

Coronavirus Pandemic

Factors predicting caregivers' readiness for vaccination of 5-11 years old children against SARS-CoV-2 - Saudi Arabia, 2022

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Abstract

Introduction: A significant proportion of parents are still reluctant to have their children vaccinated against COVID-19. This study aimed to determine what factors influence parents' decision to get COVID-19 vaccine for the children of age group 5-11 years.

Methodology: A cross-sectional study was conducted in the region Qassim of Saudi Arabia, by using a self-administered, pre-tested questionnaire to assess the predicting factors of caregivers' readiness to get their children vaccinated against COVID-19.

Results: Two-thirds of the caregivers surveyed were unwilling to get their children vaccinated against COVID-19. The factors that influence the parents' decision to get their young children (5-11 years old) vaccinated against COVID-19 were: having secondary school education ($p = 0.019$), family members infected with SARS-CoV-2 ($p = 0.016$), caregivers completed the three doses of vaccination ($p = 0.003$) and those who received additional flu vaccine ($p = 0.014$), and not experiencing the side effects of COVID-19 vaccine ($p = 0.0001$). Additionally, no history of COVID-19 vaccine adverse events in older 12-18 year old children ($p = 0.011$) and no chronic diseases in the 5-11 year old children ($p = 0.001$) were predictors.

Conclusions: Caregivers' preferences about the children's vaccination were influenced by multiple factors, including educational level, having family members infected with SARS-CoV-2, caregivers completing three doses of COVID-19 vaccine, receiving additional flu vaccine with no or mild adverse events, and history of chronic diseases in the child. Understanding these factors can help determine the likelihood of the caregivers getting their child vaccinated.

Key words: Vaccine; COVID-19; hesitancy; SARS-CoV-2; children; Saudi Arabia.

J Infect Dev Ctries 2022; 16(10):1533-1541. doi:10.3855/jidc.17073

(Received 07 July 2022 – Accepted 15 August 2022)

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Introduction

Vaccines against the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection are considered to be the most effective method for curbing the coronavirus disease 2019 (COVID-19) pandemic. An updated list of all vaccines that are available globally is maintained by the World Health Organization (WHO) [1]. The Saudi Ministry of Health has approved four vaccines: Moderna-Spikevax (RNA), Pfizer/BioNTech-Comirnaty (RNA), Janssen (Johnson & Johnson)-Ad26.COV2. S with non-replicating viral vector, and the Oxford or AstraZeneca-Vaxzevria which also has the non-replicating viral vector [2]. More than 66 million doses of the COVID-19 vaccine have been administered to the people of Saudi Arabia [3].

In October 2021, the Food and Drug Administration (FDA) of USA authorized the BNT161b2 vaccine (developed by Pfizer) as safe for the children in the age group 5-11 yrs. The approval was based on randomized trials that included over 2000 children from this age group. These trials demonstrated 91% vaccine efficacy and immunogenicity, similar to that observed in adolescents and young adults [4].

Although vaccine refusal is statistically lower in Saudi Arabia (7%) than in the rest of the world [5], reluctance has increased, owing to worries about the safety and efficacy of vaccines. In 2009, over 80% of Saudi Arabian caregivers refused to get their child vaccinated against influenza. Furthermore, a study conducted in various primary healthcare facilities in the capital city of Saudi Arabia demonstrated that, many

people lack awareness of the influenza virus and its vaccine, hold strong misconceptions about side effects and believe it is useless [6,7]. A cross-sectional survey in Saudi Arabia reported that 82% of the respondents, who were adults, prefer to take precautions against the COVID-19 infection rather than take the vaccine [8].

Misinformation about vaccines is often associated with conspiracy theories and fabrications that spread on social media [9]. Other factors include living in deprived areas, low educational levels, unemployment, health inequalities, socioeconomic disadvantage, lower household incomes, and ethnic minorities [10–12].

