Factors affecting human papillomavirus vaccine acceptance among parents of Primary 4 to 6 boys and girls in Hong Kong

Jody KP Chu *, CW Sing, Y Li, Patrick H Wong, Eric YT So, Ian CK Wong

ABSTRACT

Introduction: Human papillomavirus (HPV) poses a substantial but underestimated healthcare burden in Hong Kong. This study investigated factors affecting parental acceptance of HPV vaccination after the introduction of an immunisation programme for primary school girls. We assessed parental perceptions and related factors concerning HPV vaccination for both boys and girls.

Methods: We conducted a cross-sectional survey between December 2021 and February 2022 among parents of Primary 4 to 6 students in Hong Kong. Our self-administered online survey collected data regarding socio-demographic characteristics, awareness and knowledge of HPV vaccination, attitudes towards HPV vaccination, and acceptance of HPV vaccination. Characteristics were compared between boys' parents and girls' parents. Factors associated with vaccine acceptance were analysed by multivariate logistic regression.

Results: We observed high awareness of HPV vaccination among boys' parents and girls' parents; however, they demonstrated relatively poor knowledge of HPV and the HPV vaccine. An alarming low HPV vaccination uptake rate was also observed. Attitudes towards the HPV vaccine were similar between parent groups. A majority of parents believed that the HPV vaccine was safe and effective in preventing infection. Parents of boys showed lower HPV vaccine acceptance. Factors associated with acceptance differed between parent groups.

Conclusion: High awareness of HPV and HPV vaccine is predictive of vaccine acceptance. Boys' parents are less likely to accept HPV vaccination and emphasis should be placed on addressing potential HPV vaccine hesitancy in this group. Public education should also aim to raise awareness of government vaccination programme, and implementation of catch-up vaccination programme to school children beyond primary school should be considered.

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[1] **JKP Chu ***, MClinPharm
[1] **CW Sing**, PhD
[1] **Y Li**, BPharm
[2] **PH Wong**, BSc
[2] **EYT So**, MPH
[1,3] **ICK Wong**, PhD

[1] *Department of Pharmacology and Pharmacy, Li Ka Shing Faculty of Medicine, The University of Hong Kong, Hong Kong SAR, China*
[2] *Merck Sharp and Dohme (Asia) Ltd, Hong Kong SAR, China*
[3] *Research Department of Practice and Policy, School of Pharmacy, University College London, London, United Kingdom*

* Corresponding author: chukpj@hku.hk

New knowledge added by this study

- Awareness of human papillomavirus (HPV) was similar between parents of boys and parents of girls (P=0.346); 81.4% of boys' parents and 78.5% of girls' parents had heard of HPV.
- Overall, attitudes towards HPV and the HPV vaccine were similar between parents of boys and parents of girls.
- High acceptance of their child receiving the HPV vaccine in both parents of boys and girls was observed; parents of girls were more likely to accept the vaccine, compared with parents of boys (89.7% vs 73.8%; P<0.001).

Implications for clinical practice or policy

- The awareness of the HPV vaccination programme among girls' parents is low, echoing the problem of insufficient information provision concerning HPV vaccination, especially during the coronavirus disease 2019 pandemic.
- To prevent future healthcare burdens caused by immunisation gaps, catch-up vaccination services for affected children should be considered and implemented as soon as possible.

Introduction

Human papillomavirus (HPV) is a common sexually transmitted infection that constitutes a substantial global healthcare burden. It is associated with genital warts and various cancers (eg, cervical, penile, anal, oropharyngeal, and head and neck cancers). Human papillomavirus causes 4.5% (630 000) of all new cancer cases worldwide.[1]

In Hong Kong, cervical cancer is the ninth most common cancer, with a crude incidence of 12.9

per 100 000 women and girls.[2,3] There are limited data regarding HPV infection or HPV-associated cancers in men and boys. A local study estimated that the incidence of genital warts in Hong Kong was 203.7 per 100 000 person-years. Men and boys had a higher incidence compared with women and girls (292.2 per 100 000 person-years vs 124.9 per 100 000 person-years, respectively), suggesting a similar or possibly higher prevalence of HPV infection in men and boys.[4]

Human papillomavirus vaccination is a highly effective preventive measure against HPV infection and its complications. National HPV vaccination programmes targeting adolescent girls have significantly reduced the incidences of HPV-associated diseases.[5] The World Health Organization recommends including HPV vaccination in routine programmes for girls aged 9 to 14 years, with possible extension to boys if feasible.[6]

Universal HPV vaccination programmes, covering both adolescent boys and adolescent girls, have become increasingly common in recent years, particularly in developed countries such as the United States, Canada, Australia, and 20 European nations. Female-only vaccination programmes with high vaccine coverage rates have demonstrated substantial public health impact concerning several HPV-related diseases and cancers.[7] Gender-neutral vaccination programmes, targeting both boys and girls, have shown greater resilience[8] and faster elimination of cervical cancer[9]; they also provide direct protection to reduce disease burden in all men and in subpopulations of men (eg, men who have sex with men and men who have sex abroad).[10-12] The achievement of an 80% vaccination rate in both sexes is expected to enable the elimination of HPV subtypes 6, 11, 16, and 18.[13]

Despite the benefits of a high vaccination rate, the current rate of HPV vaccine is much lower than desired. In Hong Kong, the rate of vaccine uptake reportedly ranged from 2.2% to 7.2% in adolescent girls and 0.6% in adolescent boys before the HPV vaccine was incorporated into the Hong Kong Childhood Immunisation Programme (HKCIP).[14-16] The 9-valent HPV vaccine was introduced into the Programme for Primary 5 and 6 girls, with a reported first-dose uptake rate of 85% among Primary 5 girls in 2020.[17] However, vaccination rates are expected to remain low among adolescent boys.

