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Knowledge, attitudes, barriers and uptake rate of influenza virus vaccine among children from 6 months to 5 years of age in Jordan: a multicentric cross-sectional study



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Abstract

Background Vaccination against influenza is the major primary preventive measure to reduce the major health and economic burden of influenza infections. Children aged 6 months to five years, have been identified as the highest risk group for influenza complications, therefore, it is essential to ensure a high uptake rate of influenza vaccine amongst this age group.

Methods A structured questionnaire based on the Health Belief Model was used to collect data from parents through face-to-face interview on influenza vaccine uptake among children from 6 months to 5 years of age in Jordan. It also aimed to assess knowledge, attitudes and barriers towards influenza vaccine for this age group.

Results 477 parents completed the study questionnaire. The study revealed a low influenza vaccine uptake rate of 12.0% for the 2022/2023 influenza season. Around one fifth (19.3%) of study participants reported to ever had their child vaccinated against influenza. The study identified several factors motivating parents to get their children vaccinated; such as healthcare professional advice, higher income and history of previous severe influenza infection requiring hospitalization. On the other hand, several barriers related to influenza vaccine were identified; such as cost and concerns about the vaccine safety.

Conclusions There is an overall low uptake of influenza vaccine amongst children in Jordan. There is a need for public health programs and more involvement of the healthcare professionals to improve the reported rates of vaccination from Jordan. This is in addition to focusing these programs on reported barriers for the influenza vaccine uptake.

Keywords Influenza vaccine, Below 5, Uptake, Barriers, Attitudes, Jordan

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Background

Vaccination against influenza is the major primary preventive measure to reduce the significant health and economic burden of influenza infections. Although the health and economic burden of influenza has been wellestablished, rates of vaccination are low [1]. Children aged 6 months to five years, have been identified as the highest risk group for influenza complications, therefore, it is essential to ensure a high uptake rate of influenza vaccine amongst this age group [2]. Recent study from Jordan revealed that Influenza infections contributed to 9.9% of admission for children younger than age of 5 with respiratory symptoms [1]. Jordan has been known to have one of the best healthcare systems in the Middle East with a total health expenditure of 6.73% of the GDP [3].

The Jordanian healthcare system is divided into a public system, private sector, and refugee insurance system. The governmental and semi-governmental insurances cover approximately 64.3% of the Jordanian population. The current national strategies are aiming to expand the health care umbrella to cover all Jordanian citizens [4, 5]. Although the pediatrics nation immunization system in Jordan is one of the success stories in developing countries, high risk groups vaccines such as influenza vaccine is still limited, similar to many countries worldwide [1, 2]. Influenza vaccine is offered free of charge for healthcare providers in the public sector, but not offered free of charge for other high risk groups including children aged six months to five years.

Vaccine hesitancy has become one of the issues postcovid pandemic globally with higher negative impacts in developing countries [6]. A recent study examined the parental attitude toward childhood influenza vaccine and identified determinants of vaccine hesitancy (VH) in the Eastern Mediterranean region (EMR). The findings revealed that parents were hesitant to vaccinate their children against seasonal influenza [7] Another recent research conducted in Jordan revealed that cultural, socioeconomic, and individual factors were significant determinants in shaping attitudes toward vaccination. Understanding these factors coupled with addressing concerns about vaccine safety were reported essential for improving childhood vaccination rates in Jordan [8–10].

In Jordan, there is limited data on influenza vaccine uptake amongst children aged 6 months to five years from a representative sample. A study based on a convenient sample from shopping malls in the year 2016 in Irbid City, North of Jordan, showed that 10.9% of participants had vaccinated their children during the last season 2015/2016 [11]. Another study on parents of children with type I diabetes revealed that only 6.4% of the study sample reported vaccinating their children against the flu annually [12]. Low vaccine uptake for high risk groups including children aged 6 months to 5 years has public health implications in Jordan. It is essential, therefore, to obtain updated data from a representative sample in Jordan on the uptake of influenza vaccines amongst children aged 6 months to five years, and to assess knowledge, barriers, and attitudes of parents towards influenza vaccine for their children. Such data is essential for implementing strategies to improve vaccination coverage among this high-risk group.

Methodology

Study design

A structured questionnaire in a cross-sectional study setting was used to collect data for the study. The aim is to obtain necessary baseline data for supporting influenza virus vaccine uptake among children from 6 months to 5 years of age in Jordan and to assess knowledge, attitudes and barriers related to influenza vaccine for this age group based on interview with the parents.

Inclusion criteria

Parents of children aged 6 months to 5 years of age with Jordanian nationalities living permanently in the study area.

Exclusion criteria

- Not living permanently in study areas.
- Presence of Contraindications to influenza vaccine.

Study population

A representative sample from the Middle, North and South of Jordan was included, the sample was collected from cities of Amman, Zarqa, Irbid and Karak. Amman is the capital of Jordan and represents along with Zarqa governorate, the central region of Jordan. Irbid governorate represented that north of Jordan, while Karak governorate represented the south of Jordan. Data was collected from rural and urban areas in these governorates.

