

RESEARCH ARTICLE

Determinants of human papillomavirus vaccine hesitancy among Lebanese parents

Ramia Zakhour¹, Hani Tamim^{2,3}, Farah Faytrouni⁴, Maha Makki⁵, Rayan Hojeij¹, Lama Charafeddine^{1*}

1 Division of Pediatric Infectious Diseases, McGovern Medical School Houston, University of Texas, Austin, Texas, United States of America, **2** Department of Internal Medicine, Clinical Research Institute, American University of Beirut Medical Center, Beirut, Lebanon, **3** College of Medicine, Alfaisal University, Riyadh, Saudi Arabia, **4** Department of Pediatrics, Medcare Medical Centers, Dr Sulaiman Al Habib Medical Group, United Arab Emirates, **5** Clinical Research Institute, American University of Beirut Medical Center, Beirut, Lebanon

* lc12@aub.edu.lb



Abstract

OPEN ACCESS

Citation: Zakhour R, Tamim H, Faytrouni F, Makki M, Hojeij R, Charafeddine L (2023) Determinants of human papillomavirus vaccine hesitancy among Lebanese parents. *PLoS ONE* 18(12): e0295644. <https://doi.org/10.1371/journal.pone.0295644>

Editor: Ghada Abdrabo Abdellatif Elshaarawy, National Research Centre, EGYPT

Received: January 22, 2023

Accepted: November 27, 2023

Published: December 13, 2023

Copyright: © 2023 Zakhour et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: All relevant data are within the paper and its [Supporting information](#) files.

Funding: The authors received no specific funding for this work.

Competing interests: The authors have no conflicts of interest to disclose.

Abbreviations: ACIP, Advisory Committee on Immunization Practices; HPV, Human Papillomavirus; KAP, Knowledge Attitude and Practices; LMIC, Low-Middle Income Country;

Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection. HPV is responsible for cancer of cervix uteri. Despite its safety and immunogenicity, HPV vaccine hesitancy is one of the most challenging topics that pediatricians face.

Methods

We aimed to describe the impact of knowledge, attitude, and practice towards vaccines in general, on practice related to HPV vaccination in Lebanon. A questionnaire addressed to parents of students (3–18 years of age) was distributed in 2 public and 2 private schools randomly selected from the greater Beirut area during the school year 2017–2018. Questionnaires covered knowledge, attitude, and practices of vaccination in general and HPV vaccine in particular.

Results

Out of 400 distributed questionnaires, 306 (76.5%) were returned. Of the 185 parents aware of HPV vaccine, 60% hadn't given or were not planning to give the HPV vaccine to their children. Of parents not in favor of HPV vaccine, 7.5 thought that vaccines aren't necessary versus none among those in favor of HPV vaccine ($p = 0.02$). Thirteen percent of those not in favor of HPV vaccine thought that vaccines are not safe versus 2.7% in the group in favor ($p = 0.02$). An effect of gender on vaccine acceptance was noted: mothers vs fathers and daughters vs sons. Lack of recommendation by pediatricians and the thought that too little is known about the vaccine were the most selected reasons for parents not wanting to vaccinate their children against HPV, whereas cost and religious and cultural beliefs seemed to have no impact.

SPSS, Statistical Package for Social Sciences;
WHO, World Health Organization.

Conclusion

Most parents in our study did not vaccinate or weren't willing to vaccinate their children against HPV even when they were in favor of vaccines in general. Physician recommendation was shown to be one of the most important predictors of vaccination. Effort should be put into educating parents about the importance of the vaccine and its well-established safety and efficacy regardless of gender. Lebanese physicians should also be educated and empowered to recommend HPV vaccine more strongly and consistently.

Introduction

Human papillomavirus (HPV), the most common sexually transmitted infection worldwide, is responsible for virtually all cases of cancer of the cervix uteri, over 90% of cases of anal cancer and a large percentage of vaginal, vulvar, penile, and oropharyngeal cancers as per the National Cancer Institute at the National Institute of Health (NIH) [1]. HPV vaccines have been licensed and widely studied since 2006 [2–4]. There is currently solid evidence supporting HPV vaccines' safety, immunogenicity, and efficacy in reducing the circulation of vaccine preventable strains and hence the development of precancerous lesions secondary to oncogenic HPV strains [4]. HPV vaccine is currently recommended by the advisory committee on immunization practices (ACIP) and by the world health organization (WHO) for both females and males [5]. Despite these recommendations, rates of HPV vaccine coverage remain lower than any other adolescent vaccine with a global HPV immunization coverage for 2018 estimated at 12.2% only [6]. Based on the most recent UNICEF report, globally only one in eight girls are vaccinated against HPV [7]. The rates in developed countries are slightly higher ranging between 19% in France and 40–50% in the United States [8, 9].

In a meta-analysis Dorji et al reported a pooled estimate of 61.69% HPV vaccine uptake in low- and middle-income countries with a wide gap ranging between 4.72% and 87.98% [10]. Regionally the rate of immunization coverage against HPV varies between countries from less than 1% in Morocco [11] to 9.2% among female university students in Kuwait [12] and 11% in UAE [13]. As for Lebanon the latest published studies report a low vaccination rate ranging between 16 and 18.9% among 454 surveyed Lebanese female university students between 17 and 30 years who reported having received a minimum of one dose of the HPV vaccine [14, 15].

Hesitancy to HPV vaccine and to vaccination in general is present worldwide and originates from multiple levels. Identified causes for deficient HPV vaccination include lack of healthcare provider recommendation, safety concerns, parental perception of low risk of exposure to HPV, parental concerns about vaccine encouraging promiscuity, fear of needles and cost [16–19]. Less is known about the cultural influence on vaccine uptake in countries like Lebanon where cervical cancer ranks as the 10th most frequent cancer among women across all age groups and the 8th most frequent cancer among women between 15 and 44 years of age [20].

Approved HPV vaccines are available in Lebanon although not mandatory by the ministry of public health (MOPH) [21]. A study published in 2015 investigating knowledge and attitudes of Lebanese female college students towards HPV vaccination showed that only 16.5% were vaccinated against HPV [22]. A later school survey of mothers of adolescent girls conducted in a group of religious conservative schools showed that only 2.5% had given the HPV vaccine to their daughters [23]. Overall, the Lebanese population, including parents and physicians, seem to have a suboptimal knowledge of the vaccine [22–24].

There is paucity of information on knowledge and attitudes of parents in general (of both males and females and across age groups) towards HPV vaccine in Lebanon, and no study has looked at the impact of parental attitudes towards vaccination in general on acceptance of specific vaccines, like HPV vaccine. Understanding better the awareness of Lebanese parents towards HPV vaccine and recognizing the presence of specific cultural barriers can help develop targeted strategies to increase HPV vaccine uptake in Lebanon and the region. These strategies could potentially be adopted by other low-to-middle income countries or other countries from the MENA (Middle East and North Africa) region that share similar socio-cultural characteristics with Lebanon.

