

RESEARCH PAPER



# The factors associated with maternal consent to human papillomavirus vaccination among adolescents in Israel

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## ABSTRACT

**Purpose:** To evaluate the knowledge and attitudes toward the human papillomavirus (HPV) vaccine among mothers of 8th graders in Israel, and to determine the factors associated with maternal consent to the HPV vaccine.

**Methods:** We conducted a cross-sectional study among mothers of 8th grade students in 27 schools in Haifa and Northern districts of Israel during the 2016–17 school year. Data were collected using a structured telephone questionnaire.

**Results:** 313 mothers answered the questionnaire (response rate = 91.8%). The mean knowledge level score was low (3.96 points [out of 10]  $\pm$  2.68). Knowledge level was positively associated with Jewish nationality, being secular in religious practice and higher education. The attitude mean score was low-moderate (11.22 points [out of 18]  $\pm$  5.01). Attitude score was positively associated with Arab nationality. No significant association was found between knowledge level and attitudes. According to multivariate analysis, mothers' consent to the HPV vaccine was associated with the knowledge level score (OR = 0.82; 95%CI 0.68–0.98), the attitude score (OR = 1.76; 95%CI 1.53–2.02) and nationality (OR = 27.86, 95%CI 3.41–227.56).

**Conclusions:** The knowledge level and attitudes toward the HPV vaccine were found to be unsatisfactory with racial disparities between Arabs and Jews. Jewish mothers compared with Arab mothers, mothers with a higher knowledge level or less positive attitudes were less likely to consent to the vaccine. These findings could contribute toward adapting programs to the different Israeli sectors in order to improve the rates of HPV vaccine receipt among adolescents.

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Human papillomavirus vaccination; knowledge; attitude; parental consent; adolescent

## Introduction

Reports from countries with human papillomavirus (HPV) vaccine programs indicate that the HPV vaccine reduces the prevalence of cervical dysplasia, vaccine-related HPV-type infections and the incidence of genital warts.<sup>1–4</sup> Cervical cancer prevention and other HPV-related cancers are obvious potential benefits, given that persistent infection is a prerequisite for subsequent dysplasia and malignancies.

In Israel, the vaccine has been routinely offered free of charge to all 8th grade girls (aged 12–13 years) since 2012, as part of a publicly funded school-based vaccination program. Since 2015 it has been offered free of charge to both boys and girls in grade 8.<sup>5</sup> In spite of the known benefits of the HPV vaccine and the fact that it is publicly funded for all 8th graders, the national coverage rates for the HPV vaccine are suboptimal (52% in the school year of 2016–17), compared to the high coverage rates ( $\geq$ 95%) for other routine vaccines offered in schools.<sup>6</sup>

A number of factors could influence parental decision-making regarding consent to the HPV vaccine. Possible factors include: knowledge, attitudes, receipt of other routine childhood immunizations and socio-demographic variables.<sup>7,8</sup>

In this study, we aimed to: 1) evaluate the level of knowledge about and attitudes towards the HPV vaccine among mothers of 8th grade boys and girls in Israel, and 2)

determine the factors associated with their decision to vaccinate their child against HPV.

## Results

The study comprised of 313 mothers of 8th grade students with an overall response rate of 91.8%. The study population characteristics are summarized in Table 1.

Only 65.8% of the mothers consented to their children receiving the HPV vaccine (54.3% and 98.8% among Jewish and Arab mothers, respectively;  $p = .000$ ), compared to 96.2% who consented to other routine childhood vaccinations (95.3% and 98.8% among Jewish and Arab mothers, respectively;  $p = .197$ ).

## Knowledge about and attitudes towards the HPV vaccine

Of all the participants, 254 mothers (81.2%) were aware of HPV, and 263 (84.0%) were aware of the HPV vaccine. The majority of Jewish mothers (81.2%) were aware of the virus compared to 37% of the Arab mothers ( $p = .000$ ). All Jewish mothers were aware of the vaccine compared to 38.3% of the Arab mothers ( $p = .000$ ).

