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Research Article

Vaccine Literacy and Hesitancy Relating to Child Routine Vaccination among Jordanian Parents Post COVID-19

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Abstract

Background: The COVID-19 pandemic has created a debate about routine vaccination, mainly among parents, resulting in decreased immunization rates in some countries. ***Objective***: To identify child routine vaccine hesitancy and health literacy post-COVID-19 pandemic among Jordanian parents and to investigate the factors predicting vaccine hesitancy. ***Methods***: A descriptive cross-sectional study was conducted using the Parental Attitudes Towards Childhood Vaccines Scale and the Health Literacy Scale with 327 Jordanian parents recruited from maternal and child health centers from July to August 2024. ***Results***: Vaccine hesitancy was reported by 51 parents who scored ≥ 50 out of 100, and 276 parents scored < 50 out of 100, indicating that the majority of parents were not hesitant. Parents had a moderate level of vaccine literacy (2.54±0.42), with a significant difference in the participants' functional vaccine literacy based on their educational level (p=0.001). Furthermore, functional vaccine literacy, number of children, and parents who received the COVID-19 vaccine were significant predictors of vaccine hesitancy (p<0.05). ***Conclusions***: About 51% of parents were not hesitant, with moderate vaccine literacy and high vaccine trust. Functional vaccine literacy was a predictor of vaccine hesitancy. Policymakers and healthcare providers in the public and private sectors need to work together on this issue to be equipped with sufficient information to combat future health emergencies similar to those of COVID-19.

Keywords: Jordanian parents; Post-COVID-19; Routine childhood vaccinations; Vaccine hesitancy; Vaccine literacy.

معرفة الآباء الأردنيين باللقاحات والتردد فيما يتعلق بالتطعيم الروتيني للأطفال بعد كوفيد-19

الخلاصة

الخلفية: أثارت جائحة كوفيد-19 جدلا حول التطعيم الروتيني، خاصة بين الآباء، مما أدى إلى انخفاض معدلات التطعيم في بعض الدول. **الهدف**: تحديد تردد تلقيح الأطفال الروتيني والثقافة الصحية بعد جائحة كوفيد-19 بين الآباء الأردنيين ودراسة العوامل التي تتنبأ بتردد التطعيم. **الطرائق**: أجريت دراسة مقطعية وصفية باستخدام مقياس مواقف الوالدين تجاه لقاحات الأطفال ومقياس الثقافة الصحية مع 327 آباء أردنيين تم تجنيدهم من مراكز صحة الأمهات والأطفال من يوليو إلى أغسطس 2024. **النتائج**: أبلغ 51 والدا عن تردد في التطعيم حصلوا على ≤ 50 من 100، وحصل 276 آباء على > 50 من أصل 100، مما يشير إلى أن غالبية الآباء لم يكونوا مترددين. كان لدى الآباء مستوى متوسط من معرفة اللقاحات (2.54±0.42)، مع فرق كبير في معرفة المشاركين الوظيفية باللقاحات بناء على مستواهم التعليمي (p=0.001). علاوة على ذلك، كانت الثقافة الوظيفية في اللقاح، وعدد الأطفال، والآباء الذين تلقوا لقاح كوفيد-19 مؤشرات مهمة على تردد اللقاح (p<0.05). **الاستنتاجات**: حوالي 51٪ من الآباء لم يترددوا، مع معرفة متوسطة باللقاحات وثقة عالية في اللقاح، وكانت المعرفة الوظيفية باللقاحات مؤشرا على تردد اللقاح. مما يشير إلى الارتباط بين المتغيرين. يحتاج صانعو السياسات ومقدمو الرعاية الصحية، في القطاعين العام والخاص، إلى العمل على زيادة معرفة الوالدين حول تطعيمات الأطفال لتزويدهم بمعلومات كافية لمواجهة الطوارئ الصحية المستقبلية المشابهة لتلك التي تحدث مع كوفيد-19.

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INTRODUCTION

Immunization is one of the most effective public health interventions, saving millions of children's lives worldwide each year, preventing life-threatening diseases, and enabling people to live healthier [1, 2]. Since the emergence of the COVID-19 pandemic, many countries have experienced declines in routine child vaccination rates [3, 4], with global coverage dropping from 86% in 2019 to 83% in 2020 and 81% in 2021 for key vaccines such as Diphtheria-Tetanus-Pertussis [5]. This decline has left approximately 14.7 million children unvaccinated [6, 7]. In Jordan, a measles outbreak occurred in April 2023 due to 60% of children missing their doses, significantly impacting measles immunization coverage [5, 7]. Prior to the pandemic, measles vaccine coverage was 98% in 2019, but it dropped to 82% and 86% for the first and second doses by 2021 [8]. Sociocultural and health system factors, particularly parental beliefs and attitudes like vaccine hesitancy and health literacy, significantly affect immunization uptake [9-11]. A considerable number of children are either unvaccinated or insufficiently vaccinated due to hesitancy and non-compliance with scheduled vaccination programs [12]. Parents' vaccine hesitancy (PVH) is defined as the "delay in accepting or refusing the vaccine despite its availability" [13]. Vaccine hesitancy is shaped by behavioral, attitudinal, and safety-related factors [14]. It significantly jeopardizes public health by diminishing routine childhood vaccination rates [15, 16]. Despite strong evidence supporting vaccine safety