This study is part of a larger project investigating knowledge, attitude, and practice of Lebanese parents towards immunization in general with a focus on selected vaccines including HPV vaccine. This part of the study investigated the practice of Lebanese parents towards HPV vaccine. It also explored possible determinants of knowledge, attitude, and practice towards vaccines in general on practice related to HPV vaccination.

Materials and methods

Study area and design

This study was a cross-sectional survey conducted between April and November 2017. A school-based questionnaire was distributed and collected after being filled by parents across four different schools in Greater Beirut area: two private (Lycee Francais AbdelKader and Armenian Evangelical Central high school) and two public (Fakhreddine high school for girls and Raml al-Zarif secondary school). These schools are in an urban setting within the capital of the country and include students from diverse religious backgrounds.

The study team composed of bilingual doctors devised the questionnaire based on previously published questionnaires used in similar studies [25–27]. The questionnaire was developed in English and translated to Arabic. The questionnaire comprised 50 questions which addressed: knowledge, attitude and practice of parents regarding childhood vaccination in general and socio-demographic data (age, education, occupation and family income) (S1 Appendix in [S1 File](#)). Results presented in this paper focused on data collected in relation to HPV vaccine and its relation to data related to childhood vaccination in general.

Study population and eligibility

Target population was parents of children between the ages of 3 and 18 enrolled in schools. Non-Lebanese parents and parents who were younger than 18 years of age were excluded from the study.

Sample size determination and sampling techniques

A convenient target sample size in the original study was set at 400 based on prior similar studies [28, 29]. Post-hoc sample size calculation yielded the following: with a proportion of 60% outcome, will have a margin of error of 0.04 at 95% confidence for the 306 who were eligible for the HPV questions.

The schools were randomly selected by a computer-generated random list using a list of schools located in Greater Beirut area provided by Ministry of education. Suboptimal immunization rates and barriers to immunization are a major public health issue. Understanding parental perception of childhood immunizations and factors that encourage or discourage them from administering vaccines to their children is at the basis of improving vaccination rates in a population. The questionnaire was first piloted for face validity with 15 parents

recruited from different socioeconomic levels, asking about its clarity, comprehension, length, and cultural acceptability. No modifications were required after piloting. The piloted questionnaires were not included in the final analysis but ensured that study participants were able to voice any concerns regarding the questionnaire. The questionnaire was also reviewed, and contents were approved by the responsible official in the Lebanese Ministry of Education and the Directors of the schools involved.

Ethical considerations

The study was approved by the institutional board review at the American university of Beirut in addition to the MoPH, the ministry of education and administrations of the selected schools. Waiver of "written or verbal" informed consent was obtained from the IRB; by responding to the questionnaire individual participants gave their informed consent to include their information in the study. Questionnaires were filled out anonymously and returned in sealed envelopes to protect the privacy and confidentiality of the participants.

Data collection

Questionnaires were self-administered and anonymous: they were distributed to students in the enrolled schools in sealed envelopes in addition to a letter instructing parents to fill out the questionnaire and return it in a sealed envelope. Filled questionnaires were then collected and returned to the study team.

Questions related to knowledge, beliefs, attitude, and trust were answered on a 5-point Likert-scale (Strongly Agree to strongly disagree). Knowledge and attitude questions were grouped into themes. For knowledge 3 themes were identified: efficacy (4 questions), safety (11 questions) and general knowledge (6 questions). For attitude, 3 themes were included: reasons (3 questions), trust (6 questions) and hesitancy (5 questions).

Answers to each question were converted into a score over 100. Basically, questions with positive answers were given a full score of 100 for "strongly agree", 75 for "agree", 50 for "undecided", 25 for "disagree" and 0 for "strongly disagree", the inverse was done for questions with negative answers. Each theme was given a final score that was equal to the average score of the individual questions listed under that theme.

Data analysis

The IBM-Statistical Package for Social Sciences SPSS version 24 was used for data management and analysis. We calculated means and standard deviations for continuous variables and proportions for categorical variables. Associations between acceptance of Human papilloma virus and other variables were tested using Chi-squares test to compare with categorical variables whereas Student's t-test was used to compare with continuous variables. Multivariate analysis was carried out to assess the factors associated with the outcomes. More specifically, multiple logistic regression was carried out for the practice of HPV, where results were presented as odds ratio (OR) and 95% confidence interval (CI). On the other hand, multiple linear regression was carried out for the parental knowledge and attitude towards HPB vaccine, and results are reported as beta coefficient (B) and 95% CI. A p-value of less than 0.05 was considered statistically significant.

Results

Participant characteristics

The overall study response rate was 76.5% [306 out of 400, 134 (43.8%) from public schools and 172 (56.2%) from private schools], however only 60.5% [185 out of 306, 68 (36.8%) from

public schools and 117 (63.2%) from private schools] answered questions related to HPV vaccine and were included in the analysis (S1 Table in [S1 File](#)). Of 287 who answered the HPV questions 185 were aware of HPV vaccine (64.4%); of those 111 parents (60%) answered that they had not given or were not planning to give the HPV vaccine to their children, whereas the remaining 40% had a favorable attitude towards the vaccine.

[Table 1](#) summarizes the sociodemographic characteristics of the participants. There was a significant difference in gender distribution between students whose parents were against HPV vaccine and those who were in favor of HPV vaccine. Parents of girls were more likely to vaccinate their child (77% compared to 60%), while parents of boys were more likely to refuse vaccinating their child (23% vs 39%).

Respondents were mostly mothers (85% compared to 60%) in the group that had not heard about the vaccine and thus could not respond to the HPV specific questions. Mean child's age was comparable between HPV respondents and non-respondents. Overall parents who were in favor of HPV vaccine had a higher income, however within each of the public and private school groups there was no significant difference in income distribution ([Table 1](#)).

Knowledge

[Table 2](#) highlights data collected concerning parental knowledge about vaccines and acceptance of HPV vaccine. Overall scores of parents in favor of HPV vaccine reflected better general knowledge about vaccines, this was mainly driven by the private school respondents ([Fig 1](#)). Knowledge scores of parents from public school showed no significant difference between those in favor compared to those not in favor of HPV vaccine administration unlike the scores of parents from private schools (see also S2 Table in [S1 File](#)).

More than 95% of participants stated getting information on vaccines from doctors with no statistically significant difference between all groups. Respondents reported the best way to raise awareness about vaccines to be through their doctor followed by television (55.6% and 42.6% respectively). Compared to parents who refused HPV vaccination, more parents in favor of the vaccine thought that childhood vaccines are effective in protecting their child and that vaccination is important for the health of others and the community. These differences were statistically significant ($p = 0.02$, $p = 0.001$ respectively).