The mean knowledge level score for the study population was 3.96 points (out of 10)  $\pm$  2.68 (4.64  $\pm$  2.22 and 1.99  $\pm$  2.92

**Table 1.** Study population characteristics.

Categorical characteristics	n (%)
Nationality	
Jewish	232 (74.1)
Arab	81 (25.9)
Religious observance	
Secular	130 (41.5)
Observant	103 (32.9)
Religious	80 (25.6)
Education level	
≤ 10 years	22 (7.0)
10–11 years	103 (32.9)
>12 years without academic degree	71 (22.7)
Academic degree	117 (37.4)
Place of residence	
Urban	202 (64.5)
Rural	111 (35.5)
Gender (of the adolescent)	
Male	153 (48.9)
Female	160 (51.1)
Continuous characteristics	Mean (± SD)
Age (years)	42.9 (±4.8)

among Jewish and Arab mothers, respectively;  $p = .000$ ). The mean attitude score was  $11.2$  (out of  $18$ )  $\pm 5.01$  ( $10.52 \pm 5.04$  and  $13.17 \pm 3.22$  among Jewish and Arab mothers, respectively;  $p = .000$ ). The frequencies of responses to the knowledge and attitude statements among the participants are presented in Table 2.

Less than half of the mothers agreed with the statement that the vaccine is safe. Among Jewish mothers, 37.1% agreed with this statement, compared with 77.8% among Arab

**Table 2.** Knowledge and attitudes toward HPV vaccine.

Questions exploring knowledge	Correct answer, n (%)		
Is HPV transmitted by sexual contact?	194 (62.0)		
Can HPV cause cervical cancer?	231 (73.8)		
Can HPV cause genital warts?	111 (35.5)		
Can HPV cause oropharyngeal cancer?	60 (19.2)		
Can HPV cause anal cancer?	56 (17.9)		
Can HPV cause bladder cancer?	25 (8.0)		
Is the HPV vaccine recommended to prevent cervical cancer in the future?	236 (75.4)		
Is the HPV vaccine recommended to prevent several types of cancer in the future?	51 (16.3)		
Is the HPV vaccine recommended to prevent genital warts?	88 (28.1)		
Who is given the HPV vaccine in 8th grade: boys/girls/both?	186 (59.4)		
Attitude statements	Agree n (%)	Disagree n (%)	Neutral n (%)
The HPV vaccine is an effective vaccine	194 (62.0)	96 (30.7)	23 (7.3)
The HPV vaccine is a safe vaccine	149 (47.6)	98 (31.3)	66 (21.1)
You are concerned about the side effects of the HPV vaccine	178 (56.9)	20 (6.4)	115 (36.7)
Your son/daughter is too young to get the vaccine	118 (37.7)	59 (18.8)	136 (43.5)
It is important that your son/daughter receive the HPV vaccine	196 (62.6)	47 (15.0)	70 (22.4)
You rely on the Ministry of Health statements regarding the vaccine's effectiveness	213 (68.1)	44 (14.1)	56 (17.9)
You rely on the Ministry of Health statements regarding the safety of the vaccine	175 (55.9)	57 (18.2)	81 (25.9)
Your son/daughter may be infected with HPV at some point	149 (47.6)	79 (25.2)	85 (27.2)
Your child may suffer from HPV-related diseases at some point	137 (43.8)	85 (27.2)	91 (29.1)

mothers ( $p = .000$ ). The level of trust in the Ministry of Health's statements regarding the effectiveness of the vaccine and its safety among all mothers (Jewish and Arab) was relatively low (68.1% and 55.9%, respectively). More Arab than Jewish mothers agreed with the statement that they rely on the Ministry of Health statements regarding the effectiveness of the vaccine (87.7% and 61.2%, respectively;  $p = .000$ ) and its safety (80.2% and 47.4%, respectively;  $p = .000$ ).