Unlike in the western countries, the factors that predict caregivers' readiness to vaccinate children in the age group 5-11 years and vaccination hesitancy among caregivers has not been explored in Saudi Arabia. Therefore, detecting and addressing caregiver concerns with COVID-19 immunization is critical to preventing recurrent vaccination hesitancy. This study was carried out in the Kingdom of Saudi Arabia and aimed to determine what factors influence parents' desire to get COVID-19 vaccine for the children in the age group 5-11 years. The findings of this study may help with the efforts taken by the Saudi Ministry of Health (MoH) to expand COVID-19 vaccination coverage by developing effective measures directed towards mitigating the factors contributing to the hesitancy to vaccinate children in the age group of 5-11 years.

Methodology

Study settings and study design

An observational, cross-sectional survey was carried out for one month (between 16 January to 16 February 2022) when the two mRNA vaccines against COVID-19, developed by Pfizer and Moderna, were declared safe and readily available for children aged 5-11 years. A structured, pre-tested online questionnaire was used in the Qassim region of Saudi Arabia. The Qassim region is located in the center of Saudi Arabia.

The candidates for this survey were caregivers with at least one child aged between 5-11 years attending primary school in the Qassim region. Eligible caregivers were required to have internet access and be proficient in reading Arabic. The study invitation with details about the study was sent using the Ministry of Education platform, which included all caregivers' contact information. Participation was voluntary and no individual identifiers were requested in the survey to maintain data privacy. The school health teams in all primary schools in the Qassim region supervised the data collection by sending the invitations to each school through the platform.

We used the statistical package Epi-info version 7.2.5.0 [13] to select a representative quota sample from each city in the Qassim region; ideal sample size was estimated to be 536 participants, with a margin of error of +/- 5%, 95% CI (confidence intervals), and 80% power. The number of study participants was increased to 600 to improve precision of the survey findings. We carefully selected the minimal portion from the target study populations. This included a certain percentage of respondents with 1 or > 1 children of the age 5-11 years.

The questionnaire was developed using previously published surveys based on the study's objectives, where acceptance of COVID-19 vaccination was considered. In addition, questions related to COVID-19 vaccination status and self-reported adverse events of caregivers and their older children were included in the survey [14–16].

The questionnaire included the following sections:

1. Socio-demographic characteristics: nationality, age, caregivers' education level, marital status, number of children under the caregivers' care, employment, and family income.
2. Health status of the caregivers and the child: chronic diseases and history of COVID-19 infection.
3. Vaccination history: flu vaccine acceptance, routine childhood vaccination status, COVID-19 vaccination in caregivers and adolescents, adverse reaction to COVID-19 vaccination reported by the caregivers and adolescents.

The participants took about 10 minutes to respond to the 20 questions. Three public health experts examined the final questionnaire. The questionnaire was tested with 50 participants from the same population of interest to verify its reliability and validity and adjusted accordingly. Ethical approval was obtained from the ethical committee of Qassim University (Ref. No 1443-1050821).

The primary outcome variable was the caregivers' willingness to get their children vaccinated to combat COVID-19. The following questions were asked: did your child aged 5-11 years receive the vaccine against COVID-19? If the response was no, the next question was: do you want your child to be vaccinated for COVID-19? [Yes, No, and Unsure].

Statistical analysis

Descriptive statistics was calculated for the survey responses. Mean and standard deviation (SD) were calculated for the definite variables in the form of

numbers and proportions. Next, the association between the caregivers' intent of getting COVID-19 vaccine for their young child and the independent variables was calculated by using binomial logistic regression (two

groups: ready to get vaccine, hesitant of getting vaccine), outlining both adjusted and unadjusted odds ratios with 95% CIs. Variables in the adjusted model were frequently associated with vaccination behaviors from earlier studies and those with a *p* value below 0.10 in the unadjusted model.

Table 1. Demographic information of all caregivers who would or would not vaccinate their 5 to 11 years old children against COVID-19, including health status of caregivers and child.