Overall, higher scores for the safety theme were observed among those in favor of the HPV vaccine, a statistically difference was noted within the private school sample ($p = 0.04$) ([Fig 1](#)).

Attitudes

Overall parents in favor of HPV vaccine were more likely to give recommended vaccines ($p = 0.04$), to follow their doctor's recommendations ($p = 0.02$), and to be always in favor of vaccines ($p = 0.01$). They were less likely to express concerns about serious side effects of vaccines ($p = 0.01$) ([Table 3](#)). Of parents who were not in favor of HPV vaccine, 7.5% reported thinking that vaccines are not necessary versus none in the group in favor ($p = 0.02$). Of the group not in favor of HPV vaccine, 13.1% thought that vaccines are not safe versus 2.7% in the group in favor of the vaccine ($p = 0.02$). [Fig 2](#) illustrates acceptance of HPV vaccine in the different groups in relation to scores related to specific aspects of parental general attitudes towards vaccines under the themes of reasons, trust, and hesitancy. Hesitancy scores were lower among people who are in favor of vaccines, and this difference was statistically significant for the private school sample ($p < 0.05$) ([Fig 2](#)).

Table 1. Demographic characteristics of study participants in relation to HPV vaccine acceptance.

	HPV-Vaccine (N = 111) No. (%)	HPV+ Vaccine (N = 74) No. (%)	p-value
Gender			
Female	67 (60.9)	57 (77.0)	0.02
Child Age, years	12.04 ± 3.18	11.22 ± 3.38	0.10
School Grade			0.19
Preschool	8 (7.5)	7 (9.5)	
Elementary School	28 (26.4)	29 (39.2)	
Middle School	60 (56.6)	30 (40.5)	
Secondary School	10 (9.4)	8 (10.8)	
Parent filling the questionnaire, n (%)			0.46
Father	11 (10.3)	10 (13.9)	
Mother	96 (89.7)	62 (86.1)	
Mother's Age, years, n (%)			0.23
≤ 30	2 (1.8)	2 (2.7)	
>30–50	101 (91.8)	71 (95.9)	
>50	7 (6.4)	1 (1.4)	
Mother's employment,			0.18
Employed	44 (40.4)	36 (48.6)	
Self-Employed	8 (7.3)	9 (12.2)	
Not Employed	57 (52.3)	29 (39.2)	
	HPV-Vaccine	HPV+ Vaccine	p-value
Mother's Education, n (%)			0.66
No Formal Schooling	2 (1.8)	2 (2.7)	
High School Graduate or less	43 (39.4)	22 (30.1)	
Post-Secondary Technical	6 (5.5)	7 (9.6)	
University/College	58 (53.2)	42 (57.5)	
Father's Age, years, n (%)			0.69
≤ 30	2 (1.8)	0 (0.0)	
>30–50	80 (73.4)	56 (81.2)	
>50	27 (24.8)	13 (18.8)	
Father's Education, n (%)			0.11
No Formal Schooling	7 (6.4)	1 (1.4)	
High School Graduate or less	45 (41.3)	29 (42)	
Post-Secondary Technical	9 (8.3)	1 (1.4)	
University/College	48 (44.0)	38 (55.1)	
Father's Employment, n (%)			0.22
Employed	70 (66.0)	38 (55.1)	
Self-Employed	35 (33.0)	29 (42.0)	
Not Employed	1 (0.9)	2 (2.9)	
Household Income, n (%)			0.04
<1000\$/month	27 (33.3)	10 (17.9)	
1000–5000\$/month	44 (54.3)	31 (55.4)	
>5000\$/month	10 (12.3)	15 (26.8)	

HPV+ vaccine: Parents in favor of HPV vaccine HPV- vaccine: Parents not in favor of HPV vaccine.

<https://doi.org/10.1371/journal.pone.0295644.t001>

Table 2. Association between parental knowledge and HPV vaccine acceptance among Lebanese parents of school-aged children.

	HPV-Vaccine (N = 111) No. (%)	HPV+ Vaccine (N = 74) No. (%)	p-value
Barriers n (%)			
Lack of awareness	61 (56.5)	46 (66.7)	0.18
Financial issue	62 (57.4)	39 (56.5)	0.91
Lack access or availability of the vaccine	21 (19.4)	22 (31.9)	0.06
No barriers	26 (24.1)	5 (7.2)	0.004
Awareness n (%)			
Source of information			
Doctor	104 (96.3)	69 (95.8)	1.00
TV	22 (20.4)	13 (17.8)	0.67
Internet	29 (26.9)	15 (20.5)	0.33
School	6 (5.6)	4 (5.5)	1.00
Best way to raise awareness			
Group meeting	47 (43.5)	28 (38.4)	0.49
Pamphlets	50 (46.3)	34 (47.2)	0.90
Internet	27 (25.0)	28 (38.4)	0.05
SMS	24 (22.2)	9 (12.3)	0.09
TV	46 (42.6)	35 (47.9)	0.48
Doctor	60 (55.6)	45 (61.6)	0.42
Efficacy*			
Q1 Childhood vaccines are effective in protecting my child from serious disease	87.85 ± 17.96	92.81 ± 11.39	0.02
Q2 Having my child vaccinated is important for the health of others in my community	79.21 ± 23.41	89.58 ± 14.38	0.001
Safety*			
Q5 I don't mind having my child receive more than 5 types of vaccine in one visit	44.34 ± 31.68	56.51 ± 30.34	0.01
Q6 My child is getting too many vaccines during the first two years of life which may weaken his immune system	46.19 ± 25.89	37.33 ± 25.39	0.02
Q8 Vaccines are not tested enough for safety	47.75 ± 25.15	36.76 ± 26.79	0.01

HPV+ vaccine: Parents in favor of HPV vaccine HPV- vaccine: Parents not in favor of HPV vaccine;

*numbers represent mean scores ± Standard deviation.

<https://doi.org/10.1371/journal.pone.0295644.t002>

Practice

Parents not in favor of HPV vaccine were more likely to refuse or delay vaccines in general compared to those in favor of the vaccine ($p = 0.02$). Fig 3 shows reasons stated for not being in favor of HPV vaccination. Lack of recommendation by pediatrician and less awareness about the vaccine were the most selected reasons, whereas cultural/ religious reasons were rarely stated as a reason for not being in favor of the vaccine.

Tables 4 and 5 shows results of multiple regression correlating different respondent characteristics with parental knowledge, attitude, and practice towards HPV vaccine.