The factors that were found to be significantly associated with the knowledge level according to the bivariate analysis were nationality, religiosity, education level and age (Table 3). No correlation was found between knowledge levels and attitudes. According to the linear regression model, the socio-demographic variables that remained positively predictive of the knowledge level were Jewish nationality, being secular in religious practice and a higher education level (Table 3).

The bi-variate analysis for characterizing factors associated with the attitude score demonstrated only a significant association with nationality; the mean attitude score among Arab mothers was higher than among Jewish mothers ( $13.17 \pm 3.22$  and  $10.52 \pm 5.04$ , respectively;  $p = .000$ ) (Table 4). Accordingly, no further multivariate analyses were performed.

### Factors associated with the mothers' consent to the HPV vaccine

Results of the bi-variate analysis and of the multivariate logistic regression model are presented in Table 5. The three factors that remained, significantly associated to the mothers' consent to the HPV vaccine using the logistic regression model were the knowledge level, which was negatively associated with the mother's consent to the vaccine (OR = 0.82,  $p = .036$ , 95%CI 0.68–0.98); the attitude level, which was positively associated with the mother's consent to the vaccine (OR = 1.76,  $p = .000$ , 95%CI 1.53–2.02), and Arab vs. Jewish nationality (OR = 27.86,  $p = .002$ , 95%CI 3.41–227.56).

### Discussion

This study found a consent rate to the HPV vaccine of 65.8% (54.3% among Jewish mothers and 98.8% among Arab mothers). The rates obtained in our study are consistent with the actual rates of HPV vaccine receipt in Jewish schools (excluding ultra-orthodox schools) and Arab schools in Haifa and the northern districts of Israel during the school year of 2016–17.<sup>6</sup>

The low knowledge level regarding the HPV vaccine is surprising. Although the vaccine has been used in Israel for almost a decade and has been part of the routine childhood immunization program for over four years, a significant proportion of the participants were unaware of HPV and the HPV vaccine. This was more noticeable among Arab women. The knowledge gap between Arab and Jewish mothers was also observed in the results of the linear regression model, which demonstrated a significant positive association between a higher knowledge level and Jewish nationality, higher education, and secularism. These findings raise questions about the reasons for the existence of such gaps and the responsibility of public health personnel in

**Table 3.** Factors associated with the knowledge level regarding HPV vaccine.

a. Bi-variate analysis					
Categorical independent variables	Knowledge score mean ( $\pm$ SD)	95% CI for mean	F	df	P
Nationality			72.52	311	0.000
Jewish	4.64( $\pm$ 2.22)	4.36–4.93			
Arab	1.99( $\pm$ 2.92)	1.34–2.63			
Religious observance			13.19	310	0.000
Secular	4.81( $\pm$ 2.53)	4.37–5.25			
Observant	3.59( $\pm$ 2.68)	3.07–4.12			
Religious	3.04( $\pm$ 2.53)	2.47–3.60			
Education level			12.78	309	0.000
$\leq$ 10 years	1.82( $\pm$ 2.36)	0.77–2.87			
10–11 years	3.76( $\pm$ 2.38)	3.29–4.22			
>12 years without academic degree	3.30( $\pm$ 2.57)	2.69–3.90			
Academic degree	4.93( $\pm$ 2.68)	4.44–5.42			
Place of residence			1.31	311	0.253
Urban	3.83( $\pm$ 2.61)	3.46–4.19			
Rural	4.19( $\pm$ 2.78)	3.66–4.71			
Gender (of the adolescent)			0.006	311	0.938
Male	3.97( $\pm$ 2.89)	3.50–4.43			
Female	3.94( $\pm$ 2.46)	3.66–4.71			
Continuous independent variables					
	Pearson's r				P
Age	0.188				0.001
Attitudes	0.063				0.263
b. Results of the linear regression model					
Independent Variables	B	95% CI for B	$\beta$	t	P
(constant)	5.41	2.57–8.26	0.09	3.75	0.000
Age	0.05	–0.01–0.12	0.09	1.73	0.086
Nationality*	–2.03	–2.70– –1.35	–0.34	–5.90	<b>0.000</b>
Religious observance **					
Observant	–0.39	–1.05– –0.26	–0.07	–1.18	0.240
Religious	–1.07	–1.76– –0.37	–0.18	–3.02	<b>0.003</b>
Education***					
$\leq$ 10 years	–1.84	–2.97– –0.72	–0.18	–3.23	<b>0.001</b>
10–11 years	–0.77	–1.42– –0.11	–0.13	–2.30	<b>0.022</b>
>12 years without academic degree	–1.26	–1.96– –0.57	–0.20	–3.57	<b>0.000</b>