Prior to the inclusion of HPV vaccination in the HKCIP, few local studies explored parental decision-making[14-16,18]; those that did primarily focused on girls, with limited examination of factors influencing vaccine acceptance or uptake. One survey did include parents of adolescent boys but was hindered by its small sample size (162 boys' parents).[14] Considering the recent implementation of the HPV vaccination programme for primary school girls and the lack of sufficient data concerning HPV vaccination in Hong Kong, further local research is warranted. An understanding of parental acceptance, particularly for boys, can inform strategies to improve vaccine uptake.

This study aimed to identify factors affecting HPV vaccination acceptance among Hong Kong parents of Primary 4 to 6 students. It compared the knowledge, attitudes, and acceptance between girls' parents and boys' parents, then explored the underlying reasons for their vaccination decisions.

影響香港家長對小四至小六男女生接受人類乳頭瘤病毒疫苗接種的因素

朱幗珮、成楚頴、李羽舟、黃河、蘇耀庭、黃志基

引言：人類乳頭瘤病毒（HPV）為香港造成沉重的醫療負擔，但其影響一直被低估。本研究探討推出小學女生HPV疫苗接種計劃後影響家長接受子女接種HPV疫苗的因素。我們評估了家長對男女生接種HPV疫苗的看法及相關因素。

方法：我們在2021年12月至2022年2月期間對香港小四至小六學生的家長進行橫斷面調查，以網上問卷調查形式收集了社會人口統計學特徵、對HPV疫苗的認知和知識、對子女接種HPV疫苗的態度及接受HPV疫苗接種的意願的數據。我們比較男生家長和女生家長的特徵，並使用多變項迴歸分析影響疫苗接種意願的因素。

結果：我們發現男生家長和女生家長對HPV疫苗都有很高的認知度，但對HPV及HPV疫苗的知識相對貧乏。我們還觀察到家長報告十分低的HPV疫苗接種率。兩組家長對HPV疫苗的態度類似；大多數家長認為HPV疫苗是安全及有效預防感染。男生家長對接種HPV疫苗的意願較低。影響疫苗接種意願的因素在男女家長之間有所不同。

結論：家長對HPV及HPV疫苗有較高認知有助預測他們較會接受疫苗接種。相比女童家長，男童家長較不願意讓兒子接種HPV疫苗，因此應著重解決這組別對HPV疫苗的猶豫態度，亦應加強公眾教育以提高公眾對政府疫苗接種計劃的認知，並考慮為小學以上年級的學生追加HPV疫苗補種計劃。

Methods

Study design

This cross-sectional survey was conducted from December 2021 to February 2022. Invitation letters were sent to 554 primary schools in Hong Kong, including public local schools, private local schools, and Direct Subsidy Scheme schools. In total, 65 schools agreed to participate. After consent had been obtained from participating schools, parents of Primary 4 to 6 students at those schools received a self-administered online survey through the Qualtrics platform.

Measures

The survey was divided into four sections, namely, (1) socio-demographic characteristics, (2) awareness

and knowledge regarding HPV and HPV vaccination, (3) attitudes towards HPV vaccination, and (4) acceptance of HPV vaccination. The questionnaires were available in both English and Chinese (online supplementary Appendices 1 and 2, respectively). A detailed description of the survey sections is provided in online supplementary Appendix 3. Upon completion of the online survey, the results were stored in the Qualtrics platform for further analysis.

Data analysis

Human papillomavirus vaccination attitudes were measured using a five-point Likert scale. Two statements (Questions 41 and 42) with strong internal consistency (Cronbach's alpha=0.81) were combined to form the variable 'Worried about HPV infection', and the mean score of the two statements was used for analysis. Similarly, two other statements (Questions 46 and 47) with strong internal consistency (Cronbach's alpha=0.91) were merged into the variable 'Worried that HPV vaccine might negatively impact child's sexual activity'.

Descriptive statistics were used to characterise the participants and study variables. The first analysis compared the knowledge, attitudes, and acceptance of the HPV vaccine between boys' parents and girls' parents. Significant differences between groups were identified using the Chi squared test for nominal variables, the *t* test for continuous variables, and the Mann-Whitney *U* test for ordinal variables (age-group, household income, and education level). In the second analysis, we investigated factors associated with the acceptance of HPV vaccination for children. Participants whose children had already received HPV vaccination were excluded from the analysis due to missing values in some variables (Questions 49 to 51). Univariate logistic regression was used to estimate the crude odds ratio (OR) and 95% confidence interval (CI). The study variables were included as independent predictors; the acceptance of HPV vaccination for children was regarded as a binary dependent variable ('Yes' or 'No'). Variables with P values <0.1 were entered into multivariate logistic regression. P values <0.05 were considered statistically significant.

Because free HPV vaccination was only provided for primary school girls in Hong Kong, we assumed that factors affecting the acceptance of HPV vaccination for their child varied between boys' parents and girls' parents. Consequently, the second analysis was conducted separately for each parent group.

All analyses were conducted using R software (version 4.1.1).

Results

In total, 844 participants completed the survey. Of these, 43.8% were parents of boys and 56.2% were parents of girls. The socio-demographic characteristics of the parents are presented in Table 1.

Vaccine uptake rate

The HPV vaccine uptake rate is low with boys' parents reported 6.8% and girls' parents reported 4.9%. Among children who have received HPV vaccine, >90% of parents in both groups reported that their children received the HPV vaccine through the HKCIP (Table 1).

Awareness and knowledge of human papillomavirus and the vaccine among parents

Awareness of HPV was similar between boys' parents and girls' parents (81.4% vs 78.5%; P=0.346). Knowledge scores regarding HPV and the HPV vaccine were low in both parent groups; parents of boys had higher mean scores compared with parents of girls (6.48 vs 6.03; P=0.012). More boys' parents discussed sexually transmitted disease (STDs) with their children, relative to girls' parents (33.0% vs 15.2%; P<0.001) [Table 2].