Probability multistage sampling technique was followed at each site to avoid convenience sampling. About 40% of the sample was obtained from the immunization center to capture children aged 6 months to 18 months. The sample of children aged 18 months to 60 months was obtained through door-to-door approach at the study areas.

Data were collected between February and June 2023 for the vaccine uptake for the season of 2022/2023, which is recommended in Jordan in October annually. Vaccines were given until early December 2022.

A group of medical students trained on the study protocol and questionnaire assisted in obtaining a representative sample from study sites. If the parents had more

Data collection

Data was collected using a structured questionnaire that was specifically developed for this study. The questionnaire was developed based on validated questionnaires then translated into Arabic through a backward-forward translation process that was conducted by public health experts [13–15].

The first section captured demographic data, medical and drug history, and socioeconomic factors. The second part of the questionnaire, on the other hand, covered influenza vaccine uptake and vaccine knowledge. The last part consisted of close-ended questions organized into key areas based on the Health Belief Model (HBM) including the perceived susceptibility, severity, benefits and barriers to influenza vaccination. HBM is a wellestablished behavioral model for predicting the vaccines uptake and attitudes toward vaccines [16].

Health belief model (HBM) framework

The HBM has been used to facilitate the assessment of perceptions and attitudes of parents towards influenza vaccination for their children [13–16]. The following components of HBM were utilized in the study: the parent's perceived risk of their child getting influenza (perceived susceptibility), the belief of the resulting consequences for their child (perceived severity), the potential positive benefits of influenza vaccine (perceived benefits), the perceived barriers to influenza vaccine, vaccine availability, exposure to factors which prompt action (cues to action) and modifying variables (a person's characteristics).

According to the HBM, the parents' readiness to take action (to get their child vaccinated) depends on the following beliefs or conditions: Their child's susceptibility to influenza? Is the threat of influenza serious to their child's health? What are the benefits and risks of influenza vaccine? Do the benefits of their child taking the vaccine outweigh the risks? Is he/she confident that their child will take the vaccination safely? Are there cues-to-action present to motivate them to get their child vaccinated?

Questionnaire development and pilot testing

To ensure clarity, acceptability and relevance, the questionnaire was piloted with 30 parents within the study areas. These pilot interviews helped refine the questionnaire's format and content for clarity, length and participant comprehension. The final version comprised close-ended questions organized into key areas based on the HBM, including perceived susceptibility, severity, benefits and barriers to influenza vaccination. Internal consistency was assessed during the pilot phase. It provided an acceptable threshold and met the minimum cutoff of 0.60 and above. Cronbach's Alpha ranged between 0.76 and 0.87.

Sample size calculation

There are 1,321,985 children younger than the age of 5 in Jordan [17]. The calculated minimum sample size was 385 with a 95% significance level ($\alpha = 0.05$, $\beta = 0.2$), a 5% margin of error and a 50% population proportion. A Sample of 477 was collected to allow for comparison in attitudes, knowledge and perceptions between parents of children who received influenza vaccine with parents of those who had not.

Statistical analysis

SPSS software version 28.0 was used to analyze the data. The frequencies and percentages were used to represent the categorical variables. Chi-square analysis was utilized to estimate the association between all baseline characteristics, knowledge level and vaccination status. Binary logistic regression was performed to find the predictors of vaccine uptake.

Results

Sociodemographic characteristics

A total of 477 parents accepted to take part in the study and completed the questionnaire. Demographic characteristics of the study participants are summarized in Table 1. of the pediatric participants 59.7% were females with a mean age of 23.85 months, about 70.9% of them were living in urban areas and 41.5% were insured by the Ministry of Health.

The overall vaccine uptake rate was 12.0% for the influenza season 20,232/2023. Around one fifth (19.3%) of study participants reported to ever had their child vaccinated against influenza. As shown in Table 1, urban areas had statistically higher reported vaccine uptake rates compared with rural areas, with rates of 13.9% versus 7.2% for the same season (P = 0.04) and 21.9% versus 12.9% for ever being vaccinated (P = 0.024). When comparing included governorates, participants from Amman, the capital of Jordan, reported the highest vaccine uptake rate for their children with a rate of 27.9% for ever receiving influenza vaccine (P = 0.006), while participants from Al-Zarqa governorate, reported the highest vaccine uptake rates for their children with rate of 16.4% for the current season (P = 0.181). Parents who reported previous admission for their children for influenza/flu like illness had statistically higher reported history of ever getting their child vaccinated against influenza when compared with parents who did not report a similar admission (25.6% vs. 15.9%, P = 0.002). Moreover, awareness of the