\*Arab vs. Jewish

\*\*Dummy variable. Reference category – secular

\*\*\* Dummy variable. Reference category – academic degree

**Table 4.** Bi-variate analysis to identify factors associated with the attitudes towards HPV vaccine.

Categorical Independent variables	Attitude score mean( $\pm$ SD)	95%CI for mean	F	df	P
Nationality			10.35	311	0.000
Jewish	10.52( $\pm$ 5.04)	9.87–11.17			
Arab	13.17( $\pm$ 3.22)	12.46–13.88			
Religious observance			2.10	310	0.125
Secular	10.83( $\pm$ 5.18)	9.83–11.73			
Observant	12.01( $\pm$ 4.42)	11.15–12.87			
Religious	10.85( $\pm$ 4.45)	9.86–11.84			
Education level			1.57	309	0.197
$\leq$ 10 years	12.68( $\pm$ 3.93)	10.94–14.43			
10–11 years	11.67( $\pm$ 4.42)	10.81–12.53			
>12 years without academic degree	11.06( $\pm$ 4.97)	9.88–12.53			
Academic degree	10.66( $\pm$ 5.05)	9.73–11.58			
Place of residence			3.27	311	0.071
Urban	11.58( $\pm$ 4.84)	10.91–12.25			
Rural	10.57( $\pm$ 4.61)	9.70–11.43			
Gender (of the adolescent)			2.22	311	0.137
Male	11.63( $\pm$ 4.69)	10.88–12.38			
Female	10.83( $\pm$ 4.83)	10.08–11.59			
Continuous independent variables					
	Pearson's r				P
Age	–0.071				0.223
Knowledge	0.063				0.263

general and School Health Services in particular, regarding improving public awareness and knowledge of the HPV vaccine, and reducing the knowledge gap between the different social sectors. The basis of any medical service, including

vaccinations, is founded upon providing information and making it accessible to the target audience, regardless of the association between the knowledge level and consent to the vaccine.

**Table 5.** Factors associated with the mothers' consent to the HPV vaccine.

a. Bi-variate analysis						
Continuous independent variables	Consent to HPV vaccine Mean ( $\pm$ SD)	Refusal to HPV vaccine Mean( $\pm$ SD)	<i>df</i>	<i>F</i>	<i>P</i>	
Knowledge level	3.70( $\pm$ 2.91)	4.44( $\pm$ 2.10)	311	5.39	<b>0.021</b>	
Attitudes	13.67( $\pm$ 3.25)	6.51( $\pm$ 3.56)	311	319	0.000	
Age, years	42.72( $\pm$ 4.95)	43.40( $\pm$ 4.33)	296	1.39	0.240	
Categorical independent variables			OR	95% CI	<i>P</i>	
Place of residence			0.83	0.51–1.35	0.457	
Gender			1.21	0.77–1.93	0.475	
Nationality*			67.30	9.21–491.87	0.000	
Religious observance			-	-	0.008	
Education level			-	-	0.104	
The receipt of other routine childhood vaccinations			10.52	2.26–48.92	0.001	
The adolescent's willingness to receive the HPV vaccine			-	-	0.000	
b. Results of the multivariate logistic regression model						
Independent variables			OR	95% CI	<i>P</i>	
Knowledge level			0.82	0.68–0.98	<b>0.036</b>	
Attitudes			1.76	1.53–2.02	<b>0.000</b>	
The receipt of other routine childhood vaccinations			12.61	0.58–272.57	0.106	
The adolescent's willingness to receive the HPV vaccine			1.09	0.84–1.42	0.506	
Nationality*			27.86	3.41–227.56	<b>0.002</b>	
Religious observance			1.18	0.74–1.96	0.460	