Discussion

In this study, we aimed to describe the impact of knowledge, attitude, and practice towards vaccines in general on practice related to HPV vaccination among parents of school aged children in Lebanon. Most parents-respondents who were aware of HPV vaccine had not given or were not planning to give it to their children. Most parents-respondents thought that vaccines are necessary, but a small proportion said they are not safe. Lack of recommendation by

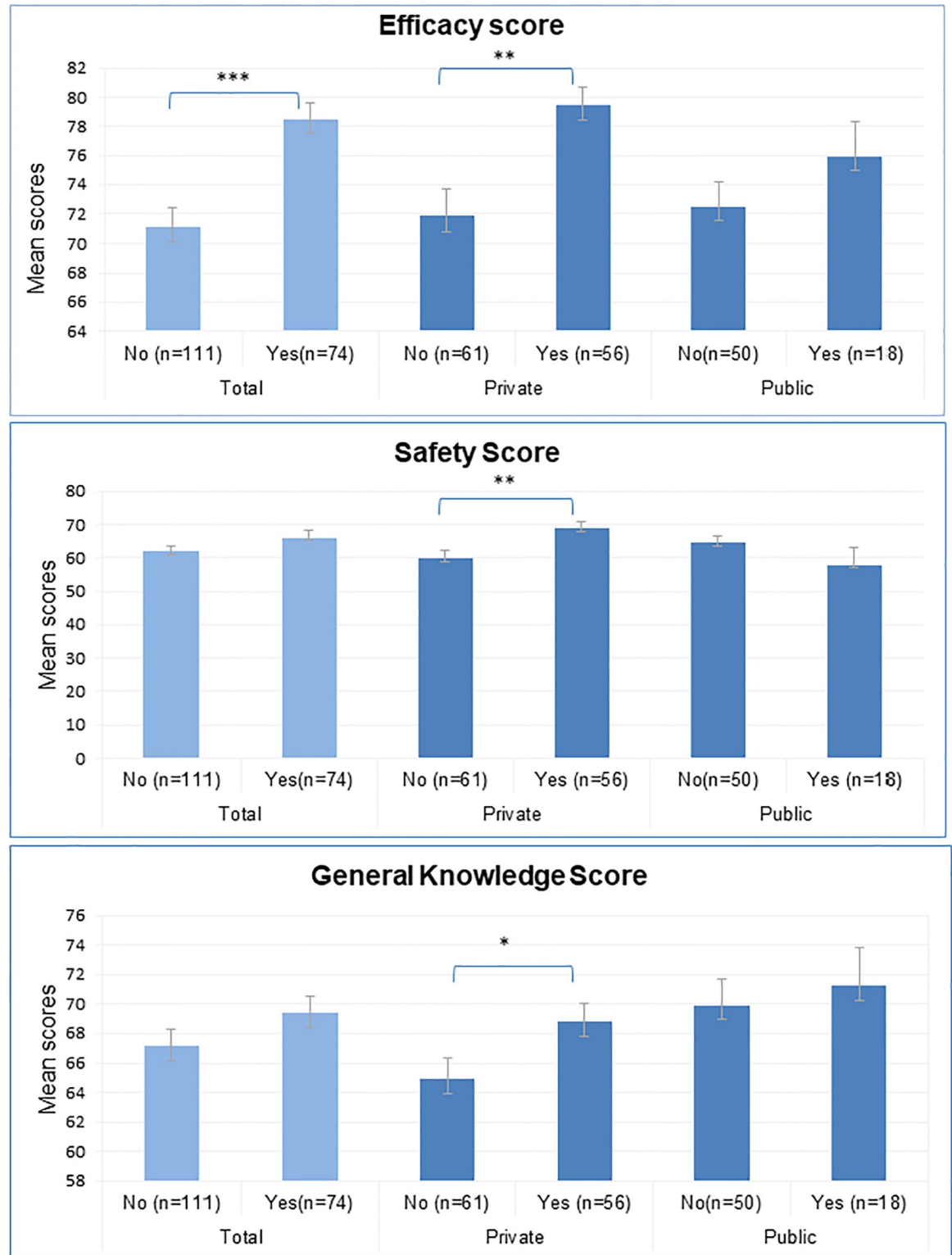


Fig 1. Mean knowledge scores by acceptance of HPV vaccine in private and public schools. *p<0.05; ** p<0.01; ***p<0.001.

<https://doi.org/10.1371/journal.pone.0295644.g001>

Table 3. Association between parental attitude towards vaccines and HPV vaccine acceptance among Lebanese parents of school-aged children.

	HPV-Vaccine (N = 111) No. (%)	HPV+ Vaccine (N = 74) No. (%)	p-value
Perception of knowledge n (%)			
Willingness to give recommended shots	86 (90.5)	66 (98.5)	0.04
Number of concomitant injections considered acceptable			0.30
1 to 2	51 (47.7)	25 (33.8)	
3 to 4	5 (4.7)	4 (5.4)	
More than 4	3 (2.8)	3 (4.1)	
Whatever the doctor recommends	48 (44.9)	42 (56.8)	
Concerns of the effects of vaccines			
Fever	94 (87.9)	62 (86.1)	0.73
Rash	31 (29.0)	19 (26.4)	0.71
Diarrhea	25 (23.4)	14 (19.4)	0.53
Infection	42 (39.3)	26 (36.1)	0.67
Too numerous	31 (28.7)	15 (20.5)	0.22
Vaccine not safe	14 (13.1)	2 (2.7)	0.02
Side effects	52 (48.6)	26 (35.6)	0.08
No concern	31 (29.0)	32 (43.8)	0.04
Trust*			
Q22 I trust the information I receive about shots	70.05 ± 20.53	72.92 ± 17.68	0.33
Q29 Generally I do what my doctor recommends about vaccines for my child/children	79.67 ± 19.46	86.23 ± 16.90	0.02
Q 38 I recommend vaccination to others	83.48 ± 25.51	89.64 ± 22.02	0.10
Hesitancy*			
Q30 I am concerned about serious adverse effects of vaccines.	56.37 ± 25.13	46.47 ± 25.81	0.01
Q31 I am concerned that newer vaccines are not as safe as older vaccines because they haven't been tested or tracked for as long	60.28 ± 25.22	54.51 ± 26.31	0.14
Q37 I am in favor of vaccination.	82.26 ± 25.08	90.99 ± 19.35	0.01

HPV+ vaccine: Parents in favor of HPV vaccine HPV- vaccine: Parents not in favor of HPV vaccine;

*numbers represent mean scores ± Standard deviation.

<https://doi.org/10.1371/journal.pone.0295644.t003>

pediatricians and the thought that too little is known about HPV vaccine were the most selected reasons for parents not wanting to vaccinate their children against HPV, whereas cost and religious and cultural beliefs seemed to have no impact.

A review of all studies from the MENA region looking at knowledge, awareness, and acceptability of HPV vaccine, reported overall vaccine awareness rates of 14.2–34.2% among studies focusing on parents and 32.3–63.5% among studies focusing on females only [30].