Table 1 Baseline characteristics and of participants by vaccination status

	1	Rawt	total	Have y	you ever ha e?	d the flu	u vaccine	Have ing tl	you had t his year?	he flu va	ccine dur-
				YES		NO		YES		NO	
		N	%	N	%	N	%	N	%	N	%
Mean Age in month	s (23.85±17.19)										
Gender	Female	285	59.70%	53	18.60%	232	81.40%	32	11.20%	253	88.80%
	Male	192	40.30%	39	20.30%	153	79.70%	25	13.00%	167	87.00%
	P-value			0.641				0.554			
City	AlKarak	95	19.90%	13	13.70%	82	86.30%	7	7.40%	88	92.60%
	AlZarqaa	67	14.10%	8	11.90%	59	88.10%	11	16.40%	56	83.60%
	Amman	179	37.50%	50	27.90%	129	72.10%	27	15.10%	152	84.90%
	Irbid	136	28.50%	21	15.40%	115	84.60%	12	8.80%	124	91.20%
	P-value			0.006				0.181			
Place of living	Rural	139	29.10%	18	12.90%	121	87.10%	10	7.20%	129	92.80%
-	Urban	338	70.90%	74	21.90%	264	78.10%	47	13.90%	291	86.10%
	P-value			0.024				0.04			
Mother's Education	Advanced Diploma	12	2.50%	2	16.70%	10	83.30%	1	8.30%	11	91.70%
Level	Bachelor's Degree	261	54.70%	59	22.60%	202	77.40%	33	12.60%	228	87.40%
	Diploma	46	9.60%	9	19.60%	37	80.40%	9	19.60%	37	80.40%
	Doctorate	4	0.80%	0	0.00%	4	100.00%	0	0.00%	4	100.00%
	Haven't been schooled	2	0.40%	0	0.00%	2	100.00%	0	0.00%	2	100.00%
	High School	84	17.60%	13	15.50%	71	84.50%	9	10.70%	75	89.30%
	Master's degree	33	6.90%	8	24.20%	25	75.80%	4	12.10%	29	87.90%
	Middle School	29	6.10%	1	3.40%	28	96.60%	1	3.40%	28	96.60%
	Primary School	6	1.30%	0	0.00%	6	100.00%	0	0.00%	6	100.00%
	P-value			0.216				0.586			
Father's Education	Advanced Diploma	7	1.50%	2	28.60%	5	71.40%	3	42.90%	4	57.10%
Level	Bachelor's Degree	235	49.30%	56	23.80%	179	76.20%	33	14.00%	202	86.00%
	Diploma	35	7.30%	4	11.40%	31	88.60%	3	8.60%	32	91.40%
	Doctorate	19	4.00%	9	47.40%	10	52.60%	3	15.80%	16	84.20%
	Haven't been schooled	4	0.80%	0	0.00%	4	100.00%	0	0.00%	4	100.00%
	High School	102	21.40%	14	13.70%	88	86.30%	8	7.80%	94	92.20%
	Master's Degree	34	7.10%	3	8.80%	31	91.20%	2	5.90%	32	94.10%
	Middle School	34	7.10%	4	11.80%	30	88.20%	5	14.70%	29	85.30%
	Primary School	7	1.50%	0	0.00%	7	100.00%	0	0.00%	7	100.00%
	P-value			0.004				0.129			
Parents Job	Full Time	344	72.10%	73	21.20%	271	78.80%	44	12.80%	300	87.20%
	Part Time	84	17.60%	14	16.70%	70	83.30%	8	9.50%	76	90.50%
	Retired	19	4.00%	1	5.30%	18	94.70%	3	15.80%	16	84.20%
	Unemployed	30	6.30%	4	13.30%	26	86.70%	2	6.70%	28	93.30%
	P-value			0.233				0.623			
Monthly income of	1000-1500	68	14.30%	16	23.50%	52	76.50%	7	10.30%	61	89.70%
the family in dinars	500-1000	196	41.10%	39	19.90%	157	80.10%	25	12.80%	171	87.20%
	Less than 500	180	37.70%	26	14.40%	154	85.60%	20	11.10%	160	88.90%
	More than 2000	33	6.90%	11	33.30%	22	66.70%	5	15.20%	28	84.80%
	P-value			0.052				0.864			