and effectiveness, hesitancy has increased globally, leading to delayed or missed vaccinations [17]. Parents' hesitancy can be a barrier to routine childhood vaccination and may increase the risk of vaccine-preventable diseases. A study by Nguyen *et al*. (2021) found that exposure to childhood vaccination coverage for all vaccines was higher among children of non-hesitant parents than among children of hesitant parents, and the population attributable fraction for under-vaccination due to hesitancy was between 15% and 25%, with the highest for ≥ 1 dose of the mumps, rubella, and measles vaccine [18]. The COVID-19 pandemic further intensified parental concerns and hesitancy toward routine immunizations [19-20]. In Saudi Arabia, Alzahrani *et al*. (2024) found that 72.9% of parents maintained positive attitudes toward vaccination, and 16.5% demonstrated knowledge gaps regarding disease prevention [21]. Similarly, Temsah *et al*. (2021) reported that parents were more confident in routine childhood vaccines than in COVID-19 vaccines, with concerns about safety and side effects influencing their decisions [22]. Vicario *et al*. (2024) identified cognitive empathy and lower interoceptive awareness as predictors of post-pandemic vaccine hesitancy, suggesting that reduced stress levels after the pandemic may influence decision-making [23]. Barqawi *et al*. (2024) reported that over 95% of parents from the Arab Emirates held positive attitudes toward routine vaccines, 14% exhibited hesitancy, and parental knowledge and personal identity were significantly associated with vaccine hesitancy levels [24]. Vaccine literacy is defined as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" [17]. It includes knowledge, motivation, and competencies that enable individuals to evaluate vaccine information and act accordingly. Since vaccine literacy is linked to health literacy, it focuses specifically on vaccination behaviors and decisions [17,25]. Low vaccine literacy correlates with poor health outcomes, lower use of preventive services, and reduced vaccination rates [17, 26], while higher literacy promotes understanding, compliance with immunization programs, and fosters more positive attitudes toward childhood vaccination [27, 28]. Previous studies show that, while vaccine literacy predicts vaccination intentions, its link to actual vaccination status is weak. Additionally, a strong correlation exists between vaccine literacy and trust in healthcare professionals. Three types of health literacy are identified: functional, communicative, and critical [29, 30]. Functional literacy includes basic skills in reading and writing; communicative literacy relates to social skills that help understand and communicate with others to apply health information, while critical literacy includes more advanced social and cognitive skills, such as evaluating and applying health information. Furthermore, hyper-critical literacy refers to an advanced level of critical appraisal in which individuals actively evaluate, question, and compare vaccine-related information sources, including assessing credibility, potential bias, and relevance before accepting or rejecting information [31]. Functional vaccination literacy relates to language skills about vaccines, focusing on locating, reading, understanding, and applying information, as well as engaging in critical communication [32]. Communicative health literacy measures a person's ability to extract and apply information, while critical literacy assesses their capability to analyze this information for decision-making [33]. A systematic review by Isonne *et al*. (2024) found that vaccine literacy predicts vaccination intentions but shows minimal association with vaccination status [28]. The relationship between vaccine literacy and vaccine hesitancy remains debatable since the findings are inconsistent. Romate *et al*. (2022) emphasized that vaccine literacy can reduce hesitancy and strengthen immunization planning and promotion [34]. Other studies report that higher literacy is associated with greater vaccine acceptance. Lorini *et al*. (2018) reviewed nine studies between 2007 and 2017 and found that the influence of health literacy on vaccine hesitancy varies across demographic and contextual factors such as age, country, and vaccine type [35]. Furthermore, Zhang *et al*. (2023) conducted a systematic review of 21 studies published since 2015, which found that vaccine literacy predicts hesitancy levels and vaccination intentions [36]. While Biasio *et al*. (2025) reported a negative correlation between vaccine literacy and the three dimensions of hesitancy (complacency, convenience, and confidence) among 359 Italian adults, this finding indicates that higher literacy is associated with lower levels of hesitancy [17]. Furthermore, Ustuner Top *et al*. (2023) studied the role of digital literacy among 582 parents of preschool children and found vaccine hesitancy to be 2.77 times higher among parents with a high school education and 1.81 times higher among parents who perceived themselves as knowledgeable about vaccines [37]. Hesitancy correlated negatively with digital literacy, with low scores on the impact of online information on vaccine attitudes. In Jordan, few studies explored vaccine hesitancy and vaccine literacy among parents' post-COVID-19 pandemic. Barakat *et al*. (2023) examined parental acceptance of the measles/rubella vaccine among 273 Jordanian parents using the Parental Attitudes Toward Childhood Vaccines (PACV) scale [19]. The findings showed that most parents expressed either resistance or hesitancy toward MR vaccination. Factors associated with vaccine acceptance were trust in vaccine safety and efficacy, previous vaccination behavior, and having fewer children. Abu-Farha *et al*. (2024) explored Jordanian parents' attitudes toward childhood vaccination, identifying a post-pandemic shift to more negative perceptions, particularly among parents who did not vaccinate against COVID-19 [38]. Karasneh *et al*. (2020) found that 27.1% of the 294 participants in their study exhibited low health literacy levels [39]. Predictors of inadequate literacy were the living area, age, having chronic health problems, and educational level. This study aimed to examine vaccine hesitancy and vaccine literacy among Jordanian parents and to identify factors predicting vaccine hesitancy among parents in the post-COVID-19 period.