Attitudes towards the vaccine in parents

Two questions addressed the timing of vaccination, namely: 'At what age should a child receive the HPV vaccine?', and the yes/no statement 'I believe it's better for my child to receive the HPV vaccine before they become sexually active'. A majority of parents, both of boys (83.6%) and of girls (85.9%), believed that their children should receive the HPV vaccine at age ≥13 years. Additionally, more parents of boys (55.7%) believed that their children should receive the HPV vaccine before becoming sexually active; more parents of girls (51.1%) reported a neutral perspective on this statement. Regarding HPV infection and HPV vaccine effectiveness, parents in both groups were worried about HPV infection (mean±standard deviation [SD] out of 5: 3.56±0.74 in boys' parents; 3.48±0.76 in girls' parents). Over 70% in parents of both groups believe that their children cannot be protected from HPV without HPV vaccination, furthermore a majority of parents in both groups also believe in the vaccine's effectiveness (90.2% in boys' parents and 84.6% in girls' parents) [Table 2].

Concerning vaccine safety, impacts, and cost, most parents of boys (90.8%) and parents of girls (84.8%) agreed that the HPV vaccine is safe. They had a neutral perspective or were less worried about the vaccine's short-term (62.5% and 67.6%, respectively) and long-term side-effects (80.5% and 82.3%, respectively) [Table 2].

TABLE 1. Socio-demographic characteristics of parents of boys and girls (n=844)*

	Parents of boys (n=370)	Parents of girls (n=474)	P value§
Sex			0.002
Male	149 (40.3%)	142 (30.0%)	
Female	221 (59.7%)	332 (70.0%)	
Age-group, y			0.003
≤30	3 (0.8%)	5 (1.1%)	
31-35	37 (10.0%)	33 (7.0%)	
36-40	228 (61.6%)	366 (77.2%)	
41-45	96 (25.9%)	68 (14.3%)	
>45	6 (1.6%)	2 (0.4%)	
Marital status			0.207
Married	352 (95.1%)	460 (97.0%)	
Single/separated/divorced/widowed	18 (4.9%)	14 (3.0%)	
Highest education level completed			0.030
Secondary school or below	97 (26.2%)	81 (17.1%)	
Bachelor's degree/non-degree tertiary education	255 (68.9%)	384 (81.0%)	
Master's/PhD	18 (4.9%)	9 (1.9%)	
Monthly household income, HKD			0.005
<20 000	12 (3.2%)	20 (4.2%)	
20 000-39 999	164 (44.3%)	244 (51.5%)	
40 000-59 999	156 (42.2%)	185 (39.0%)	
>60 000	38 (10.3%)	25 (5.3%)	
Occupation			0.182
Architecture and engineering	29 (7.8%)	24 (5.1%)	
Arts and entertainment	22 (5.9%)	28 (5.9%)	
Business administration and management	55 (14.9%)	55 (11.6%)	
Communications	43 (11.6%)	55 (11.6%)	
Community and social services	25 (6.8%)	42 (8.9%)	
Education	32 (8.6%)	34 (7.2%)	
Science and technology	23 (6.2%)	34 (7.2%)	
Installation repair and maintenance	24 (6.5%)	33 (7.0%)	
Farming fishing and forestry	22 (5.9%)	17 (3.6%)	
Government	26 (7.0%)	50 (10.5%)	
Health and medicine	20 (5.4%)	20 (4.2%)	
Law and public policy	17 (4.6%)	21 (4.4%)	
Sales	22 (5.9%)	33 (7.0%)	
Others	10 (2.7%)	28 (5.9%)	
No. of child(ren) in Primary 4 to Primary 6			0.527
1	243 (65.7%)	324 (68.4%)	
2	104 (28.1%)	128 (27.0%)	
≥3	23 (6.2%)	22 (4.6%)	

Abbreviations: HKCIP = Hong Kong Childhood Immunisation Programme; HKD = Hong Kong dollars; HPV = human papillomavirus; PhD = Doctor of Philosophy

* Data are shown as No. (%)

† Percentages were calculated among female participants

‡ Percentages were calculated among participants whose children had received the HPV vaccine

§ Significant differences between groups were identified using the Chi squared test for nominal variables and the Mann-Whitney *U* test for ordinal variables (age-group, household income, and education level)

TABLE 1. (cont'd)

	Parents of boys (n=370)	Parents of girls (n=474)	P value§
Receipt of regular seasonal influenza vaccines			<0.001
Yes	101 (27.3%)	71 (15.0%)	
No	226 (61.1%)	300 (63.3%)	
Not sure	43 (11.6%)	103 (21.7%)	
Receipt of HPV vaccine			<0.001
Yes	38 (10.3%)	23 (4.9%)	
No	269 (72.7%)	405 (85.4%)	
Not sure	63 (17.0%)	46 (9.7%)	
Completion of Pap smear†			<0.001
Yes	26 (11.8%)	12 (3.6%)	
No	141 (63.8%)	274 (82.5%)	
Not sure	54 (24.4%)	46 (13.9%)	
Child's school type			0.971
Public local	219 (59.2%)	276 (58.2%)	
Private	88 (23.8%)	115 (24.3%)	
Aided	54 (14.6%)	73 (15.4%)	
Direct Subsidy Scheme	9 (2.4%)	10 (2.1%)	
Child's current year of enrolment			0.744
Primary 4	105 (28.4%)	146 (30.8%)	
Primary 5	169 (45.7%)	208 (43.9%)	
Primary 6	96 (25.9%)	120 (25.3%)	
Child's receipt of any vaccine under the HKCIP			<0.001
Yes	115 (31.1%)	106 (22.4%)	
No	199 (53.8%)	322 (67.9%)	
Not sure	56 (15.1%)	46 (9.7%)	
Child's receipt of regular seasonal influenza vaccines			<0.001
Yes	149 (40.3%)	103 (21.7%)	
No	207 (55.9%)	338 (71.3%)	
Not sure	14 (3.8%)	33 (7.0%)	
Child's receipt of HPV vaccine			0.035
Yes	25 (6.8%)	23 (4.9%)	
No	314 (84.9%)	429 (90.5%)	
Not sure	31 (8.4%)	22 (4.6%)	
Child's receipt of HPV vaccine through the HKCIP‡			0.511
Yes	23 (92%)	21 (91.3%)	
No	2 (8%)	1 (4.3%)	
Not sure	0	1 (4.3%)	

Additionally, parents had a neutral perspective or were less worried about the vaccine's negative impacts or influence on adolescent development. However, most parents agreed that the HPV vaccine is too expensive (88.1% and 79.8%, respectively) [Table 2].