		Raw 1	otal	Have y before	you ever ha e?	d the flu	ı vaccine	Have ing t	e you had tl this year?	he flu va	ccine dur-
				YES		NO		YES		NO	
		N	%	N	%	N	%	N	%	N	%
Type of Child's Insurance	Ministry Of Health/ Governmental	198	41.50%	37	18.70%	161	81.30%	28	14.10%	170	85.90%
	No health coverage available	81	17.00%	14	17.30%	67	82.70%	8	9.90%	73	90.10%
	Private Sector	89	18.70%	22	24.70%	67	75.30%	13	14.60%	76	85.40%
	Royal Jordanian Army Services	97	20.30%	16	16.50%	81	83.50%	6	6.20%	91	93.80%
	University Hospitals	6	1.30%	2	33.30%	4	66.70%	2	33.30%	4	66.70%
	UNRWA	6	1.30%	1	16.70%	5	83.30%	0	0.00%	6	100.00%
	P-value			0.667				0.14			
Does Your Child	Yes	82	17.20%	19	23.20%	63	76.80%	15	18.30%	67	81.70%
have any Chronic	No	395	82.80%	73	18.50%	322	81.50%	42	10.60%	353	89.40%
Illnesses	P-value			0.327				0.052	2		
Does your child	Yes	43	9.00%	8	18.60%	35	81.40%	7	16.30%	36	83.70%
take medication	No	434	91.00%	84	19.40%	350	80.60%	50	11.50%	384	88.50%
regularly	P-value			0.905				0.359	Ð		
Have you heard of	Yes	383	80.30%	83	21.70%	300	78.30%	50	13.10%	333	86.90%
the influenza Vac-	No	94	19.70%	9	9.60%	85	90.40%	7	7.40%	87	92.60%
cine Before	P-value			0.008				0.133	3		
Does your child	Yes	180	37.70%	41	22.80%	139	77.20%	25	13.90%	155	86.10%
get flu like illness	No	297	62.30%	51	17.20%	246	82.80%	32	10.80%	265	89.20%
regularly	P-value			0.133				0.309	9		
Has your child ever	Yes	90	18.90%	23	25.60%	67	74.40%	16	17.80%	74	82.20%
been admitted	No	352	73.80%	56	15.90%	296	84.10%	35	9.90%	317	90.10%
to the hospital	Not sure	35	7.30%	13	37.10%	22	62.90%	6	17.10%	29	82.90%
enza/flu like illness Complications?	P-value			0.002				0.076	5		

Table 1 (continued)

influenza vaccine was associated with higher previous uptake (21.7% vs. 9.6%, P = 0.008) (Table 1).

Factors affecting influenza vaccine uptake among participants

Perceived benefits, barriers, and cues to action

Chi-square analysis showed significant associations between perceived influenza risk and vaccination status (Table 2.a). Parents who thought their child are at a high risk of serious influenza infection reported higher vaccination rates, for both, previous seasons (24.9% vs. 14.1%, P = 0.003) and this season (18.3% vs. 6.0%, P < 0.001,). Also, those who felt that their children might get severe symptoms, if they got the flu, had higher rates of vaccination for their children than those who did not, both in their lifetime (20.4% vs. 11.9%, P = 0.019) and during that season (18.4% vs. 7.7%, P = 0.01). Furthermore, parents who believed their child posed a risk of infecting others were more likely to have vaccinated them in previous seasons (22.7% vs. 9.4%, p = 0.023), but this perspective had no significant effect on current-year vaccination uptake (p = 0.828).

Bivariate analysis using the Chi-square test assessed the association between vaccination status and perceived benefits as shown in Table 2.b. Significant findings highlighted the role of perceived benefits, including reduced worry about influenza, in influencing vaccination rates positively both during lifetime (24.3% vs. 17.7%, P = 0.025) and during the year of the interview (16.7% vs. 5.1%, P=0.008). Agreement with the statement: "Getting the flu vaccine will benefit my child" was associated with higher vaccination uptake compared to disagreement, in both previous years/seasons (25.3% vs 7.1%, P < 0.001) and this year (16.0% vs. 4.8%, P = 0.002). The same trend was seen with agreeing vs. no agreeing with the statement: "Taking the Influenza Vaccine will decrease the risk of my child of getting the flu" (23.2% vs. 10.4%, P=0.014) for previous years and (14.7% vs 6.3%, P = 0.045) for that year (Table 2.b).

Barriers to vaccination such as concerns about unknown risks, dislike of vaccines, cost and accessibility were notable. Worries about vaccine side effects negatively influenced vaccination status; participants who expressed high levels of concern about side effects