Variable/Group	Total n (%) (n=597)
Caregiver	
Father	109 (18.26%)
Mother	479 (80.23%)
Other	9 (1.51%)
Nationality	
Non-Saudi	12 (2.01%)
Saudi	585 (97.99%)
Age of caregiver (years)	
18-24	14 (2.35%)
25-34	126 (21.11%)
35-44	302 (50.59%)
45-54	131 (21.94%)
55-64	16 (2.68%)
65+	8 (1.34%)
Educational level of caregiver	
Illiterate	15 (2.51%)
Primary school	34 (5.70%)
Intermediate school	31 (5.19%)
Secondary school	105 (17.59%)
University level	374 (62.65%)
Post grade level	38 (6.37%)
Marital status of the caregiver	
Married	552 (92.46%)
Single (Widowed/Separated)	45 (7.54%)
Number of children under the care of the caregiver	
No response/Missing data	3 (0.50%)
One	53 (8.88%)
Two	107 (17.92%)
Three or more	434 (72.70%)
Job of caregiver	
Government employee	308 (51.59%)
Private employee	28 (4.69%)
Healthcare worker	8 (1.34%)
Unemployed	218 (36.52%)
Student	5 (0.84%)
Freelance	30 (5.03%)
Family income (monthly)	
< 6,000 SR (< 1600 USD)	140 (23.45%)
6,000-10,000 SR (1600-2666 USD)	181 (30.32%)
10,000-15,000 SR (2666-4000 USD)	162 (27.14%)
> 15,000 SR (> 4000 USD)	114 (19.10%)
Caregiver's history of chronic diseases	
No response/Missing data	61 (10.22%)
No	365 (61.14%)
Yes	171 (28.64%)
Medical history of the child (5-11 years) including chronic diseases	
No response/Missing data	2 (0.34%)
No	461 (77.22%)
Yes	134 (22.45%)
History of COVID-19 infection among family	
No	349 (58.46%)
Yes	248 (41.54%)
Member who got COVID-19 infection in the family	
No COVID-19 infection	349 (58.46%)
Family member including the child	108 (18.09%)
Family member without the child	135 (22.61%)
Only child infected	5 (0.84%)

Ethical approval

This study received approval from the Research Ethics Board at Qassim University and Qassim Ethics Committee No 1443-1050821. Access to the data was restricted to the study group to protect anonymity. Parents' privacy and confidentiality were guaranteed throughout the study, and no identifiers were used. Informed consent was obtained from caregivers before conducting the survey.

Results

A total of 600 surveys were conducted. Three of them were excluded because the responses were incomplete.

Socio-demographic characteristics

The median age of the participants was 35-44 years. Nearly 98% (n = 585) were of Saudi nationality, 92% were married (n = 552), and the majority (n = 434, 72.7%) had three or more children under their care. More than half (n = 374, 62.65%) of the study respondents had university degrees, and around half (n = 344, 57.62%) were employees with an average family income between 6,000-15,000 SR [1600-4000 USD] (n = 343, 57.45%). 98.5% of the parents completed the surveys.

Table 1 summarizes the sociodemographic data, for all the caregivers in the three groups (who would, would not, or were unsure) related to immunizing the young child (5-11 years) against COVID-19. In addition, 198 (33.2 %) caregivers stated that, they wanted to get their child vaccinated by the COVID-19 vaccine, 341 (57.1 %) indicated that they do not want to get their child vaccinated, and 58 (9.7%) stated that they were unsure. Only 4/198 (2 %) in the acceptance group received the vaccine.

Health status of the caregiver and child, including (chronic diseases and history of COVID-19 infection)

The study identified that 171 (28.64%) caregivers and 134 (22.45%) children had a chronic disease, and 41.54% (n = 248) of those families had experienced COVID-19 infection.

Vaccination history

A total of 582 (97.49%) caregivers declared that they were vaccinated against COVID-19; 436 (73.03%) received two doses and 119 (19.93%) received three doses. Among the caregivers, 41.5% (n = 248) self-reported moderate adverse effects of the COVID-19 vaccine. Half of the families had an older child between 12-18 years who was already vaccinated against COVID-19, and 43% (n = 149) had experienced moderate COVID-19 vaccine adverse events. In addition, 474 (79.40%) caregivers stated that their children completed all routine vaccines, and 50 (8.38%) stated that their children had not received any vaccination. Only 87 (14.57%) of the children had received the flu vaccine (Table 2).