Vaccine acceptance in parents of boys and girls

We observed high acceptance of the HPV vaccine for their children in boys' parents (73.8%) and girls' parents (89.7%). If the HPV vaccine were subsidised under the HKCIP, acceptance in parents would slightly increase because the government would cover the cost (78.9% and 92.6%, respectively) [Table 2].

TABLE 2. Knowledge, attitudes, and acceptance of the human papillomavirus vaccine among parents of boys and girls*

	Parents of boys (n=370)	Parents of girls (n=474)	P value¶
Awareness and knowledge of HPV			
Heard of HPV vaccine			0.346
Yes	301 (81.4%)	372 (78.5%)	
No	69 (18.6%)	102 (21.5%)	
HPV knowledge score (maximum score=20)	6.48 (2.47)	6.03 (2.72)	0.012
Discussion with child regarding prevention of STDs†			<0.001
Yes	122 (33.0%)	72 (15.2%)	
No	204 (55.1%)	344 (72.6%)	
Not sure	44 (11.9%)	58 (12.2%)	
Attitudes towards HPV and HPV vaccine‡			
Age at which a child should receive the HPV vaccine, y			0.825
Never	9 (2.4%)	11 (2.3%)	
<9	2 (0.5%)	1 (0.2%)	
9-10	7 (1.9%)	6 (1.3%)	
11-12	43 (11.6%)	49 (10.3%)	
13-14	102 (27.6%)	117 (24.7%)	
15-16	94 (25.4%)	126 (26.6%)	
17-18	105 (28.4%)	155 (32.7%)	
>18	8 (2.2%)	9 (1.9%)	
I believe it's better for my child to receive the HPV vaccine before they become sexually active			<0.001
Strongly disagree	6 (1.6%)	15 (3.2%)	
Disagree	17 (4.6%)	24 (5.1%)	
Neutral	141 (38.1%)	242 (51.1%)	
Agree	191 (51.6%)	178 (37.6%)	
Strongly agree	15 (4.1%)	15 (3.2%)	
Worried about HPV infection§	3.56 (0.74)	3.48 (0.76)	0.126
I believe my child can be protected from HPV without HPV vaccination			0.842
Strongly disagree	1 (0.3%)	5 (1.1%)	
Disagree	271 (73.2%)	329 (69.4%)	
Neutral	46 (12.4%)	78 (16.5%)	
Agree	17 (4.6%)	17 (3.6%)	
Strongly agree	35 (9.5%)	45 (9.5%)	
I believe the HPV vaccine is effective in preventing HPV infection for my daughter/son			0.016
Strongly disagree	2 (0.5%)	1 (0.2%)	
Disagree	4 (1.1%)	17 (3.6%)	
Neutral	30 (8.1%)	55 (11.6%)	
Agree	288 (77.8%)	352 (74.3%)	
Strongly agree	46 (12.4%)	49 (10.3%)	

Abbreviations: HKCIP = Hong Kong Childhood Immunisation Programme; HPV = human papillomavirus; STD = sexually transmitted disease

* Data are shown as No. (%) or mean±standard deviation, unless otherwise specified

† Responses to 'No' or 'Not sure' were combined for meaningful analysis

‡ Five-item Likert scale data were coded as 1 = 'Strongly disagree' to 5 = 'Strongly agree'. Higher values indicate stronger beliefs. The data were regarded as continuous data for statistical tests

§ Mean score of the two statements 'HPV infection is very common' and 'I believe my child is at risk of HPV infection in the future'

‖ Mean score of the two statements 'I think HPV vaccination will encourage my child to engage in early sexual activity' and 'I think HPV vaccination will encourage my child not to use protection during sex'

¶ Significant differences between boys' parents and girls' parents were assessed using the Chi squared test for nominal variables and ***t*** test for continuous variables

TABLE 2. (cont'd)

	Parents of boys (n=370)	Parents of girls (n=474)	P value[¶]
I believe the HPV vaccine is safe for my child			<0.001
Strongly disagree	1 (0.3%)	2 (0.4%)	
Disagree	7 (1.9%)	18 (3.8%)	
Neutral	26 (7.0%)	52 (11.0%)	
Agree	159 (43.0%)	250 (52.7%)	
Strongly agree	177 (47.8%)	152 (32.1%)	
I am worried about the short-term side-effects (eg, headache, dizziness, and redness at the injection site) of the HPV vaccine	n=345	n=451	0.011
Strongly disagree	6 (1.7%)	4 (0.9%)	
Disagree	36 (10.4%)	60 (13.3%)	
Neutral	174 (50.4%)	241 (53.4%)	
Agree	88 (25.5%)	132 (29.3%)	
Strongly agree	41 (11.9%)	14 (3.1%)	
I am worried that the HPV vaccine might have unknown long-term side-effects	n=345	n=451	0.929
Strongly disagree	6 (1.7%)	3 (0.7%)	
Disagree	136 (39.4%)	186 (41.2%)	
Neutral	136 (39.4%)	182 (40.4%)	
Agree	62 (18.0%)	65 (14.4%)	
Strongly agree	5 (1.4%)	15 (3.3%)	
Worried about the negative impact of the HPV vaccine on child's sexual activity[‖]	2.27 (0.75)	2.31 (0.74)	0.475
I think people will be labelled promiscuous if they are infected with HPV			0.518
Strongly disagree	81 (21.9%)	93 (19.6%)	
Disagree	212 (57.3%)	289 (61.0%)	
Neutral	38 (10.3%)	66 (13.9%)	
Agree	27 (7.3%)	10 (2.1%)	
Strongly agree	12 (3.2%)	16 (3.4%)	
I am worried that the HPV vaccine might affect adolescent development	n=345	n=451	0.066
Strongly disagree	7 (2.0%)	14 (3.1%)	
Disagree	122 (35.4%)	184 (40.8%)	
Neutral	150 (43.5%)	185 (41.0%)	
Agree	59 (17.1%)	55 (12.2%)	
Strongly agree	7 (2.0%)	13 (2.9%)	
The HPV vaccine is too expensive			<0.001
Strongly disagree	4 (1.1%)	8 (1.7%)	
Disagree	7 (1.9%)	26 (5.5%)	
Neutral	33 (8.9%)	62 (13.1%)	
Agree	144 (38.9%)	189 (39.9%)	
Strongly agree	182 (49.2%)	189 (39.9%)	
I think it is difficult to explain the reason for HPV vaccination to my child			0.317
Strongly disagree	4 (1.1%)	5 (1.1%)	
Disagree	57 (15.4%)	68 (14.3%)	
Neutral	145 (39.2%)	179 (37.8%)	
Agree	157 (42.4%)	204 (43.0%)	
Strongly agree	7 (1.9%)	18 (3.8%)	
Acceptance of the HPV vaccine			
Will you allow your child to receive the HPV vaccine?			<0.001
Yes	273 (73.8%)	425 (89.7%)	
No	97 (26.2%)	49 (10.3%)	
Will you allow your child to receive the HPV vaccine if it is included in the HKCIP by the Hong Kong SAR Government?			<0.001
Yes	292 (78.9%)	439 (92.6%)	
No	78 (21.1%)	35 (7.4%)	