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A. Perceive Susceptibili	ity														
					Raw total			Have befor	you ever h e?	ad the flu	vaccine	Have y ing thi	/ou had the is year?	flu vaccin	e dur-
								, YES		Q		YES		N	
						z	%	z	%	z	%	z	%	z	%
Do you feel your son get:	s Influenza more than ot	her childr	en?		Yes	152	31.9%	32	21.1%	120	78.9%	19	12.5%	133	87.5%
					No	194	40.7%	32	16.5%	162	83.5%	24	12.4%	170	87.6%
					Not sure	131	27.5%	28	21.4%	103	78.6%	14	10.7%	117	89.3%
					P-value			0.44				0.87			
Without the vaccine, I fee	el my child is at high risk	of severe	flu infectior	Ċ.	Yes	229	48.0%	57	24.9%	172	75.1%	42	18.3%	187	81.7%
					No	248	52.0%	35	14.1%	213	85.9%	15	6.0%	233	94.0%
					P-value			0.003				< 0.00	-		
If my child gets the flu, th	ney may experience seve	re sympto	smo		Yes	152	31.9%	31	20.4%	121	79.6%	28	18.4%	124	81.6%
					No	143	30.0%	17	11.9%	126	88.1%	11	7.7%	132	92.3%
					Not sure	182	38.2%	44	24.2%	138	75.8%	18	%6.6	164	90.1%
					P-value			0.019				0.01			
If my child gets the flu, th	iey may experience mod	lerate sym	Iptoms		Yes	305	63.9%	53	17.4%	252	82.6%	31	10.2%	274	89.8%
					No	64	13.4%	11	17.2%	53	82.8%	13	20.3%	51	79.7%
					Not sure	108	22.6%	28	25.9%	80	74.1%	13	12.0%	95	88.0%
					P-value			0.13				0.075			
If my child gets the flu, th	ney are at risk of serious c	complicati	ons		Yes	81	17.0%	17	21.0%	49	79.0%	14	17.3%	67	82.7%
					No	262	54.9%	41	15.6%	221	84.4%	26	%6.6	236	90.1%
					Not sure	134	28.1%	34	25.4%	100	74.6%	17	12.7%	117	87.3%
					P-value			0.062				0.194			
If my child gets the flu, th	ney pose a risk of infectio	n to those	e around th	em.	Yes	277	58.1%	63	22.7%	214	77.3%	35	12.6%	242	87.4%
					No	85	17.8%	∞	9.4%	77	90.6%	10	11.8%	75	88.2%
					Not sure	115	24.1%	21	18.3%	94	81.7%	12	10.4%	103	89.6%
					P-value			0.023				0.828			
B. Perceived Benefits															
		Raw to	tal	Have y before	ou ever hac ?	l the flu v	accine F	łave you ł ng this ye	ar? ar?	vaccine d	-r-				
				YES		No		ĒS	z	0					
		z	%	z	%	z	%	% 	z	%					
I won't worry about Si	trongly Agree, Agree	222	46.5%	54	24.3%	168	75.7% 3	7 10	5.7% 11	35 83	3%				
getting the flu if my N	leutral	176	36.9%	24	13.6%	152	86.4% 1	6	1% 1	06 09	%6				
child receives the flu S ₁ vaccine	trongly Disagree, disacree	79	16.6%	14	17.7%	65	82.3% 4		1% 7.	94	%6				

0.008

0.025

Strongly Disagree, Disagree **P-value**

B. Perceived Benefit:											
		Raw to	otal	Have y before	ou ever ha ?	d the flu	vaccine	Have y ing thi	ou had the s year?	e flu vacc	ine dur-
				YES		Q		YES		Q	
		z	%	z	%	z	%	z	%	z	%
Getting the flu vac-	Strongly Agree, Agree	293	61.4%	74	25.3%	219	74.7%	47	16.0%	246	84.0%
cine will benefit my	Neutral	142	29.8%	15	10.6%	127	89.4%	8	5.6%	134	94.4%
child	Strongly Disagree, Disagree	42	8.8%	m	7.1%	39	92.9%	2	4.8%	40	95.2%
	P-value			< 0.00	-			0.002			
Taking the Influenza	Strongly Agree, Agree	306	64.2%	71	23.2%	235	76.8%	45	14.7%	261	85.3%
Vaccine will decrease	Neutral	123	25.8%	16	13.0%	107	87.0%	6	7.3%	114	92.7%
the risk of my child getting the flu	Strongly Disagree, Disagree	48	10.1%	Ŋ	10.4%	43	89.6%	m	6.3%	45	93.8%
	P-value			0.014				0.045			

have lesser vaccination rates either in the past (13.1% vs. 34.9%, P < 0.001) or in this year (9.5% vs. 19.8%, p = 0.038). The barrier that led to the lowest lifetime vaccination rate was: "The flu vaccine may pose a risk to my child" (11.7% vs. 31.0%, P < 0.001), while the barrier that led to the lowest vaccination rates during the same season of the interview was not liking vaccines (7.2% vs. 17.9%, P = 0.008) (Supplementary Table 1).

Table 3 emphasizes on the importance of cues-toaction. Receiving influenza vaccine was strongly associated with agreement with the healthcare provider recommendations (21.8% vs. 5.9%, P=0.027). Furthermore, willingness to vaccinate if the vaccine is available for free strongly correlated with uptake (27.4% vs. 5.6% for lifetime vaccination, and 18.1% vs. 2.2% for that years' vaccination, P<0.001 for both). Finally, those who agreed with the statement "I feel like I have received all the information I need to determine whether or not I should give my child the flu vaccine" had higher rates of vaccination for their children than those who did not agree, for both previous and current seasons (24.0% vs. 4.7%, P<0.001, and 14.8% vs. 2.3%, P=0.007, respectively).

Social encouragement significantly increased uptake (P < 0.001). Hearing about moderate or severe illness following vaccination, along with concerns about vaccine safety were significantly associated with lower vaccination rates for this year (P < 0.001) (Supplementary Table 2).

Predictors of vaccination history and vaccination history in the past year

A noteworthy result was found using binary logistic regression analysis that examined the association between different predictors and the likelihood of receiving an influenza vaccination. Private health insurance (OR = 1.79, P = 0.001), trust in guidelines (OR = 2.34, P < 0.001) and doctor's advice (OR = 3.55, P < 0.001) were the most significant predictors of ever being vaccinated for influenza. Likewise, perceived risk for their child without influenza vaccine (OR = 2.06, P = 0.003), monthly income between 500 and 1000 Jordanian dinars (JD) compared to income less than JD500 (OR = 1.43, p = 0.020) and encouragement from friends or family (OR = 1.52, P = 0.032) all had a positive effect on vaccination rates. However, uptake was adversely affected by vaccine side effect concerns (OR = 0.61, P = 0.045) (Table 4.a).