METHODS

Study design and setting

A descriptive cross-sectional design was used to describe Jordanian parents' vaccine hesitancy and literacy and to identify predictors of vaccine hesitancy. This design is the most appropriate since it allows us to collect data from parents at a single point on specific variables without influencing those variables [40]. Data were collected from parents attending four comprehensive health centers at the Ministry of Health (MoH) in the central region of Jordan. The central region of Jordan has four governorates, with a total of 183 health centers [41]. One comprehensive health center was selected from each governorate, using a convenience method. These centers provide a range of essential health services, including antenatal and postnatal care, family planning, health education, child immunization, and growth monitoring, and are highly attended by women for reproductive health services. The selection of settings was based on feasibility, accessibility of data collection sites, and the need to ensure uniformity in service delivery across included centers.

Participants

A convenient sample of parents visiting one of the selected health centers over two months (July-August 2024) participated in the study. The sample size was calculated using G*Power statistical software with an alpha value of 0.05, a 95% confidence interval, and a margin of error of 5%, assuming that 10.5% is hesitant based on regional literature [38]. The minimum sample size was estimated to be 277 participants; an additional 10% (28 participants) were included to account for non-completions. Data collection took place over two weeks at each center, resulting in a total of 327 parents, nearly evenly distributed across the four health centers. Participants who met the inclusion criteria, being a father or mother with at least one child under 5 years old and visiting the MC during data collection, were invited to participate. Parents with children who have health conditions preventing vaccination were excluded. To ensure independent responses, only one parent per household was included in the study. In cases where both parents were present, the parent primarily responsible for the child's healthcare decisions or the first eligible parent was invited to participate.

Instrument

A paper-based self-administered questionnaire was used to collect data from parents. The questionnaire consisted of sociodemographic variables, the vaccine hesitancy scale, and the vaccine literacy scale. The sociodemographic variables included nominal variables (gender, marital status, whether the child received routine vaccinations before and after the COVID-19 period, whether the child was vaccinated against COVID-19, whether the parent was vaccinated against COVID-19, and the parent's education) and continuous variables (parent's age and monthly income).

Hesitancy measurement scale

The Arabic version of the Parents' Attitudes about Childhood Vaccines (PACV) instrument developed by Alsuwaidi *et al*. (2020) was used to assess parental hesitancy [14]. Opel *et al*. (2011) created the instrument, which has 18 items and three ways to answer: dichotomous (yes/no), a 5-point Likert scale (strongly agree to disagree), and an 11-point scale (0= not sure at all to 10= completely sure) [42]. The 11-point format was used for only two items to minimize cognitive burden while capturing nuanced attitudes regarding trust and overall hesitancy. The original scale demonstrated strong validity and reliability across studies [42, 43], with Cronbach's alpha coefficients ranging from 0.77 to 0.80. The Arabic version was translated and adapted by Alsuwaidi *et al*. (2020) [14]. It consists of 15 items distributed across three domains: behavior (items 1–2), safety and efficacy (items 7–10), and general attitudes and trust (items 3–6 and 11–15). The Arabic version of the instrument kept the same number of items as the original scale and deleted three items, which were non-relevant sociodemographic variables. The Arabic version has a satisfactory internal consistency, α= 0.79 [16]. Opel *et al*. (2011) provided scoring instructions for analyses of the PACV instrument. Items were coded as 2 for hesitant responses, 1 for "don't know/not sure," and 0 for non-hesitant responses [42]. The following steps describe the scoring of the PACV. 1- Score each of the 15 PACV survey items. Hesitant responses are assigned a 2, 'don't know' or 'not sure' a 1, and non-hesitant responses a 0. The two items in which the 'don't know' response was excluded as missing data (Q3 and Q4) are scored as 2 for the hesitant response and 0 for the non-hesitant response. 2- Calculate the raw total PACV score by simply summing each item. The total raw score will range from 0 to 30 if all items have responses and Q3 and Q4 are not excluded as missing data. If there is at least one item without a response, or if Q3 or Q4 is answered as 'don't know' and therefore excluded as missing data, the total raw score must be adjusted. For instance, if there is one response missing or excluded, the total raw score will range from 0 to 28; if there are two responses missing or excluded, the total raw score will range from 0 to 26; etc. 3-Convert the raw score to a 0 to 100 scale using a simple linear transformation, accounting for items with missing values. Scores <50 indicate non-hesitant parents, and scores >50 indicate hesitant parents.

The vaccine literacy scale

The Functional, Communicative, and Critical Health Literacy Scale (FCCHL) developed by Ishikawa *et al*. (2008) was used in this study. It is originally a health literacy scale with 14 items categorized under three dimensions: functional health literacy (5 items),

communicative health literacy (5 items), and critical health literacy (4 items) [30]. The scale was validated with 138 type 2 diabetic patients and tested for internal consistency, which showed alpha coefficients of 0.84, 0.77, and 0.65 for the functional, communicative, and critical HL scales, respectively. Furthermore, Mirczak (2022) reported Cronbach's alpha reliability coefficients of 0.77 and 0.8, reflecting a satisfactory internal consistency of the scale [44]. Although the scale was validated with diabetic patients, the authors then released a general scale that is applicable to any health problem.