In this study 60% of responding parents knew about the HPV vaccine. This was comparable to 63.5% of Lebanese female college students from a prior study who reported being aware of the existence of the vaccine [22] but higher than the 34% awareness rate reported in a more recent publication targeting Lebanese mothers of older female school students [23]. In our study, only 40% of parents who knew about the vaccine (24% of the total participants) were willing to give or had given it to their children, a much higher rate than the 2.5% vaccine uptake reported in the above-mentioned study [23]. The differences noted may be due to the fact that the study looking at mothers' attitudes was conducted in a group of schools with rather conservative religious socioeconomic backgrounds. A study published in 2012, from Aleppo Syria, showed that 34.2% of mothers of 6th grade girls had heard about the vaccine but



Fig 2. Mean attitude scores by acceptance of HPV vaccine in private and public schools. * $p < 0.05$.

<https://doi.org/10.1371/journal.pone.0295644.g002>

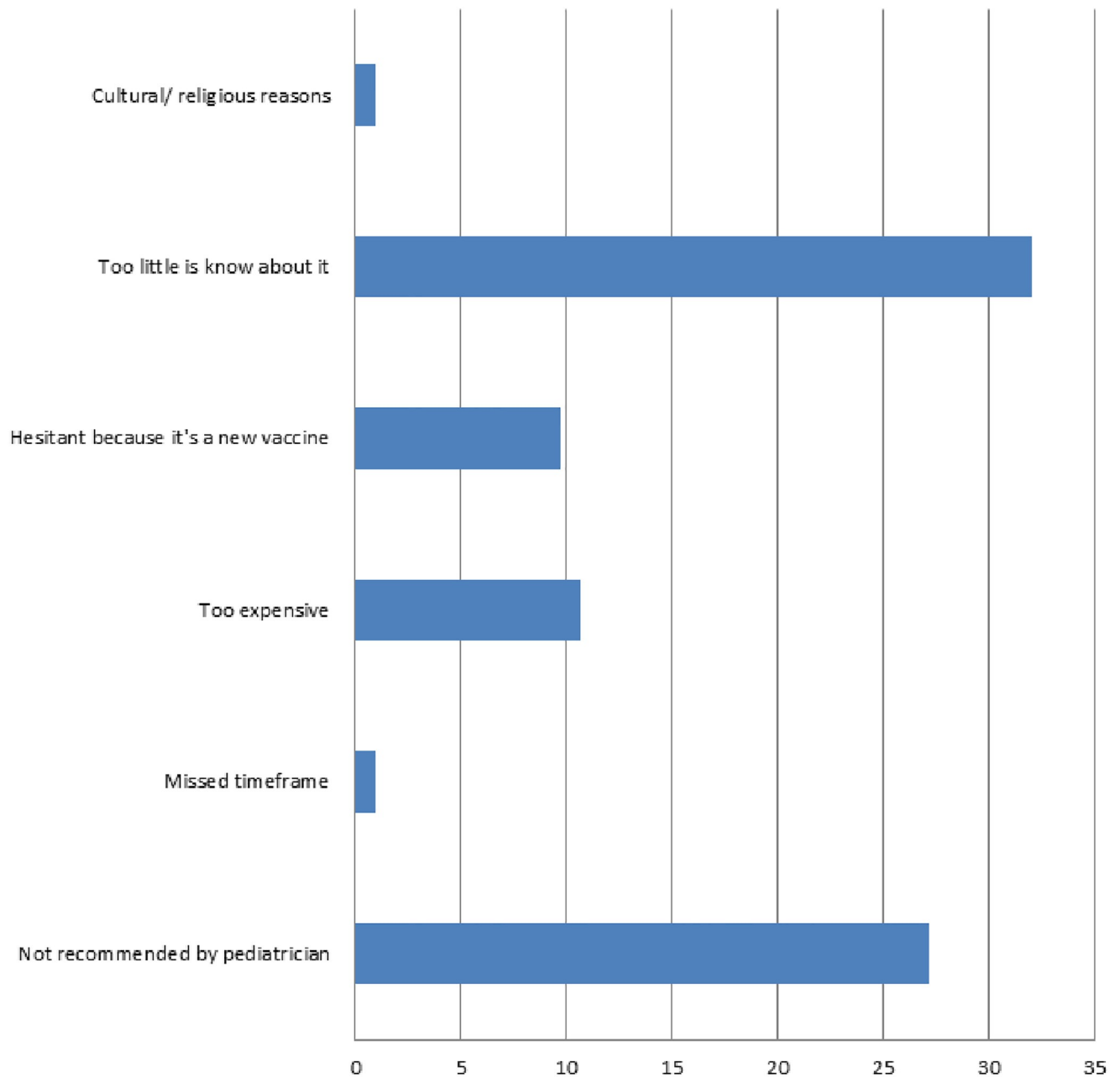


Fig 3. Main reasons for non-acceptance of HPV vaccine (percentage of total HPV respondents).

<https://doi.org/10.1371/journal.pone.0295644.g003>

their level of knowledge was low [31]. A 2019 review looking at studies from Iran showed that overall population knowledge of HPV vaccine was low but attitude towards the vaccine tended to be positive; the only study from the review that looked at parental attitude towards the vaccine showed that 76% of parents had no knowledge about HPV infection [32]. In a recent study from Lebanon only 11.3% of students 15–18-year-old reported receiving at least one dose of HPV vaccine, 36.5% were not sure if they had received any doses [33].

In the previously mentioned MENA region review, out of the 18 studies reviewed only 3 looked at parental awareness and knowledge and all interviewed parents of girls only [30]. Our

Table 4. Multiple logistic regression of factors associated with practice of HPV.

	OR (95% CI)	p
Mother's Age	1.167 (0.062–21.867)	0.92
Mother's employment	0.714 (0.255–2.001)	0.52
Mother's Education	0.823 (0.286–2.369)	0.72
Father's education	0.724 (0.243–2.154)	0.56
Parents income	1.388 (0.391–4.922)	0.61
Private vs public	4.732 (1.143–19.580)	0.032

For maternal age reference group was >30, for education reference group was university, for income reference group was >1000.

<https://doi.org/10.1371/journal.pone.0295644.t004>

study showed that there remains a gender bias driving knowledge about the vaccine (mothers versus fathers) and willingness to administer the vaccine (daughters versus sons) in the Lebanese population: mothers were more likely to know about the vaccine and parents of girl students were more likely to have a favorable attitude towards the vaccine. In a review from Iran, mothers' information score was higher than that of fathers [32]. This is also comparable to what has been reported from other areas of the world where mothers tend to be the respondents to surveys related to HPV-vaccination [34, 35] and knowledge about HPV administration to boys is significantly lower than knowledge about its administration to girls [36, 37]. Among secondary schools' Lebanese students, a low vaccination rate was noted in males (87% of vaccinated students were females and 13% were males) and 39.1% of surveyed students thought that only women can get infected. Interestingly, a recent study from Turkey surveying 18–29-year-old university students in health sciences found that only 10% thought HPV infects only women and 82% of males had heard about HPV vaccine compared to 60% of female students included [38].