The factors that were most strongly linked to vaccination during the previous year were perceived high risk without vaccination (OR=4.52, p < 0.001), doctor advice (OR=3.39, p = 0.001), trust in healthcare providers (OR=2.13, p = 0.020) and having adequate knowledge about vaccine safety (OR=2.26, p = 0.014). Conversely, concerns about vaccine side effects had a negative effect (OR=0.55, p = 0.033) (Table 4.b).

Table 3 The association between perceived cues to action and vaccination status

		Raw	total	Have cine l	you ever pefore?	had the	e flu vac-	Have durin	you had t g this yea	he flu v r?	vaccine
				YES		NO		YES		NO	
		Ν	%	N	%	N	%	N	%	N	%
The recommendation of	Strongly agree/agree	367	76.9%	80	21.8%	287	78.2%	48	13.1%	319	86.9%
the doctor/nurse/phar-	Neutral	76	15.9%	10	13.2%	66	86.8%	8	10.5%	68	89.5%
macist is important for	Strongly disagree/disagree	34	7.1%	2	5.9%	32	94.1%	1	2.9%	33	97.1%
to give the vaccine to my child	P-value	Jisagree 34 7.1% 2 5.9% 32 94.1% 1 2.9% ee 347 72.7% 74 21.3% 273 78.7% 46 13.3% 97 20.3% 16 16.5% 81 83.5% 11 11.3% disagree 33 6.9% 2 6.1% 31 93.9% 0 0.0% ee 283 59.3% 68 24.0% 215 76.0% 42 14.8% 108 22.6% 20 18.5% 88 81.5% 13 12.0%									
I trust the guidelines rec-	Strongly agree/agree	347	72.7%	74	21.3%	273	78.7%	46	13.3%	301	86.7%
I trust the guidelines rec- ommending that high-risk children should receive the flu vaccine	Neutral	97	20.3%	16	16.5%	81	83.5%	11	11.3%	86	88.7%
	Strongly disagree/disagree	33	6.9%	2	6.1%	31	93.9%	0	0.0%	33	100.0%
flu vaccine	P-value			0.077				0.79			
I feel like I've received all	Strongly agree/agree	283	59.3%	68	24.0%	215	76.0%	42	14.8%	241	85.2%
the information I need	Neutral	108	22.6%	20	18.5%	88	81.5%	13	12.0%	95	88.0%
to determine whether I	Strongly disagree/disagree	86	18.0%	4	4.7%	82	95.3%	2	2.3%	84	97.7%
flu vaccine	P-value			< 0.00	01			0.007	,		
If the flu vaccine is avail-	strongly agree/agree	237	49.7%	65	27.4%	172	72.6%	43	18.1%	194	81.9%
able for free, I will give it to	Neutral	150	31.4%	22	14.7%	128	85.3%	12	8.0%	138	92.0%
my child	Strongly disagree/disagree	90	Have you ever had the flu vac- cine before? Have you had the flu vac- during this year? YES NO YES NO 76.9% 80 21.8% 287 78.2% 48 13.1% 319 15.9% 10 13.2% 66 86.8% 8 10.5% 68 7.1% 2 5.9% 32 94.1% 1 2.9% 33 0.027 0.201 0.201 0.201 0.201 72.7% 74 21.3% 273 78.7% 46 13.3% 301 20.3% 16 16.5% 81 83.5% 11 11.3% 86 6.9% 2 6.1% 31 93.9% 0 0.0% 33 0.077 0.79 0.00% 33 0.077 0.79 95 59.3% 68 24.0% 215 76.0% 42 14.8% 241 <tr< td=""><td>97.8%</td></tr<>	97.8%							
	P-value			< 0.00	01			< 0.00	01		

 Table 4
 Regression analysis for predictors of reported influenza vaccines uptake

<u> </u>	-			
Predictor	В	Odds Ratio (OR)	95% CI for OR	<i>p-</i> value
Health Insurance	0.580	1.79	1.30-2.48	0.001
Monthly Income (500–1000 dinars)	0.356	1.43	1.12–1.82	0.020
Doctor's Recommendation	1.268	3.55	2.45-4.98	< 0.001
Perceived risk for their child without influenza vaccine	0.725	2.06	1.53–2.78	0.003
Trust in Guidelines	0.848	2.34	1.72-3.20	< 0.001
Concerns About Vaccine Side Effects	-0.495	0.61	0.41-0.90	0.045
Family/Friend Encouragement	0.422	1.52	1.18–1.96	0.032

		-		
Predictor	В	Odds Ratio (OR)	95% Cl for OR	<i>p</i> - value
Advice from a doctor	1.220	3.39	1.70–6.75	0.001
Enough information about vaccine safety	0.815	2.26	1.20–4.28	0.014
Perception of high risk without vaccine	1.507	4.52	2.20-9.28	< 0.001
Trust in healthcare pro- vider's advice	0.755	2.13	1.30–3.51	0.020
Concern about vaccine side effects	-0.595	0.55	0.32–0.95	0.033