Multivariate logistic regression analysis

Multivariate logistic regression identified factors that can predict the willingness of caregivers for getting their child vaccinated (Table 3). After adjusting other variables, few sociodemographic properties were associated with willingness to get vaccinated in the multivariable analysis. Caregivers with secondary school educational levels were relatively more interested in getting their children vaccinated against SARS-CoV-2 (aOR = 1.78, 95% CI: 1.1–2.87, *p* = 0.019) compared to caregivers with other education levels. In addition, families who had at least one member (including children) infected with SARS-CoV-2 (aOR = 9.28, 95% CI: 1.53-56.44, *p* = 0.016) and families with at least one member (not including children) infected with SARS-CoV-2 (aOR = 9.55, 95% CI: 1.58-57.68, *p* = 0.014) had a higher likelihood to be inclined to get their children vaccinated, compared to families without any history of COVID-19 infection.

Furthermore, the multivariable analysis indicated that some vaccination-related variables were correlated with the caregivers' readiness to immunize their children against SARS-CoV-2. First, caregivers who had received all the three COVID-19 vaccine doses were more willing to get their children vaccinated against SARS-CoV-2 (aOR = 1.88, 95% CI: 1.24-2.85, *p* = 0.003) in comparison to the people who had received only one or two doses. Secondly, the caregivers of children who received the additional flu vaccine were more inclined to vaccinate their young child against SARS-CoV-2 (aOR = 1.8, 95% CI: 1.13-2.87, *p* = 0.014) in comparison to the children who did not receive their influenza vaccine.

In addition, the caregivers who had experienced no or mild effects after vaccination had higher intentions of getting vaccination for the young child (aOR = 3.96,

95% CI: 2.16-7.28, *p* value < 0.0001) and (aOR = 3.48, 95% CI: 2.06-5.87, *p* value < 0.0001) respectively, compared to those who had experienced severe adverse events. The caregivers who were living in a family with a history of minor and unrevealed COVID-19 vaccine adverse events in older children (12-18 years) were more inclined to vaccinate their younger children (5-11 years) (aOR = 2.81, 95% CI: 1.27-6.23, *p* = 0.011) and (aOR = 3.34, 95% CI: 1.68-6.65, *p* = 0.001) respectively; compared to families whose older children experienced severe adverse events. Another significant result was that having no medical history of chronic

Table 2. Caregiver experience with vaccine including all caregivers who would or would not vaccinate their 5 to 11 years old children against COVID-19.

Variable	Total n (%) (n=597)
Caregiver took COVID-19 vaccine	
No	15 (2.51%)
Yes	582 (97.49%)
Number of doses received by caregiver	
Not vaccinated	15 (2.51%)
One dose	27 (4.52%)
Two doses	436 (73.03%)
Three doses	119 (19.93%)
Reasons why caregiver did not take the COVID-19 vaccine	
Vaccinated	582 (97.49%)
Due to medical condition	3 (0.50%)
Does not believe in vaccine	4 (0.67%)
No reason given	8 (1.34%)
Caregiver experience with COVID-19 vaccine adverse events	
Asymptomatic	82 (13.74%)
Mild	141 (23.62%)
Moderate	248 (41.54%)
Severe	107 (17.92%)
Critical	4 (0.67%)
Not vaccinated	15 (2.51%)
Routine immunization status of the child (5-11 years)	
Fully vaccinated for age	474 (79.40%)
Partially vaccinated for age	38 (6.37%)
Only birth vaccine received	35 (5.86%)
No vaccine received	50 (8.38%)
Extra-vaccine (flu vaccine) received by the child (5-11 years)	
No	510 (85.43%)
Yes	87 (14.57%)
Have child aged between 12-18 years	
No	254 (42.55%)
Yes	343 (57.45%)
Adverse events experienced by the child (12-18 years) with the COVID-19 vaccine	
Asymptomatic	47 (7.87%)
Mild	80 (13.40%)
Moderate	149 (24.96%)
Severe	59 (9.88%)
Critical	2 (0.34%)
Not vaccinated	6 (1.01%)
No child in this age group	254 (42.55%)

diseases in 5-11 years aged children was a predictor for the caregivers to have a greater intention of getting their child vaccinated against SARS-CoV-2 (aOR = 1.92, 95% CI: 1.29-2.87, $p = 0.001$).