The reasons for accepting the HPV vaccine for their children were similar between parent groups (Fig), with a majority citing concerns about HPV infection (91.0% in boys' parents and 78.6% in girls' parents). Acceptance was least influenced by religions and culture (<3%) or advertisements (<5%) in parents of both sexes. The reasons for declining the HPV vaccine for their children were somewhat different between boys' parents and girls' parents. 'The HPV vaccine is too expensive' was the top reason chosen by both boys' parents (46.4%) and girls' parents (42.9%). The other two reasons most often selected by boys' parents were 'Not enough information about the HPV vaccine provided to me' (32.0%) and 'My child doesn't like vaccinations' (22.7%). For girls' parents, the other two reasons were 'My child doesn't like vaccinations' (38.8%) and 'The HPV vaccine can cause adverse effects/is not safe' (36.2%) [online supplementary Fig].

Factors associated with vaccine acceptance for children

The association analysis excluded 25 parents of boys and 23 parents of girls whose children had already received the HPV vaccine. The acceptance rates of the HPV vaccine for children of boys' parents and girls' parents, stratified according to the study variables, are listed in online supplementary Tables 1 and 2, respectively.

Regarding boys' parents, 24 study variables with P values <0.1 in univariate logistic regression were entered into multivariate logistic regression (Table 3). Factors associated with higher acceptance of the HPV vaccine for children included parental receipt of the HPV vaccine (OR=9.36, 95% CI=1.5-63.82; P=0.018), knowledge of the HPV vaccine (OR=10.16, 95% CI=3.02-39.07; P<0.001), and stronger beliefs that 'it's better for my child to receive the HPV vaccine before they become sexually active' (OR=3.27, 95% CI=1.66-7.09; P=0.001) and 'I am worried that the HPV vaccine might affect adolescent development' (OR=2.56, 95% CI=1.39-5.03; P=0.004). Conversely, factors associated with lower acceptance of the HPV vaccine were the presence (in the respondents' families) of more children in Primary 4 to Primary 6 (OR=0.28, 95% CI=0.12-0.63; P=0.002), a history of discussing STD prevention with their children (OR=0.23, 95% CI=0.08-0.64; P=0.005), receipt of regular seasonal influenza vaccines (OR=0.15, 95% CI=0.04-0.48; P=0.002), child's receipt of regular seasonal influenza vaccines (OR=0.25, 95% CI=0.08-0.80; P=0.021), and stronger beliefs that 'my child can be protected from HPV without HPV vaccination' (OR=0.28, 95% CI=0.11-0.66; P=0.005) [Table 3].

Regarding girls' parents, 19 study variables were entered into multivariate logistic regression. Higher acceptance of the HPV vaccine for their children was associated with higher monthly household income (OR=4.3, 95% CI=1.95-10.47; P=0.001) and the combined variable 'worried about HPV infection' (OR=2.39, 95% CI=1.08-5.73; P=0.038). Older age-group (OR=0.38, 95% CI=0.17-0.82; P=0.018) was the only variable associated with lower acceptance of the HPV vaccine (Table 4).