Translation and adaptation

The FCCHL was originally developed by Ishikawa *et al*. (2008) in the English language, and we translated it into the Arabic language using forward-backward translation [45]. The translation process used a four-step approach: the English version was translated (forward translation) into Arabic by a bilingual expert, and a second bilingual expert back-translated the Arabic version into English, without knowledge of the original English version. The group of translators agreed to review both the English and Arabic versions and examine the consistencies between them to identify any discrepancies. Finally, the Arabic version was examined for cultural relevance and semantic equivalence, and there were no discrepancies detected in the final English version of the FCCHL. The scale adaptation required very few changes since it is a general scale that accommodates any health problem; therefore, we replaced the space with child vaccination, which appeared only in the instructions for completing the scale. In addition, the translated scale was validated by a panel of three maternal and child health specialists for content validity and was pilot tested with 30 participants. The expert's feedback revealed minor edits and comments, which were integrated into the final version. Participants from the pilot study concluded that the scale was clear, with no ambiguities, and took around 20 minutes to complete. The scores of the FCCHL were obtained by calculating total means for all 14 items; subscale scores were obtained by averaging items 1–5, 6–10, and 11–14, respectively. All scores range theoretically from 1 to 4. Items 1–5 (Functional Vaccine Literacy) are reversed items, and these reversals were applied before computing the total score and subscale scores to ensure that higher scores consistently reflect higher levels of health literacy.

Validity and reliability of the instruments

An expert review group of academics with experience in the field of nursing provided their comments to ensure face and content validity. The expert review group assessed the content for soundness, clarity, and relevance to the study scale. Only a few modifications were suggested, such as formatting of some demographic variables. No modifications were required regarding the scales' items. In addition, a pilot study was conducted involving 10% of the total study participants (n = 30) to evaluate the feasibility of administering the scale, assess the clarity and comprehensibility of the instructions and items, estimate the time required to complete the survey, and measure the reliability of the scale. Participants were encouraged to provide detailed feedback regarding any difficulties or ambiguities they encountered while responding to the questionnaire. No comments were provided by participants. The overall time needed to fill out the questionnaire was 20 minutes. Cronbach's alpha reliability coefficient was used to measure the reliability of the hesitancy and literacy instruments, and results showed that the Cronbach's alpha coefficient of the PACV scale is 0.80, and the vaccine literacy scale is 0.71, which exceeds the cut-off level (0.70), indicating that all scales are reliable.

Data collection

The main researcher visited the four selected health centers to coordinate the data collection process with center directors. Data collection took around two months (July to August 2024). The researcher met with eligible participants, explained the study objectives, and informed them of their right to decline participation without any consequences before data collection. Participants were assured that all information would remain confidential and be used only for research purposes.

Ethical considerations

The study was approved by the Ethics Committee of Scientific Research/Faculty of Nursing at (hidden for blind review) (Ref. 308/2024). Permission was granted by FCCHL scale authors to use, adapt, and translate the scale into the Arabic language. Participants' rights were protected in accordance with ethical research standards, including respect for privacy, confidentiality, and voluntary participation. The study objectives and potential benefits were explained to all participants, who were informed that data would remain confidential, accessible only to the researcher, and that anonymity would be maintained. Written informed consent was obtained before participation, and participants were reminded of their right to withdraw at any time without penalty.

Data analysis

Before analysis, data were tested for normal distribution, and test results indicated no deviation from normality, which supports the assumption of normality for parametric analyses. Statistical analyses were performed using IBM SPSS Statistics, Version 26. Data screening confirmed the absence of missing values. Descriptive statistics (frequencies, means, standard deviations, and chi-square) were used to describe the sample and levels of parental vaccine literacy and vaccine hesitancy. Pearson correlation analysis was conducted as an initial explanatory step to examine the strength and direction of the bivariate correlation between vaccine literacy and vaccine

hesitancy. Correlation analysis provides a primary comprehension of the relationship among study variables; however, it does not account for potential confounding factors. Therefore, logistic regression analysis was performed to identify independent predictors of vaccine hesitancy while controlling for sociodemographic characteristics and other covariates. The combined use of correlation and regression analysis enabled both the assessment of unjustified relationships and the determination of adjusted effects.

RESULTS

Participants' ages ranged from 18 to 53 years, with a mean of 34.53 ± 6.73, and income ranged between 180 JD and 4000 JD (1 JD = 1.4 USD), with a mean income of 697.39 ± 53. The number of children ranged from 1 to 8, with a mean age of 3.04 ± 1.46 years. Around 74% (n=242) were mothers and 26% (n=85) were fathers. All participants reported vaccinating their children for the routine vaccinations before and during/after the COVID-19 period. Only 14.98% (n = 49) vaccinated their children against COVID-19, while 90.21% (n = 295) received the COVID-19 vaccine themselves. Table 1 presents the detailed socio-demographic characteristics of participants.

Table 1: Socio-demographic Characteristics of Parents (n=327)

Variable	Range	mean±SD
Participants' age (year)	18-53	34.53±6.73
Income (JD)	180-4000	697.39±531.41
Number Of Children	1-8	3.04±1.46
Variables		n(%)
Participants gender		
Mother		242(74.01)
Father		85(25.99)
Marital status		
Married		294(89.91)
Divorced		17(5.2)
widow/er		16(4.89)
Education level		
Secondary or less		66(20.18)
Diploma		97(29.66)
Bachelor's or above		164(50.15)
Vaccinate the child against COVID-19		
Yes		49(14.98)
No		278(85.02)
Parents received the COVID-19 vaccine		
Yes		295(90.21)
No		32(9.79)