\*Arab vs. Jew

The mean attitude score towards the HPV vaccine was not high (11.22 [out of 18 points]  $\pm$  5.01).

While only 37.1% of Jewish mothers agreed with the statement that the vaccine was safe and 47.4% said that they rely on the Ministry of Health's statements regarding the safety of the vaccine, 77.8% and 80.2%, respectively, of Arab mothers agreed with both these statements. It seems that the high level of trust in the Ministry of Health among Arabs in general has led to a higher level of trust in the safety of the HPV vaccine in particular. It is important to note that the skepticism regarding the safety of the HPV vaccine among the mothers is contrary to the ongoing scientific evidence of its high safety level.<sup>9</sup>

Communicating the high safety profile of the vaccine poses a challenge for public health services. There is a need to develop a suitable, appropriate program that is able to penetrate the target audience and to convince the public of the advantages of the vaccine.

Interestingly, "nationality" was the only socio-demographic variable that was significantly associated with the attitude score. This difference between Arabs and Jews is not entirely understood. Our hypothesis is that the more positive attitude of Arab mothers toward the HPV vaccination program and their resistance to the negative messages distributed around the vaccine is apparently due to less exposure to the "vaccine opponents" compared with Jewish mothers, less exposure to different media channels and social media, and a higher level of trust in the recommendations of the Ministry of Health. Further research is needed to examine the reasons for these differences between the two sectors.

The factors that were significantly and independently associated with the mothers' consent to the HPV vaccine were the attitude score, knowledge level and nationality. The positive association between positive attitudes and consent to the HPV vaccine was expected and has been demonstrated in previous studies.<sup>10,11</sup> However, a surprising finding was the negative association between the higher knowledge level about the

HPV vaccine and the mothers' consent to the vaccine. This is contrary to the findings of previous studies, some of which indicated a positive association between the knowledge level and HPV vaccine uptake,<sup>10,12,13</sup> and others that did not.<sup>14,15</sup> A recent study about ethnic and racial disparities in HPV vaccination in the United States found that any level of HPV knowledge among the Afro-American population decreased their willingness to vaccinate when compared with those who had no knowledge.<sup>16</sup> Furthermore, according to another recent study about the factors associated with HPV vaccination across the United States, United Kingdom and Australia, it was found that the correlation between HPV knowledge level and HPV vaccination status was non-linear; parents with very low and very high knowledge scores were less likely to vaccinate their daughters.<sup>17</sup>

It is possible that this discrepancy found in the current study between a higher level of knowledge and the probability of consent to the HPV vaccine is related to the "learning" process about the vaccine, meaning that those mothers with higher levels of knowledge were exposed to more information about the vaccine, which in part could have been unreliable thus generating opposition to the vaccine. This issue was not examined in the present study.

The third factor found to be strongly associated with the mothers' consent to the HPV vaccine was "nationality". This finding is in line with other previous studies which found ethnic differences in the HPV vaccine uptake rates,<sup>16,18,19</sup> Coverage rates of routine childhood immunizations in Israel are higher by about 3% among Arabs than among Jews, but in the context of the HPV vaccine, this difference was even more pronounced and exceeded 40%.<sup>6</sup> Compared with Jewish parents, Arab parents across the board tend to adopt the recommendations of the Ministry of Health in the context of routine immunizations. Despite this, it is important to carefully interpret this finding because this study was conducted only in the Haifa and northern districts of Israel. According to the Ministry of Health reports, since its inclusion in the routine

vaccination program the HPV vaccine coverage rates among Arab 8th graders in the Haifa and northern districts were above 90%. This picture is very different among Arabs in East Jerusalem and among Bedouin in the south of Israel, where the HPV vaccine coverage rates are very low.<sup>6</sup> The reasons for these differences within Arab society in Israel are not fully understood and to the best of our knowledge have not yet been evaluated.