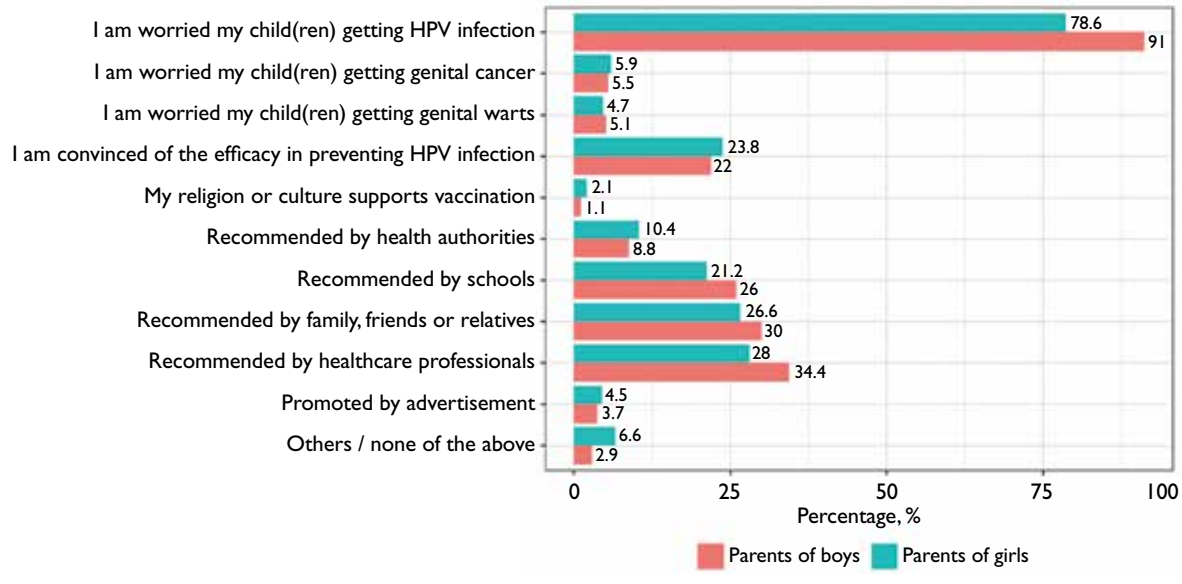

FIG. Reasons for allowing their child to receive the human papillomavirus vaccine among parents of boys (n=273) and parents of girls (n=425)
Abbreviation: HPV = human papillomavirus

TABLE 3. Associations of variables and acceptance of the human papillomavirus vaccine for children among parents of boys

	Univariate analysis		Multivariate analysis*	
	OR (95% CI)	P value§	OR (95% CI)	P value§
Socio-demographic characteristics				
Female (vs Male)	0.41 (0.24-0.69)	0.001	0.76 (0.26-2.22)	0.620
Age-group†	0.83 (0.57-1.2)	0.311	N/A	N/A
Married (vs Single/separated/divorced/widowed)	6.07 (2.28-17.93)	<0.001	1.84 (0.28-13.12)	0.532
Highest education level completed†	0.78 (0.49-1.24)	0.304	N/A	N/A
Occupation				
Law and public policy (vs Others)	0.23 (0.07-0.65)	0.006	0.41 (0.04-3.09)	0.404
Monthly household income†	0.74 (0.53-1.03)	0.077	1.08 (0.53-2.2)	0.835
No. of child(ren) in Primary 4 to Primary 6†	0.2 (0.12-0.3)	<0.001	0.28 (0.12-0.63)	0.002
Receipt of regular seasonal influenza vaccines				
Yes (vs No/not sure)	0.13 (0.07-0.22)	<0.001	0.15 (0.04-0.48)	0.002
Receipt of HPV vaccine				
Yes (vs No/not sure)	0.34 (0.14-0.79)	0.011	9.36 (1.5-63.82)	0.018
Child's school type				
Public local (vs Private/aided/Direct Subsidy Scheme)	3.81 (2.33-6.31)	<0.001	0.73 (0.25-2.01)	0.554
Child's current year of enrolment				
Primary 5 (vs Primary 4)	1.17 (0.67-2.04)	0.570	1.48 (0.55-3.96)	0.434
Primary 6 (vs Primary 4)	2.06 (1.06-4.1)	0.035	2.21 (0.68-7.48)	0.191
Child's receipt of any vaccine under the HKCIP				
Yes (vs No/not sure)	0.12 (0.07-0.21)	<0.001	1.68 (0.51-5.86)	0.400
Child's receipt of regular seasonal influenza vaccines				
Yes (vs No/not sure)	0.11 (0.07-0.2)	<0.001	0.25 (0.08-0.80)	0.021
Awareness and knowledge of HPV				
Heard of HPV vaccine	8.17 (4.59-14.87)	<0.001	10.16 (3.02-39.07)	<0.001
HPV knowledge score	1.38 (1.23-1.55)	<0.001	1.09 (0.89-1.34)	0.412
Discussion with child regarding prevention of STDs				
Yes (vs No/Not sure)	0.2 (0.12-0.33)	<0.001	0.23 (0.08-0.64)	0.005
Attitudes towards HPV and HPV vaccine‡				
Worried about HPV infection	3.02 (2.1-4.47)	<0.001	1.95 (0.83-4.79)	0.132
Worried about the negative impact of HPV vaccine on child's sexual activity	0.58 (0.4-0.82)	0.002	1.16 (0.51-2.85)	0.729
I believe it's better for my child to receive the HPV vaccine before they become sexually active	1.62 (1.16-2.26)	0.004	3.27 (1.66-7.09)	0.001
The HPV vaccine is too expensive	2.01 (1.45-2.85)	<0.001	1.41 (0.72-2.81)	0.319
I believe the HPV vaccine is safe for my child	1.39 (1.01-1.92)	0.044	1.1 (0.6-2.06)	0.762
I believe my child can be protected from HPV without HPV vaccination	0.49 (0.37-0.65)	<0.001	0.28 (0.11-0.66)	0.005
I believe the HPV vaccine is effective in preventing HPV infection for my daughter/son	1.26 (0.79-2.00)	0.323	N/A	N/A
I think people will be labelled promiscuous if they are infected with HPV	0.65 (0.49-0.86)	0.002	1.61 (0.79-3.39)	0.200
I am worried about the short-term side-effects (eg, headache, dizziness, and redness at the injection site) of the HPV vaccine	1.6 (1.21-2.16)	0.001	0.92 (0.5-1.68)	0.785
I am worried that the HPV vaccine might affect adolescent development	1.35 (1-1.85)	0.052	2.56 (1.39-5.03)	0.004
I am worried that the HPV vaccine might have unknown long-term side-effects	1.27 (0.95-1.74)	0.116	N/A	N/A
I think it is difficult to explain the reason for HPV vaccination to my child	0.91 (0.66-1.23)	0.537	N/A	N/A

Abbreviations: 95% CI = 95% confidence interval; HKCIP = Hong Kong Childhood Immunisation Programme; HPV = human papillomavirus; N/A = not applicable; OR = odds ratio; STD = sexually transmitted disease

* Variables with P values <0.1 in univariate analysis were entered into multivariate analysis

† Ordinal data were modelled as continuous data for analysis

‡ Five-item Likert scale data were coded as 1 = 'Strongly disagree' to 5 = 'Strongly agree' and modelled as continuous data for analysis