Discussion

This study showed a low influenza vaccine uptake of 12% amongst children aged six months to five years in Jordan during influenza season 2022/2023. Moreover, the history of ever being vaccinated was only 19.3% amongst study participants. This rate is considered relatively low compared to countries with similar Gross domestic product (GDP) such as Bolivia. A multi-country South American quantitative study reported that the coverage for influenza vaccination in 2018 was 58.4% of children under six years of age. Vaccination coverage across all risk groups in Argentina, Bolivia, Brazil, Chile, Colombia, and Ecuador was above the regional average, with Paraguay, Peru, Uruguay, and Venezuela performing below average [18].

Additionally, the reported vaccine uptake rates in urban areas were statistically much higher than those in rural areas. These rates mirror uptake patterns in other developing countries [19, 20]. These findings could be linked to differences in healthcare infrastructure or socioeconomic factors. In our study, the higher vaccination rates in Amman, the capital of Jordan, compared to other cities may be due to a better vaccination infrastructure including access to health services. A large study from Brazil revealed that residents of capitals of federal districts had higher immunization rates than other cities or rural areas. Future campaigns in Jordan on influenza vaccine uptake particularly among children should consider these disparities [21].

The influenza vaccine uptake was much lower than reported from developed countries. For example, a recent study from Spain revealed that the Influenza vaccine uptake was 50% for children aged 6 months to 5 years based on reporting of 9999 parents [22]. Vaccination is the most effective strategy for preventing influenza and its complications [23]. These low rates have been reflected in the morbidity and mortality from influenza infections for children within this age group. A recent study from Jordan revealed that 9.9% of children aged younger than 5 months admitted with upper respiratory tract symptoms were positive for influenza virus. Interestingly, there were no positive influenza cases among participants if they or any of their family members received the influenza vaccine, highlighting the vaccine's protective role [1].

Parents perceived susceptibility and severity of symptoms were shown to increase vaccination rates of their children [24, 25] This was apparent in the rates children who had been admitted for influenza/flu like illness and those whom their parents perceived them to be at high risk of serious influenza infection or severe symptoms. The same trend was seen with perceived benefits and belief of efficacy in previous studies [26-28]. A recent systematic review including 30 studies showed consistent results with our findings [29]. Childhood influenza vaccination was positively associated with parents' knowledge of influenza vaccine, positive attitudes toward influenza vaccine, self-efficacy, perceived susceptibility to influenza, severity of influenza, belief in the efficacy of influenza vaccine, the worry of getting sick, healthcare workers' recommendations, and previous influenza vaccination experiences [29]. These factors should be considered in future programs in Jordan to enhance the uptake rate of influenza vaccine for this age group.

This study identified important predictors of vaccine uptake. Health insurance, trust in guidelines, and doctor's advice were the most significant predictors of vaccination history related to ever being vaccinated for influenza. In addition to the perceived risk in the absence of vaccination, monthly income between 500 and 1000 JD and encouragement from friends or family were also key predictors of vaccination. Previous research indicated that individuals residing in urban areas with monthly income exceeding 600 JD exhibited higher knowledge, attitudes, and practices (KAP) scores towards flu vaccination than their counter peers [11, 23, 30]. It is essential that policy makers in Jordan work on the availability of free influenza vaccine or its inclusion within the health insurance program to improve the influenza vaccine uptake in Jordan. This has been acknowledged as one of the important strategies to improve the vaccine uptake [31]. These findings underscore the importance of achieving Universal Health Coverage (UHC), which is a strategic objective of the Jordanian government, inorder to enhance access to vaccination, and therefore increase vaccination uptake rates. To attain UHC, three objectives must be met: ensuring access to care for everyone; providing quality healthcare; and removing financial barriers to accessing healthcare [6, 32] This is in addition to including the high risk groups vaccines such as influenza vaccine within the national immunization program and providing these vaccines free of charge.

Our study was aligned with other studies in showing that healthcare professionals play a major role in improving the uptake of influenza vaccines amongst children and other high risk groups [33]. A systematic review included 52 studies on strategies to improve influenza vaccine uptake revealed that healthcare professionals, including community pharmacists, can play a major role in improving influenza vaccine [31]. Therefore, it is essential that future campaigns and interventions focus on healthcare professionals' role in the influenza vaccine uptake in Jordan. Lastly, Vaccine accessibility was a major factor, whether financial or stock availability to the vaccine or information about it, in determining vaccination rates in our study as well as countries from around the world [29].

Similar to our findings, national guidelines and recommendations of influenza vaccine by different medical bodies have been considered within the most significant predictors for the uptake of vaccine in children [11, 23, 30, 34]. A cross-sectional study from Spain revealed that according to respondents (n=385), publications of the influenza vaccine recommendations (18.6%), engagement of the media and social networks (14.4%) and the active recruitment through email/letters (10.6%) are the most effective measures to increase vaccination rates [34]. This is also consistent with previous studies' showing that awareness raising programmes are effective in influencing the attitudes of parents toward influenza vaccination of their children [35–38].