Finally, multivariable analysis identified factors predicting caregivers' lack of intent to vaccinate their child aged between 5–11 years as no past COVID-19 infection history in the family, caregivers receiving 0-2 doses of the vaccine against COVID-19, children who did not receive the additional flu shots, caregivers' perception of the risk of severe adverse events resulting from the vaccine and a positive medical history of chronic disease in the 5-11 years old children.

Discussion

The SARS-CoV-2 vaccine was licensed in phases for children. The first phase was in mid-2021 for individuals > 12 years of age and the second in November of 2021 for individuals who were 5-11 years old. The vaccine was reported to demonstrate 91% efficacy in these age groups [4]. The results of this study were able to outline the different factors determining vaccine acceptance among caregivers. Two points were considered when analyzing our findings:

1. Our study is the first in Saudi Arabia that was conducted when vaccines were available for this age group, and.
2. During this survey, the number of new cases of COVID-19 had risen to its highest level since

Table 3. Predictors of caregiver willingness to vaccinate their 5 to 11-year-old children against COVID-19 identified by multivariate logistic regression analysis.

Variable/Group	Willing group (Yes)	Not willing group (No)	Unadjusted model		Adjusted model	
	(n = 198) n (%)	(n = 341) n (%)	Odds ratio (95% CI)	p value	Odds ratio (95% CI)	p value
Caregivers' education						
University level	110 (55.56%)	226 (66.28%)	1	Reference	1	Reference
Illiterate	6 (3.03%)	7 (2.05%)	1.76 (0.58, 5.36)	0.319	1.74 (0.55, 5.54)	0.350
Primary school	14 (7.07%)	18 (5.28%)	1.6 (0.77, 3.33)	0.211	1.49 (0.69, 3.24)	0.310
Intermediate school	11 (5.56%)	15 (4.40%)	1.51 (0.67, 3.39)	0.322	1.37 (0.59, 3.2)	0.465
Secondary school	42 (21.21%)	54 (15.84%)	1.6 (1.01, 2.54)	0.047	1.78 (1.1, 2.87)	0.019*
Post graduate level	15 (7.58%)	21 (6.16%)	1.47 (0.73, 2.96)	0.283	1.66 (0.81, 3.39)	0.169
History of COVID-19 infection in the family						
Only child infected	0	3 (0.88%)	1	Reference	1	Reference
Family members including the child	34 (17.17%)	66 (19.35%)	8.36 (1.4, 49.86)	0.020	9.28 (1.53, 56.44)	0.016*
Family members not including the child	46 (23.23%)	77 (22.58%)	8.83 (1.49, 52.31)	0.016	9.55 (1.58, 57.68)	0.014*
Number of COVID-19 vaccine doses taken by caregiver						
Two doses	134 (67.68%)	253 (74.19%)	1	Reference	1	Reference
Not vaccinated	4 (2.02%)	11 (3.23%)	1.16 (0.42, 3.2)	0.773	1.01 (0.36, 2.86)	0.980
One dose	5 (2.53%)	21 (6.16%)	0.82 (0.38, 1.77)	0.607	0.71 (0.32, 1.58)	0.409
Three doses	55 (27.78%)	56 (16.42%)	1.94 (1.3, 2.89)	0.001	1.88 (1.24, 2.85)	0.003*
Caregiver experience of COVID-19 vaccine adverse events						
Severe	12 (6.06%)	86 (25.22%)	1	Reference	1	Reference
Asymptomatic	40 (20.20%)	37 (10.85%)	3.92 (2.19, 7.03)	< 0.0001	3.96 (2.16, 7.28)	< 0.0001*
Mild	69 (34.85%)	54 (15.84%)	3.42 (2.04, 5.72)	< 0.0001	3.48 (2.06, 5.87)	< 0.0001*
Moderate	73 (36.87%)	149 (43.70%)	1.75 (1.1, 2.78)	0.018	1.77 (1.11, 2.83)	0.017*
Critical	0	4 (1.17%)	0.92 (0.12, 7.02)	0.934	0.81 (0.1, 6.35)	0.843
Additional flu vaccine received by the child						
No	157 (79.29%)	300 (87.98%)	1	Reference	1	Reference
Yes	41 (20.71%)	41 (12.02%)	1.99 (1.27, 3.11)	0.002	1.8 (1.13, 2.87)	0.014*
Medical history of child's chronic disease (5-11 years)						
Yes	25 (12.63%)	95 (27.86%)	1	Reference	1	Reference
No response/Missing data	1 (0.51%)	0	0.77 (0.05, 12.99)	0.858	0.6 (0.04, 10)	0.725
No	172 (86.87%)	246 (72.14%)	1.97 (1.33, 2.9)	0.001	1.92 (1.29, 2.87)	0.001*
History of adverse events of the COVID-19 vaccine in the older child (12-18 years)						
Severe	7 (3.54%)	48 (14.08%)	1	Reference	1	Reference
Asymptomatic	23 (11.62%)	21 (6.16%)	3.58 (1.66, 7.71)	0.001	2.81 (1.27, 6.23)	0.011*
Mild	40 (20.20%)	31 (9.09%)	3.37 (1.71, 6.63)	0.000	3.34 (1.68, 6.65)	0.001*
Moderate	50 (25.25%)	84 (24.63%)	1.89 (1.03, 3.47)	0.041	1.85 (1, 3.43)	0.051
Critical	0	2 (0.59%)	0.86 (0.05, 14.9)	0.917	0.45 (0.02, 8.33)	0.594