Several studies found an association between religiosity and parents' intention to vaccinate their children against HPV.<sup>20,21</sup> However, the association between religiosity levels and the consent to HPV vaccine receipt was not demonstrated in our study, although it is known that the HPV vaccine coverage rates in the Jewish secular schools in Israel are higher than in the Jewish religious schools.<sup>6</sup> Apparently, this association was not demonstrated in the current study, since 25% of the study population were Arab mothers, most of whom were religious or observant, and those, like the secular Arab mothers, consented to the vaccine. In addition, it should be remembered that the definition of religious observance is different between Arabs and Jews, and therefore this constitutes an additional limitation in interpreting our results.

To the best of our knowledge, this is the first study to evaluate the level of knowledge, attitudes, and factors associated with parental consent to HPV vaccine receipt in 8th graders in Israel since inclusion of the vaccine into the routine vaccination program for both boys and girls.

The study has some limitations: 1. Since it is a cross-sectional study, the temporal relationship between the mothers' consent to the HPV vaccine and the independent variables (mainly knowledge level and the attitudes) cannot be assessed, and therefore causality cannot be concluded. 2. The information on consent to the HPV vaccine and other routine vaccinations was collected on the basis of maternal statements. However, these were consistent with the actual vaccine coverage rates according to Ministry of Health reports, and support the validity of the mothers' statements in this context. 3. The questionnaire did not include questions about the sexual behavior among adolescents and any possible effect of the HPV vaccine receipt on such behavior. This point may have a potential impact on the mothers' consent to the HPV vaccine. Such questions were not included in the questionnaire since they were not considered to be culturally appropriate for all the study population and could have produced inadequate telephone response rates. 4. The study was conducted in only 2 of the 6 districts in Israel. Nevertheless, the population in these areas is sufficiently diverse and includes most of the subgroups of Israeli society. In addition, the study was designed so that the representation of the Jewish and Arab sectors would be proportional to that of the general population enabling the results to be applied to the majority of Israelis. 5. The study did not include mothers of children from ultra-orthodox schools, and therefore it is not possible to draw conclusions about this subsection of the population. 6. The small sample size limited us from conducting more powerful statistical analyses related to the study subgroups.

In conclusion, there is a need to improve the knowledge level about the HPV vaccine and to reduce gaps in this context between the various population groups in Israel. This process should be part of a unique program that corrects

misconceptions about the HPV vaccine, highlights its benefits and safety, which in turn could improve attitudes towards the vaccine and ultimately increase its acceptance rate. The emphasis of these programs should be adapted to the sector in which they are implemented, namely, on improving the level of knowledge and awareness of the HPV vaccine among Arab parents, while placing an emphasis on improving the attitude of Jewish parents toward the vaccine.

## Methods

### Study design

A cross-sectional study was conducted among mothers of 8th graders in Jewish and Arab schools in Haifa and Northern districts of Israel, during the school year beginning September 2016 through June 2017. Twenty-seven junior high schools (14 Jewish secular, 6 Jewish religious and 7 Arab schools) were recruited for the study. Ultra-orthodox Jewish (Haredi) schools were excluded from the study. The schools were selected by a multi-stage cluster-sampling process in order to enable representation of each sector according to its proportion in the general Israeli population. One 8th grade class was selected randomly from each school. Phone numbers of households were obtained through the School Health Services ( $n = 736$ ). Mothers were contacted (by telephone) after the first dose of the HPV vaccine had been offered to their child. Mothers who answered the phone call (after a maximum of 3 attempts) received an explanation about the study and were invited to participate in the survey ( $n = 341$ ).