Vaccination acceptance is a behavioural outcome of a complicated decision-making process. Vaccination hesitancy (VH) is controlled by a variety of variables. The WHO's Strategic Advisory Group of Experts on Immunization (SAGE) Working Group developed the 3 C model of VH underscoring three different types of VH determinants: confidence, complacency, and convenience [39]. For example, convenience may be hampered by economic factors leading to poor access, a high cost, or a long travel time. This leads to increased vaccination hesitancy and lower vaccine uptake rates [40–42].

Vaccine hesitancy is a barrier to improving childhood vaccination rates and the enhancement of vaccination coverage is significantly influenced by the population's understanding of influenza and its vaccination [11, 23, 30]. One of the key factors affecting the influenza uptake in our study was concerns about the vaccine side effects. This matches the findings of previous studies conducted to explore the main determinants of seasonal influenza

vaccine acceptance in children. It demonstrated that concerns regarding vaccine safety and efficacy were the most significant impediment to vaccination in children [20, 35–37, 43]. The same finding was documented in the above systematic review [29]. In addition, recent studies conducted in the Gulf Cooperation Council countries reported that the most common determinants of vaccine hesitancy were distrust in vaccine safety and concerns about potential side effects. Healthcare workers were among the main sources of information about vaccination, but the majority of them had never received any training on addressing vaccine hesitancy among patients [44]. This underscores the importance of the provision of capacity-building activities targeting healthcare professionals on evidence-based vaccination strategies to combat vaccination hesitancy.

Rational vaccine hesitancy is a natural outcome of public concerns regarding the potential adverse effects of vaccines while irrational hesitancy is based on false information obtained from social media and other nonevidence-based sources [45]. Online vaccine misinformation is widespread in news, websites, and social media. In combating online misinformation, public health advocates can correct misconceptions utilizing evidencebased awareness campaigns for those who are hesitant about vaccination.

Vaccine hesitancy and refusal rates vary from country to country mostly influencing the countries with higher income. Recent studies showed that people of all countries have some levels of doubt about vaccination. For example, the hesitancy rate in Croatia was 19.5%, and the refusal rate in North Carolina, USA was 12–13%. Only 11.6%, and 12% of Malaysian and Italian parents, respectively, vaccinate their children only because it is mandatory [46].

It is important to analyze the roots of this international multidimensional phenomenon. Misinformation, previous unsatisfactory experiences, parental age, and income in addition to cultural factors were among the causes of the increased hesitance rates [46]. It is important to underscore the pivotal role of health professionals in combating misinformation as the public considers them trustworthy and reliable sources of information on vaccines.

Although this study is based on a large sample from representative areas in Jordan, it has several limitations. The first one is that the reported history of severe influenza infection could not be confirmed through medical records. The study was based on all children from general populations without a selection of a specific sample for children at high risk of influenza infections. Another limitation was that confirmation of the influenza vaccine uptake through medical records was not performed, therefore this will increase the risk of recall bias. This is partially because the influenza vaccine is given at private and public primary clinics and by community pharmacists. Finally, the study relies on self-reported history of vaccination and influenza infections, which are not verified through medical records. This could lead to recall bias or inaccuracies.

Conclusion

There is an overall low uptake of influenza vaccine amongst children in Jordan. There is a need for public health programs and more involvement of healthcare professionals to improve the reported rates from Jordan. This is in addition to needing to focus these programs on reported barriers to the influenza vaccine uptake. National recommendations for influenza vaccine in Jordan including children aged 6 months to 5 years in needed along with endorsement by stakeholders and professional bodies such as the pediatrics and primary care physicians' societies. This should be parallel with the introduction of free influenza vaccine for high-risk groups such as children within these age groups. Misinformation and concerns about safety can be addressed through public health campaigns. Research would benefit from longitudinal studies to follow up on influenza uptake trends over time.

Abbreviations

HBM Health Belief Model

Supplementary Information

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Supplementary Material 1

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Author contributions

Conceptualization: MAH; Methodology: MAH; Validation: MAH, MHr; Formal Analysis: AA, MHn; Investigation: RAM, SA, MA, LAM, AA; Data Curation: RAM, SA, MA, LAM, AA; Writing—Original Draft Preparation: MAH, NNA, MHn, MHr; Writing—Review and Editing: MAH, MHn, NNA; Visualization: AA, MHn; Supervision: MAH; Project Administration: MAH, MHn. All authors read and agreed to the published version of this manuscript.

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Data availability

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki. The original project was approved by the Institutional Review Committee (IRC) for Ministry of Health Ethics Committee, Reference Number: MOH/REC/2022/328, dated 26 of October 2022. Verbal informed consent was obtained from the participants who were eligible to participate in this study. Prior to obtaining the consent form, all participants were provided with relevant information about this study. Those who did not consent were not enrolled.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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