§ Obtained from univariate and multivariate logistic regression

TABLE 4. Associations of variables and acceptance of the human papillomavirus vaccine for children among parents of girls

	Univariate analysis		Multivariate analysis*	
	OR (95% CI)	P value§	OR (95% CI)	P value§
Socio-demographic characteristics				
Female (vs Male)	1.54 (0.81-2.86)	0.176	N/A	N/A
Age-group†	0.35 (0.19-0.64)	0.001	0.38 (0.17-0.82)	0.018
Married (vs Single/separated/divorced/widowed)	1.59 (0.24-6.16)	0.556	N/A	N/A
Highest education level completed†	0.97 (0.45-1.98)	0.943	N/A	N/A
Occupation				
Law and public policy (vs Others)	0.64 (0.21-2.84)	0.496	N/A	N/A
Monthly household income†	2.13 (1.3-3.6)	0.003	4.3 (1.95-10.47)	0.001
No. of child(ren) in Primary 4 to Primary 6†	0.26 (0.16-0.42)	<0.001	0.95 (0.42-2.23)	0.910
Receipt of regular seasonal influenza vaccines				
Yes (vs No/not sure)	0.41 (0.21-0.87)	0.016	0.98 (0.27-3.98)	0.973
Receipt of HPV vaccine				
Yes (vs No/not sure)	0.27 (0.09-1.03)	0.034	3.74 (0.44-36.65)	0.235
Child's school type				
Public local (vs Private/aided/Direct Subsidy Scheme)	6.9 (3.46-15.04)	<0.001	1.65 (0.43-6.03)	0.449
Child's current year of enrolment				
Primary 5 (vs Primary 4)	0.66 (0.32-1.31)	0.248	N/A	N/A
Primary 6 (vs Primary 4)	1.36 (0.55-3.55)	0.513	N/A	N/A
Child's receipt of any vaccine under the HKCIP				
Yes (vs No/not sure)	0.06 (0.03-0.11)	<0.001	0.22 (0.04-1.02)	0.060
Child's receipt of regular seasonal influenza vaccines				
Yes (vs No/not sure)	0.07 (0.03-0.13)	<0.001	0.32 (0.08-1.45)	0.125
Awareness and knowledge of HPV				
Heard of HPV vaccine	2.16 (1.12-4.06)	0.019	1.01 (0.23-4.57)	0.989
HPV knowledge score	1.14 (1.02-1.28)	0.019	0.84 (0.68-1.01)	0.074
Discussion with child regarding prevention of STDs				
Yes (vs No/not sure)	0.9 (0.39-2.46)	0.820	N/A	N/A
Attitudes towards HPV and HPV vaccine‡				
Worried about HPV infection	7.00 (4.47-11.55)	<0.001	2.39 (1.08-5.73)	0.038
Worried about the negative impact of HPV vaccine on child's sexual activity	0.35 (0.24-0.49)	<0.001	1.19 (0.61-2.37)	0.619
I believe it's better for my child to receive the HPV vaccine before they become sexually active	2.47 (1.69-3.64)	<0.001	1.14 (0.61-2.26)	0.688
The HPV vaccine is too expensive	3.05 (2.21-4.28)	<0.001	1.74 (0.95-3.26)	0.075
I believe the HPV vaccine is safe for my child	1.3 (0.89-1.86)	0.162	N/A	N/A
I believe my child can be protected from HPV without HPV vaccination	0.23 (0.17-0.32)	<0.001	0.6 (0.32-1.12)	0.101
I believe the HPV vaccine is effective in preventing HPV infection for my daughter/son	0.59 (0.32-1.05)	0.087	1.11 (0.51-2.38)	0.785
I think people will be labelled promiscuous if they are infected with HPV	0.21 (0.13-0.31)	<0.001	0.59 (0.27-1.19)	0.154
I am worried about the short-term side-effects (eg, headache, dizziness, and redness at the injection site) of the HPV vaccine	1.12 (0.74-1.69)	0.589	N/A	N/A
I am worried that the HPV vaccine might affect adolescent development	0.47 (0.33-0.66)	<0.001	0.97 (0.47-2.14)	0.942
I am worried that the HPV vaccine might have unknown long-term side-effects	0.39 (0.27-0.56)	<0.001	0.84 (0.38-1.8)	0.647
I think it is difficult to explain the reason for HPV vaccination to my child	0.83 (0.55-1.22)	0.354	N/A	N/A

Abbreviations: 95% CI = 95% confidence interval; HKCIP = Hong Kong Childhood Immunisation Programme; HPV = human papillomavirus; N/A = not applicable; OR = odds ratio; STD = sexually transmitted disease

* Variables with P values <0.1 in univariate analysis were entered into multivariate analysis

† Ordinal data were modelled as continuous data for analysis

‡ Five-item Likert scale data were coded as 1 = 'Strongly disagree' to 5 = 'Strongly agree' and modelled as continuous data for analysis

§ Obtained from univariate and multivariate logistic regression

Discussion

This survey of 844 Hong Kong parents (370 boys' parents and 474 girls' parents) revealed high HPV vaccine awareness but relatively low knowledge of HPV and the HPV vaccine. Parents believed the vaccine was safe and effective in preventing HPV infection. Acceptance of the HPV vaccine was lower among boys' parents than among girls' parents, and factors associated with acceptance differed between the two parent groups. Differences in socio-demographic characteristics were observed, such that more boys' parents discussed STDs with their children and had experience with regular seasonal influenza vaccines, the HPV vaccine, and Pap smears.

Understanding of human papillomavirus and the vaccine

Although a majority of parents of both sexes had knowledge of the HPV vaccine, their average scores indicated a low overall understanding of HPV and HPV vaccination. This finding is consistent with the results of previous studies, which showed that general knowledge and awareness of HPV among parents in Hong Kong remain low despite some improvement over time.[14-16,18-20] Considering the substantial healthcare burden associated with HPV-related diseases in Hong Kong, there is an urgent need for educational or promotional programmes to enhance vaccine acceptance and uptake.