Table 2 presents the descriptive data on vaccine hesitancy. The majority of parents (63.0%) supported giving shots on schedule and (87.77%) supported vaccinating their children unless illness or allergy was a factor. These results indicate adherence to routine vaccination behaviors. However, one-third had delayed a shot, and about 8.56% had refused, suggesting some behavioral hesitancy. Safety and efficacy concerns were clear: over half were concerned about serious side effects (54%), and 45% were concerned about vaccine safety. Additionally, 45% agreed that children should receive fewer vaccines at the same visit, reflecting discomfort with the vaccination schedule. However, the majority still want to vaccinate another infant (88%), because they believe vaccine-preventable diseases are severe (85%), and they trust vaccine information (76%) and their child's doctor (61%, rating 8–10). Overall, hesitancy was low to moderate; 65% were not hesitant, and one in four parents (24%) identified themselves as at least somewhat hesitant. Based on the scoring system of the PACV, parents' hesitancy toward routine child vaccines post-COVID-19 reveals a mean score of 31.41 out of 100, with a range from 0.00 to 97.00. Additionally, 51 parents scored ≥ 50, while 276 parents scored below 50, indicating that the majority of parents have low hesitancy. An independent samples t-test was conducted to compare participant age, number of children, and income between those "hesitant" and "unhesitant" toward vaccination. No statistically significant differences were reported; the low percentage of hesitant parents could explain these findings. In addition, the Chi-square test indicated that marital status and parents' COVID-19 vaccination status were significantly associated with vaccine hesitancy ($p< 0.05$). Currently unmarried parents (divorced or widowed) were more likely than married individuals to be hesitant, and there was a relation between those who received the COVID-19 vaccine and vaccine hesitancy (X^2 (1, n = 327) = 12.92, $p< 0.0001$). Education, literacy, and income were not found to be significantly associated with vaccine hesitancy. Overall vaccine literacy scores were moderate (M= 2.54). Functional literacy was the highest (M= 2.97), indicating better literacy. Communicative literacy was the lowest (M= 2.05), suggesting limited ability to seek, interpret, or use vaccine information from different sources. Critical literacy was moderate (M= 2.61), indicating that parents occasionally assessed the credibility and relevance of vaccine information (Table 3). Age was negatively associated with vaccine literacy but weakly (r= -0.12 and -0.15, $p= 0.03$ and 0.007, respectively), indicating that older participants had slightly higher functional literacy but slightly lower communicative and critical literacy. Income showed no significant relationship with any vaccine literacy domain. The number of children was unrelated to most domains, except for a small negative correlation with critical literacy, suggesting parents with more children were slightly less likely to critically evaluate vaccine information. Overall, correlations were weak, indicating minimal demographic influence on vaccine literacy. The independent-samples t-test showed that participants with a bachelor's degree or higher had significantly higher functional vaccine literacy than those with a diploma or less ($p= 0.001$). Critical vaccine literacy differed significantly between parents who vaccinated their children against COVID-19 and those who did not ($p= 0.002$), with the non-vaccinating group reporting higher critical literacy. Participants who received the COVID-19 vaccine exhibited significantly greater functional vaccine literacy than those who did not ($p< 0.001$).

Table 2: Descriptive Statistics for Parents' Attitudes about Childhood Vaccination items (n= 327)

Behavior	Response	n(%)
Have you ever delayed having your child get a shot for any reason?	No	206(63)
	Yes	107(32.72)
	I Don't know*	14(4.28)
Have you ever decided not to have your child get a shot) for reasons other than illness or allergy?	No	287(87.77)
	Yes	28(8.56)
	I Don't know*	12(3.67)
Safety And Efficacy		
It is better for children to get fewer vaccines at the same time.	Strongly disagree or disagree	79(24.16)
	Not sure	102(31.19)
	Agree or strongly agree	146(44.65)
How concerned are you that your child might have a serious side effect from a shot?	Not at all concerned and not too	107(32.72)
	Not sure	43(13.15)
	Somewhat concerned and very	177(54.13)
How concerned are you that any one of the childhood shots might not be safe?	Not at all concerned and not too	115(35.17)
	Not sure	64(19.57)
	Somewhat concerned and very	148(45.26)
How concerned are you that a shot might not prevent the disease?	Not at all concerned and not too	115 (35.17)
	Not sure	93(28.44)
	Somewhat concerned and very	119(36.39)
General attitude and trust		
If you had another infant today, would you want him/her to get all the recommended shots?	Yes	288(88.07)
	I Don't know*	16(4.89)
	No	23(7.03)
Children get more shots than are good for them.	Strongly disagree or disagree	137(41.90)
	Not sure	93(28.44)
	Agree or strongly agree	97(29.66)
I believe that many of the illnesses that shots prevent are severe.	Agree or strongly agree	279(85.32)
	Not Sure	38(11.62)
	Strongly disagree or disagree	10(3.06)
It is better for my child to develop immunity by getting sick than to get a shot.	Strongly disagree or disagree	173(52.91)
	Not sure	72(22.02)
	Agree or strongly agree	82(25.08)
I trust the information I receive about shots.	Agree or strongly agree	247(75.54)
	Not sure	68(20.8)
	Strongly disagree or disagree	12(3.67)
I am able to openly discuss my concerns about shots.	Agree or strongly agree	252(77.06)
	Not sure	49(14.98)
	Strongly disagree or disagree	26(7.95)
Overall, how hesitant about childhood shots would you consider yourself to be?	Not at all hesitant and not hesitant	214(65.44)
	Not sure	33(10.09)
	Somewhat hesitant and very hesitant	80(24.46)
How much do you trust your child's doctor?	0-5	43(13.15)
	6-7	85(25.99)
	8-10	199(60.86)
How sure are you that following the recommended shot schedule is a good idea for your child?	0-5	20(6.12)
	6-7	69(21.1)
	8-10	238(72.78)

PACV: Parent Attitude about Childhood Vaccines. *The answer "Do not know" in questions 1 and 2 is counted as excluded data in the summation.