Most stated reasons for non-acceptance of HPV vaccine in our study were the lack of knowledge and provider recommendation, both of which may be related as doctors are expected to educate patients about the vaccine when recommending it and since physicians were reported as an entrusted source of medical information. Only 21.9% of Lebanese secondary school students reported hearing about the HPV vaccine from their doctor, whereas internet was their primary source of knowledge (48%) [33]. This may be due to a lack of knowledge of primary care physicians about the vaccine or lack of empowerment in recommending the vaccine. A study from Turkey surveying physicians and nurses' attitudes as parents found that 62.5% of physicians and 74.2% of nurses would not give their children HPV vaccine; 70% and 53.9% respectively would however consider it if it was included in the routine vaccination

Table 5. Multiple linear regression of factors associated with parental knowledge and attitude towards HPV vaccine.

	Parental knowledge	p	Parental attitude	p
	B (95%CI)		B (95%CI)	
Mother's age	-2.678 (-9.95–4.59)	0.47	-3.13 (-10.82–4.56)	0.42
Mother's employment	3.47 (-0.19–7.14)	0.063	0.54 (-3.30–4.39)	0.78
Mother's Education	-0.15 (-4.39–4.09)	0.95	-1.17 (-5.63–3.29)	0.61
Father's employment	4.27 (-8.10–16.64)	0.50	0.72 (-12.36–13.81)	0.91
Father's education	0.90 (-2.97–4.78)	0.65	-1.34 (-5.42–2.74)	0.52
Parents income	-2.76 (-7.49–1.96)	0.25	3.51 (-1.46–8.47)	0.17
Private vs public	-5.54 (-10.62 - -0.46)	0.033	-9.10 (-14.37 - -3.83)	0.001

<https://doi.org/10.1371/journal.pone.0295644.t005>

schedule [38]. A survey of Saudi pediatrician and family physicians showed that 58.38% had a good knowledge score of HPV vaccine and only 66.5% recommended the vaccine for girls 12–15 y of age, they were more likely to recommended it to older girls [39]. Our findings and findings from these studies suggest that physician education is needed to empower them to recommend and educate parents and children and adolescents about HPV vaccine. Inclusion of the vaccine in official immunization guidelines and health records even if the vaccine is not provided free of charge as part of national immunization programs may help enforce its recommendation.

Surprisingly, only 10% of parents not in favor of the vaccine stated cost and only 1% stated cultural and religious reasons being behind their decision. Currently, in Lebanon, HPV vaccine is not part of the national immunization program and is not subsidized by the government. Parents would have to pay out of pocket for the vaccine, the cost of a single dose of HPV vaccine is around 175 US dollars. Prior studies on the effect of culture and religion on HPV vaccine acceptance and uptake have shown variable results with some showing religious beliefs to increase uptake of vaccine [40], other showing the opposite [41], and lastly some studies showing no effect of religious beliefs on HPV vaccine acceptance [40].

Knowledge scores from private schools reflected a better general knowledge about vaccines to be associated with higher acceptance of HPV vaccine, this did not hold true for the public-school group where knowledge was comparable between parents in favor or not in favor of HPV vaccine. This might be due to the smaller sample size not allowing for detection of a significant difference, or to the fact that in the public-school group the decision to give HPV vaccine is driven by factors other than knowledge about vaccines in general. Similarly, some of the differences in attitudes noted between the in favor and against groups were significant for the overall group and for private schools, but not the public-school group, although for most variables trends like those seen in the private and overall group were noted.

In the public-school group not in favor of HPV vaccines, rates of parents who considered themselves always in favor of vaccines and not hesitant was high and comparable to those who were in favor of the HPV vaccine overall showing again that the public-school group had an attitude towards HPV vaccine not explained by its general attitude towards vaccination. In Lebanon families attending public schools tend to be from a less favorable socioeconomic status. Studying further decision-making drivers to HPV vaccine acceptance in that population should be undertaken. An understated role of financial barriers or religious and cultural barrier may be one possibility. However, similar to our results, a previous study exploring knowledge and attitudes of Lebanese female college students towards HPV vaccine showed that vaccine awareness was the main driver of the intent to get vaccinated rather than religion or economic status [22].

The strength of this study lies in the fact that it captured parents' KAP about HPV vaccines in school aged children as opposed to college or university students. It also captured information from different socio-economic backgrounds and highlighted the attitude and practice of parents towards HPV vaccine for both boys and girls across age groups. Additionally, it allowed cross-examination of parental acceptance of HPV vaccine with their knowledge, attitude, and practice towards vaccines in general. An overall good knowledge and positive attitude towards vaccination leads to better acceptance of HPV vaccine.

One limitation of the study is that the target population was not met and for HPV in particular the population size was smaller since 40% of participants were not aware of the vaccine and thus could not be included in the analysis. Another limitation of the study was the geographic limitation to one urban setting area of Lebanon. Future larger studies in different areas of Lebanon and the region will give more insight into knowledge, attitudes, and practice of Lebanese parents towards childhood vaccination with a focus on HPV vaccine.

Based on our findings, efforts should be put towards raising awareness about HPV vaccine among Lebanese parents including fathers. Although mothers are usually the ones accompanying their children to doctor's visits and making the direct decision on vaccination in our societies, decision on vaccine administration especially costly ones still is made in concertation with the father. Moreover, there is a need to improve awareness about vaccines in general and about the need to vaccinate both males and females against HPV. Across groups, parents mentioned their doctor as one of the main sources of information to acquire knowledge about vaccines. Parents in favor of HPV vaccine were more likely to follow recommendations by physician. Physicians thus play a key role in both increasing knowledge and changing parental practices. This has been shown in other studies from other parts of the world looking at factors associated with HPV vaccine uptake [18]. Educating and empowering physicians are therefore key in attaining favorable vaccine attitudes and practices.

Conclusion

This study sheds the light on important factors that are key to future steps towards addressing HPV vaccine hesitancy in the Lebanese population and the region. The study found that lack of recommendation by physician was the main cause of non-vaccination and that there remains significant gender discrepancy in knowledge, attitude, and practice with regards to HPV vaccine. This highlights the need for efforts geared towards educating males about the vaccine and encouraging its uptake across genders as well as educating primary care physicians about the vaccine and addressing any barriers to its recommendation. These findings may help guide future efforts to improve HPV vaccination uptake in Lebanon and countries with similar cultural and socioeconomic build. Similar larger studies from other areas of Lebanon are needed to complement and confirm our findings and identify other potential barriers to HPV vaccination in Lebanon and other low-to-middle income countries.

