vaccine refusal was uncommon, whereas vaccination delay was frequent. Delays were attributed to the COVID-19 pandemic, vaccine unavailability, child illness, and the belief that vaccination was not important. Despite generally positive attitudes toward vaccination, concerns regarding vaccine safety require attention and intervention. Interventions should also promote timely vaccination and improve access to vaccination services. We recommend a nationwide study using validated measures of vaccine hesitancy and verified vaccination records to inform a national immunization strategy.

Conflict of Interest

None

Funding

None

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