### Data collection and variable definitions

Data were collected using a telephone questionnaire with close-ended questions. The questionnaire was developed by a research team based on literature reviews and other questions that were developed according to the study aims. Four experts in the field were asked to evaluate whether the questionnaire adequately and sufficiently assessed the study domain of interest. They agreed that it was a valid measurement tool (content and consensual validity). A pre-test of the questionnaire was performed among 15 mothers to ensure comprehension and feasibility. Adjustments were made accordingly. Cronbach's alpha coefficients were calculated for the knowledge level and attitude scales (0.82 and 0.83, respectively) and indicated a good internal consistency. The questionnaire included 32 questions regarding the different study variables:

1. Socio-demographic and professional characteristics (8 questions).
2. Awareness of HPV and the HPV vaccine (2 "yes/no" questions).
3. Knowledge level about the HPV vaccine: a score was calculated based on responses to 10 questions addressing the mode of HPV transmission, HPV-related diseases and the HPV vaccine recommendations (response categories: yes/no/do not know) (Table 2). Each correct

answer was counted as a single point (score range, 0–10).

4. Attitudes towards the HPV vaccine: a score was calculated based on responses to 9 statements on a 3-point Likert scale assessing the mothers' attitudes toward the HPV vaccine safety and its effectiveness, the adolescent's risk to get infected with HPV and to suffer from HPV-related diseases, the recommended age for getting the vaccine and the importance of its receipt (response categories: agree/neutral/disagree) (Table 2). A higher score expressed a more positive attitude towards the HPV vaccine (score range, 0–18).

Mothers who were not aware of HPV or the HPV vaccine received brief information about the virus and the vaccine and were asked to respond to the attitude items.

5. The mother's consent to the HPV vaccine (1 yes/no question).
6. The receipt of routine childhood vaccinations (other than the HPV vaccine). This was examined according to the mother's statement (response categories: the child either received all other recommended vaccines or did not receive all of them due to parental refusal) (1 question).
7. The adolescent's willingness to receive the HPV vaccine. This was examined according to the mother's statement (response categories: the adolescent wanted to receive the vaccine, did not want to receive the vaccine, he/she was neutral towards its receipt or did not know) (1 question).

The telephone questionnaires were conducted during March through May, 2017.

### Statistical analysis

Statistical analysis was conducted using SPSS software (version 23). To examine whether the mean scores of the knowledge level and attitudes were associated with the participants' categorical characteristics, a one-way analysis of variables (ANOVA) was performed. A Pearson's correlation was conducted to examine the association between knowledge levels and attitudes, as well as between each of them and the participants' continuous characteristics.

To identify the variables independently associated with the knowledge level and attitude scores, we conducted a linear regression analysis.

To determine the association between the variable: "the mothers' consent to the HPV vaccine" and knowledge level, attitude score and the continuous participants' characteristics, a Pearson's correlation was conducted. To determine its association with the categorical participants' characteristics and the categorical characteristics: "the receipt of other routine childhood vaccinations" and "the adolescent's willingness to receive the HPV vaccine", a chi-square test ( $\chi^2$ ) was performed.

To identify the factors independently associated with the variable: "the mothers' consent to the HPV vaccine", we conducted a logistic regression model.

Variables that were included in each of the regression models were those that had significant associations with the dependent variables in the bi-variate tests.

At the stage of processing the data in order to characterize the factors associated to the mothers' consent to the HPV vaccine, the attitude score of mothers who were not aware of the HPV vaccine or the virus was defined in SPSS as a missing value. These values were treated by using the regression imputation technique.

Results were considered significant at  $p < .05$  or when the 95% CI did not include 1.0.

### Ethical considerations

The study was approved by the Ethics Committee of the University of Haifa, and received approvals from the Directors of the Institutions in which the study was conducted.

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### Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

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