Table 3: Mean scores and standard deviations of the Vaccine Literacy Scale (n=327)

Items	Result
Functional Vaccine Literacy (Total Mean score)	2.97±0.85
Found the print to be too small to read	2.93±1.02*
Found symbols and words that I did not know	2.89±0.99*
Found the content to be too difficult	2.97±1.02*
Needed a long time to read and understand them	2.95±1.01*
Needed help from someone else to read them	3.11±1.04*
Communicative Vaccine Literacy (Total Mean score)	2.05±0.82
Gathered information from different sources	2.03±0.93
Extracted the information you wanted	2.1±1.0
Understood the information you obtained	2.06±0.97
Communicated your thoughts about childhood vaccines to someone	2.06±0.99
Applied the information you obtained in your decisions about vaccinations	2.01±0.98
Critical Vaccine Literacy (Total Mean score)	2.61±0.9
Thought about whether the information applies to your child's case	2.64±0.99
Thought about the credibility of the information about the vaccine	2.62±1.12
Verified whether the information about the vaccine was correct	2.58±1.09
Gathered information to make decisions about your child's vaccinations	2.58±1.12
Vaccine Literacy (Total Mean score)	2.54±0.42

Values are presented as mean±SD. Vaccine literacy measure responses on a four-point Likert scale: Never (1), Rarely (2), Sometimes (3), and Often (4). *The functional vaccine literacy sub-scale has inverse scores.

However, communicative vaccine literacy was significantly lower among those who took the COVID-19 vaccine than among those who did not (p= 0.02). To identify factors predicting vaccine hesitancy, logistic regression analysis was conducted (Table 4). The model included functional, communicative, and critical vaccine literacy, sociodemographic variables, and participants' COVID-19 vaccination behaviors. The significant predictors were functional literacy (B= –0.62, p= 0.009, OR = 0.53 (95% CI: 0.33–0.85)); this finding shows that for each unit increase in functional literacy, the odds of being hesitant decreased by 47% (1–0.53= 0.47). Number of children (B= 0.32, p= .01, OR = 1.37 (95% CI: 1.06–1.78)): Having more children significantly increased the likelihood of vaccine hesitancy; each additional child increased the odds of hesitancy by 37%. Finally, receiving the COVID-19 vaccine was associated with a significant

reduction in vaccine hesitancy (B= –1.03, *p*= 0.03, OR= 0.35 (95% CI: 0.14–0.90)). Parents who had received the COVID-19 vaccine themselves were significantly less likely to be hesitant; the odds of hesitancy were reduced by 65% compared with those who were unvaccinated. The following variables were not significantly associated with vaccine hesitancy: communicative literacy, critical literacy, income, education, age, and the child's COVID-19 vaccination status. To summarize the main predictors, higher functional vaccine literacy, receiving the COVID-19 vaccine personally, and having fewer children were significantly associated with lower vaccine hesitancy.

Table 4: Logistic regression analysis of factors influencing parental vaccine hesitancy

Variables	B±SE	Wald	*p*-value	OR	95% CI
Functional literacy	-0.62±0.24	6.82	0.009	0.53	0.33-0.85
Communicative literacy	0.26±0.26	0.96	0.32	1.29	0.77-2.17
Critical literacy	0.07±0.22	0.09	0.76	1.07	0.69-1.66
Number of children	0.32±0.13	5.81	0.01	1.37	1.06-1.78
Income	-0.001±0.0	1.66	0.19	0.99	0.99-1.0
Education (1)	-0.691±0.37	3.35	0.06	0.50	0.23-1.05
Participant age	-0.04±0.03	1.40	0.23	0.96	0.9-1.02
Vaccinated their children against COVID-19 (1)	-0.017±0.53	0.00	0.97	0.98	0.34-2.79
Parent received the (COVID-19) vaccine (1)	-1.03±0.47	4.71	0.03	0.35	0.14-0.9
Constant	1.26±1.49	0.71	0.39	3.54	

Variable(s) entered on step 1: functional, Communicative, Critical, if your answer (yes) mention number of children, income, education, participant age, vaccinate your children against COVID-19, parent receive (COVID-19) vaccine.