Supporting information

S1 File.
(PDF)

Acknowledgments

The authors would like to thank the general director of the ministry of education, the school's directors, the parents, and their children for their cooperation.

Author Contributions

Conceptualization: Lama Charafeddine.

Data curation: Hani Tamim, Farah Faytrouni.

Formal analysis: Hani Tamim, Farah Faytrouni, Maha Makki, Rayan Hojeij.

Methodology: Farah Faytrouni, Lama Charafeddine.

Project administration: Farah Faytrouni, Lama Charafeddine.

Supervision: Lama Charafeddine.

Writing – original draft: Ramia Zakhour.

Writing – review & editing: Ramia Zakhour, Hani Tamim, Farah Faytrouni, Maha Makki, Rayan Hojeij, Lama Charafeddine.

References

1. National Cancer Institute. HPV and Cancer [Internet]. National Cancer Institute. Cancer.gov; 2019. <https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-and-cancer>
2. Joura EA, Pils S. Vaccines against human papillomavirus infections: protection against cancer, genital warts or both? *Clinical Microbiology and Infection*. 2016 Dec; 22:S125–7. <https://doi.org/10.1016/j.cmi.2016.12.017> PMID: 28034371
3. Herrero R, González P, Markowitz LE. Present status of human papillomavirus vaccine development and implementation. *The Lancet Oncology*. 2015 May; 16(5):e206–16. [https://doi.org/10.1016/S1470-2045\(14\)70481-4](https://doi.org/10.1016/S1470-2045(14)70481-4) PMID: 25943065
4. Markowitz LE, Hariri S, Lin C, Dunne EF, Steinau M, McQuillan G, et al. Reduction in Human Papillomavirus (HPV) Prevalence Among Young Women Following HPV Vaccine Introduction in the United States, National Health and Nutrition Examination Surveys, 2003–2010. *The Journal of Infectious Diseases*. 2013 Aug 1; 208(3):385–93. <https://doi.org/10.1093/infdis/jit192> PMID: 23785124
5. Saslow D, Andrews KS, Manassaram-Baptiste D, Loomer L, Lam KE, Fisher-Borne M, et al. Human papillomavirus vaccination guideline update: American Cancer Society Guideline endorsement. *CA: A Cancer Journal for Clinicians*. 2016; 66(5):375–85. <https://doi.org/10.3322/caac.21355> PMID: 27434803
6. Spayne J, Hesketh T. Estimate of global human papillomavirus vaccination coverage: analysis of country-level indicators. *BMJ Open*. 2021 Sep; 11(9):e052016. <https://doi.org/10.1136/bmjopen-2021-052016> PMID: 34475188
7. <https://www.unicef.org/supply/stories/closing-gap-unicef-bolsters-country-efforts-increase-hpv-vaccination>, accessed July 15, 2023
8. Lefèvre H, Moro MR, Lachal J. The New HPV Vaccination Policy in France. *New England Journal of Medicine*. 2018 Mar 22; 378(12):1160–0. <https://doi.org/10.1056/NEJMc1801036> PMID: 29562152
9. Bernstein HH, Bocchini JA. The Need to Optimize Adolescent Immunization. *Pediatrics* [Internet]. 2017 Feb 6; 139(3):e20164186. Available from: <https://pediatrics.aappublications.org/content/139/3/e20164186> <https://doi.org/10.1542/peds.2016-4186> PMID: 28167517
10. Dorji T, Nopsopon T, Tamang ST, Pongpirul K. Human papillomavirus vaccination uptake in low-and middle-income countries: a meta-analysis. *E Clinical Medicine*. 2021 Apr 17; 34:100836. <https://doi.org/10.1016/j.eclinm.2021.100836> PMID: 33997733
11. Yacouti A, Elkhoudri N, El got A, Benider A, Hadrya F, Baddou R, et al. Awareness, attitudes and acceptability of the HPV vaccine among female university students in Morocco. Karimi-Sari H, editor. *PLOS ONE*. 2022 Apr 8; 17(4):e0266081. <https://doi.org/10.1371/journal.pone.0266081> PMID: 35395019
12. Alsanafia M, Salim N. A., and Sallame M. Willingness to get HPV vaccination among female university students in Kuwait and its relation to vaccine conspiracy beliefs. *Human Vaccines & Immunotherapeutics* 2023, VOL. 19, NO. 1, 2194772.
13. Al Shdefat S., Al Awar S., Osman N., Khair H., Sallam G., and Elbiss H.; 2022 Article ID 8294058.
14. Haddad SF, Kerbage A, Eid R, Kourie HR. Awareness about the human papillomavirus (HPV) and HPV vaccine among medical students in Lebanon. *Journal of Medical Virology*. 2021 Dec 17;
15. El Khoury JE, Halabi R, Hleyhel M, Kishly WER, Khoury RE, Saleh N. HPV vaccination prevalence among Lebanese Female University Students: A cross-sectional study. 2022 Sep 15; *J Environ Public Health*. 2023 Jun 5; 2023:3706466.
16. Bratic JS, Seyferth ER, Bocchini JA. Update on barriers to human papillomavirus vaccination and effective strategies to promote vaccine acceptance. *Current Opinion in Pediatrics*. 2016; 28(3):407–12. <https://doi.org/10.1097/MOP.0000000000000353> PMID: 27093354
17. Tung ILY, Machalek DA, Garland SM. Attitudes, Knowledge and Factors Associated with Human Papillomavirus (HPV) Vaccine Uptake in Adolescent Girls and Young Women in Victoria, Australia. Conso- laro MEL, editor. *PLOS ONE*. 2016 Aug 26; 11(8):e0161846. <https://doi.org/10.1371/journal.pone.0161846> PMID: 27564213
18. Cheruvu VK, Bhatta MP, Drinkard LN. Factors associated with parental reasons for “no-intent” to vaccinate female adolescents with human papillomavirus vaccine: National Immunization Survey—Teen 2008–2012. *BMC Pediatrics*. 2017 Feb 13; 17(1). <https://doi.org/10.1186/s12887-017-0804-1> PMID: 28193249
19. Mupandawana ET, Cross R. Attitudes towards human papillomavirus vaccination among African parents in a city in the north of England: a qualitative study. *Reproductive Health*. 2016 Aug 22; 13(1).
20. ICO/IARC Information Centre on HPV and Cancer. Human Papillomavirus and Related Cancers, Fact Sheet 2023 [Internet]. Lebanon: HPV information center; 2023 Mar. https://hpvcentre.net/statistics/reports/LBN_FS.pdf