* p value is statistically significant in adjusted model.

the pandemic began due to the new omicron variant. [17].

Baseline description of vaccine uptake, caregivers' acceptance rate and the impact of omicron variants on acceptance rate

In our study, 2/3rd (57%) of parents were unwilling to get vaccines against SARS-CoV2 for their children, while 9.7% were unsure. Only 33% were willing to vaccinate their children, and only two (2%) of them received their vaccination dose. The vaccine acceptance rate in our sample is lower than the other local studies [18-21] done on children aged below 18 years, where the acceptance rates were 25.6%, 54.1%, 52.5%, and 47.5%. In addition, the acceptance rate in our population was lower compared to a global dataset published recently in a systemic meta-analysis conducted in September 2021 on 317,055 caregivers [22] where overall percentage of caregivers who wanted to get their child vaccinated was 60% (range 25.6-92.2%). However, it should be noted that previous studies included all children up to 18 years, which may increase the acceptance rate compared to our result where we focus on younger children. Studies have shown an increased uptake rate among 12-18 years old individuals compared to younger children [23-25]. However, caregivers are reluctant to vaccinate their young child due to long-term vaccine safety concerns. Reports from an Israeli study and the Kaiser Family Foundation (KFF) [23,26] performed on similar age groups found an acceptance rate of 45% and 46%, respectively, 10% higher than our study.

Despite the surging omicron variant at the time of the study and new cases being recorded in this period, the acceptance rate did not increase compared with previous local studies. This finding also was cited by the KFF for the same age group as the omicron variant did not increase parents' acceptance of the vaccine [23]. A possible explanation is that SARS-CoV-2 causes mild symptoms in children, and the risk of severe illness and death remains quite low [27]. Another possibility is that adverse events are rightly or incorrectly attributed to the new COVID-19 vaccine, causing the caregivers to be concerned about the adverse events and overlook the benefits.

Sociodemographic characteristics.

We found that except for the level of education, the sociodemographic characteristics did not influence caregivers' willingness to vaccinate their child. In addition, local data with similar sociodemographic characteristics [18-21] is controversial; this might result

from all local studies being cross-sectional. This controversy has been observed in previous systemic meta-analysis, particularly in the level of education, where the younger female caregivers were more likely to report vaccine hesitancy than male caregivers and older mothers [22].