DISCUSSION

The findings of this study contribute to the limited existing evidence on parents' hesitancy and vaccine literacy post-COVID-19 pandemic regarding the routine vaccination of their children in Jordan. In general, vaccine hesitancy among Jordanian parents was low, with a small percentage of parents being hesitant. These findings align with regional findings; for instance, Barakat *et al*. (2023) reported that more than half of Jordanian parents expressed no hesitancy toward the measles–rubella vaccine [19], and studies from Saudi Arabia, the UAE, and Eastern India similarly reported high acceptance and low hesitancy rates [46]. In contrast, Biasio *et al*. (2025) found high hesitancy levels in Italy, which were explained by sociopolitical factors, public skepticism toward vaccines, and fragmented institutional messaging [17]. The commitment to the national immunization program [47] explains Jordan's low hesitancy. The recent MoH data showed that the national immunization coverage has regained its status and reached 95% post-pandemic, and the national health policy emphasizes that children's immunization is essential to school entry [48]. The Health Belief Model (HBM) emphasizes perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy as key determinants of health behavior. A 2021 study demonstrated that higher perceived benefits, greater perceived disease severity, stronger cues of action, and lower perceived barriers were significantly associated with increased COVID-19 vaccine acceptance among healthcare workers and the general population [49]. In contrast, concerns regarding vaccine safety and side effects served as major barriers. In the context of this study, the relatively low vaccine hesitancy observed among Jordanian parents may be attributed to high perceived benefits of vaccination, strong trust in national immunization programs, and institutional cues to action such as immunization requirements for school entry. Parents also expressed trust in vaccine safety, adherence to recommended schedules, and confidence in physicians. The findings suggest that Jordan reinforces strong legislation and consistent public health messaging. Although hesitancy was low, concerns and worries about side effects and multiple concurrent doses do exist. These concerns are common but do not lead to refusal when trust in health systems remains high, as stated by Kempe *et al*. (2020) [16]. Parents who took the COVID-19 vaccine were linked to their hesitancy toward routine childhood vaccines; vaccinated parents were less hesitant, consistent with that of Temsah *et al*. (2021) [22], suggesting that parents' positive experience with vaccination may enhance confidence and acceptance of routine immunization. Vaccine literacy regarding routine childhood vaccines post-COVID-19 revealed that functional literacy was moderate, indicating that although parents understand basic vaccination information, they may not fully comprehend unfamiliar terminology. This finding is partially inconsistent with earlier studies from Jordan reporting lower health literacy [39] and consistent with that reported by Biasio *et al*. (2025), who found higher literacy levels. The communicative literacy was low, reflecting challenges in obtaining, discussing, and applying vaccine information from various sources about child vaccinations. These findings may be explained by the shortage of health care professionals at the primary health care centers, who may not be fully available to communicate effectively with parents [17]. Lower communicative literacy may hinder parents' ability to evaluate risks and benefits and make informed decisions [25]. Finally, critical literacy was moderate and consistent with findings by Gao *et al*. (2024) [32]. Parents showed some ability to appraise vaccine information but still struggled to distinguish reliable sources from misinformation, a concern given the influence of misleading online content. The overall findings of moderate literacy levels may hinder parents in making informed decisions and in showing confidence in the immunization programs. In comparison with Barqawi *et al*. (2024) [24], who found

high digital vaccine literacy, age was positively associated with functional literacy and negatively associated with communicative and critical literacy. Older parents may read and comprehend basic information effectively but may be less comfortable engaging in discussions and evaluations. Their findings are also consistent with those of Omar *et al*. (2020) [33]. A negative correlation between the number of children and critical literacy suggests that parents with more children may rely on routine practices rather than actively seeking and evaluating information [50]. Income showed no significant association with literacy, consistent with evidence that education is a stronger predictor of health literacy in Jordan [50]. Parents who received the COVID-19 vaccine had higher functional but lower communicative literacy. Higher functional literacy may enhance trust in health guidance [22], while lower communicative literacy may reflect less engagement with diverse information sources. These findings imply that sociodemographic information and vaccine literacy play a limited role in determining parental vaccine decisions and are unlikely to account for the parents' vaccination decisions on their own. Rather, vaccination choices might be the result of a complex interaction and a more complex set of psychosocial influences (e.g., risk perceptions, confidence in authorities, previous vaccination experiences, and exposure to misinformation) that override basic literacy skills or demographic characteristics. Thus, the analysis suggests that future tactics should aim not solely to target sociodemographic characteristics but to emphasize specific ways of communicating, efforts to cultivate trust, and context-specific interventions to best counter vaccine hesitancy. The factors predicting Jordanian parents' vaccine hesitancy were functional vaccine literacy, number of children, and parents' COVID-19 vaccination status. These factors are interpreted within the global studies and the social context of the Jordanian healthcare system, which may have shaped parents' attitudes and decisions regarding routine childhood vaccination post-COVID-19 pandemic. Functional literacy was negatively associated with parental hesitancy, explaining that as functional literacy increased, the odds of being hesitant decreased by 47%. These findings are consistent with multiple studies demonstrating that higher literacy supports vaccine confidence and intentions [17, 33]. Findings may be attributed to the fact that the majority of parents in this study are young and educated, which gives them the basic literacy skills needed to read and understand vaccine information, thereby reducing their hesitation towards child vaccinations. Determinants such as complacency, convenience, and confidence also play critical roles in hesitancy [33]. The Ministry of Health/Jordan has created an immunization strategy that focuses on the importance of written and digital information and health communication through social media [48]. They have also created a national health communication strategy to improve health outcomes by using digital platforms, reaching out to specific groups like young people, and encouraging health through behavior change communication. The aim is to build a healthier society by improving knowledge, fostering positive attitudes, and supporting health-seeking behaviors across different segments of the population [50]. Therefore, Jordanian parents are in a better position to comprehend vaccine schedules, interpret risk–benefit information, and critically evaluate health messages and reinforce the findings that functional literacy is important for reducing parental hesitation. These findings are in line with existing studies supporting the notion that higher literacy levels promote vaccine confidence and intentions [17,33]. The WHO 3C model (confidence, convenience, and complacency) suggests that stronger literacy contributes to improving confidence and reducing complacency [33]. The number of children was positively associated with hesitancy; having more children significantly increased the likelihood of vaccine hesitancy, with each additional child raising the odds of hesitancy by 37%. These findings align with a study [49], which discovered that mothers with two or more children are more likely to be vaccine-hesitant, and this hesitancy persisted during the COVID-19 pandemic. In Jordan, larger families are more common among lower socioeconomic and rural populations [8], facing challenges such as transportation issues, long wait times at primary care centers due to a shortage of healthcare professionals, and weak counseling programs. Parents with more children may also experience a range of vaccination-related experiences, including adverse reactions, which could influence their hesitancy. Parents' COVID-19 vaccination status negatively predicted hesitancy; parents who had received the COVID-19 vaccine themselves were significantly less likely to be hesitant; their odds of hesitancy were reduced by 65% compared with those who were unvaccinated. These findings are consistent with the findings of one study and conflicting findings from elsewhere [50, 44], reflecting concerns about COVID-19 vaccine safety, which may influence attitudes toward other vaccines [50]. In Jordan, trust in COVID-19 vaccine acceptance reflects a general confidence in the immunization program and the healthcare system, as evidenced by the percentage of parents who received COVID-19 vaccines for adults but not for children. Parents who accepted the COVID-19 vaccine may therefore possess greater baseline confidence in governmental health messaging and the safety of vaccines in general. Jordan implemented a well-organized national COVID-19 vaccination campaign early during the pandemic, characterized by focused communication through digital platforms and public engagement. The conflicting findings from another study may reflect the influence of COVID-19 vaccine-specific concerns spilling over into attitudes toward routine immunizations [50]. These concerns could partially explain why unvaccinated parents remain more hesitant about routine vaccines, reinforcing the importance of trust-building and transparent communication within the health system. These findings highlight the importance of functional literacy in raising awareness through access to health and vaccination information; however, larger family sizes pose challenges that increase parents' hesitancy