21. Jumaan AO, Ghanem S, Taher J, Braikat M, A Awaidy S, Dbaibo GS. Prospects and Challenges in the Introduction of Human Papillomavirus Vaccines in the Extended Middle East and North Africa Region. *Vaccine*. 2013 Dec; 31:G58–64. <https://doi.org/10.1016/j.vaccine.2012.06.097> PMID: 24331821
22. Dany M, Chidiac A, Nassar AH. Human papillomavirus vaccination: Assessing knowledge, attitudes, and intentions of college female students in Lebanon, a developing country. *Vaccine*. 2015; 33(8):1001–7. <https://doi.org/10.1016/j.vaccine.2015.01.009> PMID: 25597945
23. Abou El Ola M, Rajab M, Abdallah D, Fawaz I, Awad L, Tamim H, et al. Low rate of human papillomavirus vaccination among schoolgirls in Lebanon: Barriers to vaccination with a focus on Mothers&RS-QUO; knowledge about available vaccines. *Therapeutics and Clinical Risk Management*. 2018;Volume 14:617–26.
24. Abi Jaoude J, Khair D, Dagher H, Saad H, Cherfan P, Kaafarani MA, et al. Factors associated with human papilloma virus (HPV) vaccine recommendation by physicians in Lebanon, a cross-sectional study. *Vaccine*. 2018; 36(49):7562–7. <https://doi.org/10.1016/j.vaccine.2018.10.065> PMID: 30420044
25. Masadeh MM, Alzoubi KH, Al-Azzam SI, Al-Agedi HS, Abu Rashid BE, Mukattash TL. Public awareness regarding children vaccination in Jordan. *Human Vaccines & Immunotherapeutics*. 2014 May 7; 10(6):1762–6. <https://doi.org/10.4161/hv.28608> PMID: 24732060
26. Weiner JL, Fisher AM, Nowak GJ, Basket MM, Gellin BG. Childhood Immunizations: First-Time Expectant Mothers' Knowledge, Beliefs, Intentions, and Behaviors. *American journal of preventive medicine [Internet]*. 2015; 49(6 Suppl 4):S426–34. <https://www.ncbi.nlm.nih.gov/pubmed/26297448> <https://doi.org/10.1016/j.amepre.2015.07.002>
27. Survey of Parents on Key Issues Related to Immunization: Final Report | immunizecanada [Internet]. immunize.ca. <https://immunize.ca/resources/survey-parents-key-issues-related-immunization-final-report>
28. Abdel Rahman El Gammal HAA. Maternal satisfaction about childhood immunization in primary health care center, Egypt. *Pan African Medical Journal [Internet]*. 2014; 18. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4236845/>
29. Ahmed Abdulrahman YM. Parents' Knowledge and Attitudes on Childhood Immunization, Taif, Saudi Arabia. *Journal of Vaccines & Vaccination*. 2014; 05(01).
30. Gamaoun R. Knowledge, awareness and acceptability of anti-HPV vaccine in the Arab states of the Middle East and North Africa Region: A systematic review. *Eastern Mediterranean Health Journal*. 2018; 24(6):538–48. <https://doi.org/10.26719/2018.24.6.538> PMID: 30079949
31. Alsaad M. A., Shamsuddin K., & Fadzil F. (2012). Knowledge towards HPV infection and HPV vaccines among Syrian mothers. *Asian Pacific Journal of Cancer Prevention*, 13(3), 879–883. <https://doi.org/10.7314/apjcp.2012.13.3.879> PMID: 22631665
32. Taebi M., Riazi H., Keshavarz Z., & Afrakhteh M. (2019). Knowledge and attitude toward human papillomavirus and HPV vaccination in Iranian population: A systematic review. *Asian Pacific Journal of Cancer Prevention*, 20(7), 1945–1949. <https://doi.org/10.31557/APJCP.2019.20.7.1945> PMID: 31350949
33. Khalil J., Boutros S., Hassoun A. et al. Human papillomavirus vaccine knowledge and conspiracy beliefs among secondary school students in Lebanon. *BMC Pediatr* 23, 363 (2023). <https://doi.org/10.1186/s12887-023-04177-w> PMID: 37454098
34. Ogilvie G, Anderson M, Marra F, McNeil S, Pielak K, Dawar M, et al. A Population-Based Evaluation of a Publicly Funded, School-Based HPV Vaccine Program in British Columbia, Canada: Parental Factors Associated with HPV Vaccine Receipt. Wright L, editor. *PLoS Medicine*. 2010 May 4; 7(5):e1000270. <https://doi.org/10.1371/journal.pmed.1000270> PMID: 20454567
35. Grandahl M, Chun Paek S, Grisurapong S, Sherer P, Tydén T, Lundberg P. Parents' knowledge, beliefs, and acceptance of the HPV vaccination in relation to their socio-demographics and religious beliefs: A cross-sectional study in Thailand. Grace M, editor. *PLOS ONE*. 2018 Feb 15; 13(2):e0193054. <https://doi.org/10.1371/journal.pone.0193054> PMID: 29447271
36. Lee Mortensen G, Adam M, Idtaleb L. Parental attitudes towards male human papillomavirus vaccination: A pan-European cross-sectional survey. *BMC Public Health*. 2015; 15(1).
37. Sherman SM, Nailer E. Attitudes towards and knowledge about Human Papillomavirus (HPV) and the HPV vaccination in parents of teenage boys in the UK. Newman PA, editor. *PLOS ONE [Internet]*. 2018 Apr 11; 13(4):e0195801. Available from: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0195801> PMID: 29641563
38. Tubaş F., DULKADİR R., TAPLAK A. Ş., & ÜNLÜ E. (2022). Knowledge and attitudes of physicians and nurses in Turkey regarding human papillomavirus vaccination of their children. *Journal of Community Health*, 48(1), 99–103. <https://doi.org/10.1007/s10900-022-01141-0> PMID: 36305983
39. Almazrou S., Saddik B., & Jradi H. (2020). Knowledge, attitudes, and practices of Saudi physicians regarding cervical cancer and the human papilloma virus vaccine. *Journal of Infection and Public Health*, 13(4), 584–590. <https://doi.org/10.1016/j.jiph.2019.09.002> PMID: 31570271

40. Grandahl M, Tydén T, Westerling R, Nevéus T, Rosenblad A, Hedin E, et al. To Consent or Decline HPV Vaccination: A Pilot Study at the Start of the National School-Based Vaccination Program in Sweden. *The Journal of School Health* [Internet]. 2017 Jan 1; 87(1):62–70. Available from: <https://pubmed.ncbi.nlm.nih.gov/27917484/> <https://doi.org/10.1111/josh.12470>
41. Shelton RC, Snavely AC, De Jesus M, Othus MD, Allen JD. HPV Vaccine Decision-Making and Acceptance: Does Religion Play a Role? *Journal of Religion and Health* [Internet]. 2011 Nov 11; 52(4):1120–30. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4616263/>