Vaccination history

In the present survey, 73% of the caregivers had received COVID-19 vaccine up to the second dose, similar to the national average (74.6%). However, only 19.9% of the caregivers received the booster dose, lower than the reported national average of 28% [28]. There was a positive relationship between the caregivers receiving their booster dose and their willingness to vaccinate their children, which can directly correlate to the influence of past behaviors on future behaviors. The justification for this is that following the surge of the cases of omicron variant, the World Health Organization recommended booster doses for all individuals above 18 years of age and reduced the period between doses to 3 months. The Ministry of Health (MoH) of Saudi Arabia recommended that all people above 18 years must receive their 3rd dose (booster dose) with the minimum gap of 3 months after getting their 2nd dose. They extended the period to three months of the second dose [29,30]. This indicates that these caregivers were among the first to receive the vaccine once it was available in Saudi Arabia and were eligible for their booster dose, indicating they had good acceptance of the COVID-19 vaccine, and were keen to vaccinate their children. This is the first study that demonstrated that the positive association between the booster dose uptake and caregivers' willingness to vaccinate their young child.

Adverse events post-vaccine was an essential future predictor of vaccine acceptance. We found that those caregivers who reported none or mild adverse events post-vaccination in themselves (or in their elder children) had a higher likelihood of vaccinating their younger children. Our study did not distinguish whether the adverse events were serious or not and reported caregivers' experience when they received the vaccines themselves and when their elder children received the vaccine. This reflects their experience and intention toward vaccinating their younger children against COVID-19. Post vaccine report, including a self-assessment of adverse events, is crucial in anticipating caregivers' acceptance of vaccinating their children. Female participants are more likely to report when there is a post vaccination adverse event [31]. It is also

important to consider the role of mothers as they are the most significant decision-maker for their younger children. Younger mothers are more likely to reject vaccines than older mothers, which is essential in anticipating the acceptance rate.

Routine and influenza vaccination

Routine childhood vaccination uptake rate was 79.40%, with 20.6 % hesitancy for routine childhood vaccination, similar to local hesitancy rates in Saudi Arabia (20% and 24%) [18,32]. The current data revealed that routine childhood vaccination had no association with caregivers' acceptance. In addition, similar studies on local and Canadian populations reported similar uptake rates of 81% [14,18]. This is probably due to the mandatory vaccination requirements in certain countries, including Saudi Arabia, and those vaccines have been approved for many years and accepted with time. Another explanation is that vaccine uptake is higher due to passive acceptance of established regulations. As reported in previous studies [14-16], acceptance of the influenza vaccine was found to be a predictor of the acceptance of COVID-19 vaccines in our study. This may be because the influenza vaccine is provided annually, and the people actively accept it.

Health status of the caregiver and children

This study concluded that caregivers whose older children had previous COVID-19 infections were more interested to get their younger child vaccinated. This can be attributed to the health awareness they acquired from visiting their doctor in COVID-19 clinics (Tatamman clinic) or by reviewing information from the MOH. Children with chronic health issues had lower vaccination rates than healthy children, similar to results from previous studies [14-16]. Our study revealed that caregivers' previous history of chronic disease had no role in the acceptance of vaccines for their children.

Conclusions

Our study concluded that caregivers' willingness to vaccinate their younger children was influenced by knowledge and awareness of available COVID-19 vaccines and their safety. We found that multiple factors positively influence caregivers' decision to vaccinate their young children. These include educational level (secondary school), SARS-CoV-2-infection among family members, caregiver receiving the three doses of the COVID-19 vaccine and the additional flu vaccine with no or mild adverse events,

and no past medical history of chronic diseases in the young child. Factors that predict the lack of caregivers' willingness to vaccinate their young children include: no past medical history of SARS-CoV-2 infection, caregivers who received none or fewer doses of the vaccine, children who did not receive additional vaccines, caregivers' wrong perception of the high risk of the adverse effects of the COVID-19 vaccine and a medical history of chronic disease in young children. Understanding the caregivers' past behaviors and patterns in a pandemic may be useful for predicting future behaviors and their intention to vaccinate their children.

Limitations

There are a few limitations to this study. First, the cross-sectional design has inherent limitations because causality cannot be established. Second, there are limitations of conducting an online survey and its ineffectiveness in reaching illiterate people and those without internet access. Finally, online surveys may affect the rate of acceptance and rejection; unlike the clinical questionnaire, the use of online questionnaire may decrease the acceptance rate [22].

Authors' Contributions

AR designed the study, supervised the data collection process, and cleaning of the data. All authors helped with data cleaning and analysis and preparing the final manuscript. All authors have read and approved the final manuscript.

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Conflict of interests: No conflict of interests is declared.