toward vaccinating their children, and personal COVID-19 vaccination status indicates that both parents and Jordan's national efforts during COVID-19 have contributed to building trust in national immunization initiatives. These findings highlight the importance of creating vaccine literacy interventions targeting parents with large families and people who cannot access health information messages.

Strengths and Limitations

This study's primary strength lies in its timely examination of vaccine hesitancy and literacy among Jordanian parents in the post-COVID-19 context, a domain characterized by a scarcity of empirical data. The employment of validated and widely accepted instruments, specifically the Arabic version of the Parents' Attitudes about Childhood Vaccination (PACV) and the Functional, Communicative, and Critical Health Literacy Scale (FCCHL), guarantees the reliability and comparability of the findings. The study attained a high response rate and encompassed a demographically diverse sample of participants, facilitating significant subgroup analysis based on sociodemographic variables. The statistical methods employed, such as logistic regression, Pearson correlation, and t-tests, establish a solid analytical framework for identifying key predictors of vaccine hesitancy. The results of this study should be interpreted considering several limitations. First, the study has been conducted using a cross-sectional approach, which makes the data prone to bias due to participants' responses. Second, the study was limited to the setting in which the data were collected, MCH, at the MoH in the central region of Jordan only, and the data were gathered from parents of children less than five years old, which further limits the applicability of the results to parents of older children. Third, the study sample included a convenience sample, which was constrained by inclusion and exclusion criteria. Finally, a structured questionnaire was used as the study instrument with limited choices for each item, which may have constrained the participants' responses and reduced the depth of data collected.

Implications and Recommendations

Although hesitancy remains low, we must continue taking action to sustain and further strengthen confidence in routine childhood vaccination. Healthcare providers, including nurses, physicians, and midwives, should be equipped with strong communication and counseling skills to address parental concerns, especially regarding vaccine safety and schedules. To enhance functional vaccine literacy, we must simplify and make educational materials more accessible, using easy-to-read brochures, booklets, and visual aids. Given the limited communicative literacy results, healthcare professionals should encourage open dialogue, allow parents to ask questions, and reinforce evidence-based information. Digital health campaigns can complement efforts by disseminating reliable content, countering misinformation, and scheduling through widely used social media platforms, especially during health emergencies and crises similar to those of COVID-19. Future studies may employ prospective or longitudinal designs to better understand how literacy affects actual vaccination uptake. Research should further explore vaccine literacy as a predictor of hesitancy, examining potential mediating factors such as health beliefs, trust in institutions, and perceived vaccine risks. Using qualitative tools, such as semi-structured questionnaires or interviews, may better understand parental concerns and information needs. Expanding study settings to include diverse health centers across multiple Jordanian governorates would improve generalizability. Finally, future research should investigate how vaccine literacy interacts with other psychosocial and structural factors to shape hesitancy, ultimately guiding interventions that support optimal vaccination outcomes.

Conclusion

The study investigated two critical factors in shaping parents' hesitancy and literacy toward child vaccine uptake in the post-COVID-19 era; these results support the evidence and information of public health concern regarding vaccination attitudes post-COVID-19 pandemic. Findings indicated that parental vaccine hesitancy among Jordanian parents is low, while vaccine literacy is moderate. Significant differences in hesitancy were associated with marital status and parents' own COVID-19 vaccination status. Vaccine hesitancy was explained by higher functional vaccine literacy, receiving the COVID-19 vaccine personally, and having fewer children. These findings lend support to the association between health literacy and hesitancy in the post-COVID-19 context. In addition to these findings, the study identifies significant practical implications for public health practice. Strengthening parental vaccine literacy, with an emphasis on functional and communicative competencies, should be prioritized within primary healthcare services. Targeted health education interventions are needed to counteract misinformation and enhance parents' capacity to access, comprehend, and critically assess vaccine-related information. Health care providers are crucial in fostering trust and informed decisions regarding routine child vaccines. Policymakers were also encouraged to integrate methods for improving vaccine literacy into routine maternal and child health programs to maintain high immunization coverage and reduce hesitancy among parents in the post-COVID-19 pandemic era.

Conflict of interests

The authors declared no conflict of interest.

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Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

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