In our study, parents expressed concern about HPV infection and strongly favoured HPV vaccination for their children before the children became sexually active. These beliefs support educational and promotional campaigns targeting the early adolescent age-group.

The reported HPV vaccine uptake rate is low in both groups (6.8% in boys and 4.9% in girls). The low vaccine uptake rate reported in girls is particularly alarming considering the recent inclusion of the HPV vaccine in the HKCIP and the high vaccination rate of 85% reported in the 2019/2020 school year.[17] Among those parents who reported their children of receiving the HPV vaccine, >90% of them, including boys' parents, indicated that their children received the vaccine through the HKCIP. This finding provides evidence suggesting insufficient public health campaigns, resulting in a lack of knowledge among parents on the HPV vaccination programme and the HKCIP, subsequently leading to potential confusion among parents.

Notably, girls' parents in our study reported a belief that the HPV vaccine is too expensive, despite the availability of free HPV vaccination through the HKCIP. This finding again reinforces a potential lack of awareness regarding the Programme, possibly due to inadequate dissemination of information during the coronavirus disease 2019 pandemic. Similar trends have been observed in other Western countries, where routine vaccinations (including HPV vaccination) were disrupted by the pandemic.[21,22] Catch-up vaccination services for affected children should be implemented promptly to prevent future healthcare burdens.[23-26]

Concern for cost and vaccine safety

This study examined the factors influencing parental acceptance of HPV vaccination for boys and girls. Parents who had more children in Primary 4 to 6 were less likely to accept the vaccine, possibly due to cost concerns. Discussions with children about STD prevention and previous receipt of seasonal flu vaccines did not lead to higher acceptance rates. These findings imply that vaccination is not a common topic in STD prevention campaigns, a point that warrants attention in future educational efforts focused on STD prevention. Intriguingly, parents with greater concern that the HPV vaccine affects adolescent development were more likely to accept it; they also had higher knowledge and awareness of HPV (online supplementary Table 3). This result highlights the need to increase parental understanding of HPV and the HPV vaccine, including efforts to clarify potential misconceptions and mitigate safety concerns.

Our data indicate that parental concerns about HPV infection strongly influence vaccine acceptance, whereas concerns about genital warts and HPV-related cancers are less impactful. This discrepancy may be attributed to an optimistic bias, where parents associate HPV complications with promiscuity and believe that their children have low STD risk.[18]

Notably, parents ranked HPV vaccine recommendations from healthcare professionals, relatives and friends, and schools as more important reasons to accept the vaccine, compared with recommendations by health authorities. This result may suggest that government initiatives provide suboptimal education concerning HPV and the HPV vaccine.

Barriers to HPV vaccine acceptance include costs and children's preferences, which may explain the discrepancies between uptake and acceptance. Cost is a well-established barrier to vaccination uptake. However, we note that the vaccine is free for girls in our study population, which highlights the importance of awareness. Health messages to boys' parents should emphasise the value of HPV vaccination as a long-term investment in their sons' health.[14] Concerns about vaccine safety and adverse effects, as well as a lack of recommendations from healthcare professionals or a lack of general knowledge, may also hinder vaccine acceptance.

We found that parental knowledge of HPV and the HPV vaccine significantly influenced decision-

making in boys' parents, indicating that educational campaigns targeting HPV acceptance may be more effective for these parents than for girls' parents. This difference might be partly related to the feminisation of HPV, especially in Hong Kong. This phenomenon has been observed in a regional qualitative study focusing on men's perceptions of HPV and HPV vaccination.[27] Because the Chinese translation of the HPV vaccine is 'cervical cancer vaccine', many boys and men in Hong Kong perceive a low risk of HPV infection.[27-29] In this context, campaigns or strategies using a fear-based approach to increase the perceived risk of HPV infection may be more effective for boys' parents.

Limitations

This study had several limitations. First, it was a cross-sectional study and thus provided less robust evidence than would be obtained in a longitudinal study. Vaccine acceptance is merely an indicator of potential uptake, and it is unclear whether this acceptance will be translated into action. Second, this study relied on parents to self-report their outcomes, and it lacked the ability to verify information provided by participants. Third, the results may have been influenced by volunteer bias or other selection biases. Because the survey was self-administered, random sampling of the general study population could not be achieved due to intrinsic differences between those who did and did not choose to participate. Volunteer bias may explain the variation in baseline characteristics between boys' parents and girls' parents. This bias limits the generalisability of the study results to the broader population. Fourth, the use of previously validated scales or items was limited. Previous studies were used as a reference to construct the survey questionnaire, but questions were not directly adapted. Although such validated measures exist, due to the lack of research regarding HPV and HPV vaccination, no measures have been validated in Hong Kong.[30,31]

One possible future research direction involves conducting longitudinal studies to examine the factors affecting vaccine uptake. These studies can produce stronger evidence and more effectively inform strategies for improved vaccine uptake. Furthermore, because this study only screened for variables involved in parental decision-making, a more thorough investigation could be done to better understand this process. Qualitative studies (eg, involving focus groups or interviews) can provide a more in-depth understanding of parents' attitudes, perceptions, and decision-making processes regarding HPV vaccination acceptance.

Conclusion

This study represents the most extensive local investigation into factors affecting parental acceptance of HPV vaccination in Hong Kong after the implementation of a school-based outreach programme. We found that high awareness of HPV and the HPV vaccine is predictive of vaccine acceptance. To increase vaccination rates among adolescents, we recommend targeted interventions based on the identified factors, including public education for parents and children to raise awareness of HPV risks, the benefits of vaccination for boys, and STD prevention. We also suggest including HPV vaccination for boys in the HKCIP and implementing catch-up vaccination for affected children. Extension of the catch-up programme to school children beyond Primary 6 should be considered to maintain high vaccination rates.

Author contributions

All authors (except for PH Wong and EYT So) contributed to the concept or design of the study, acquisition of the data, analysis or interpretation of the data, drafting of the manuscript, and critical revision of the manuscript for important intellectual content. PH Wong and EYT So contributed to the concept and design of the study questionnaire. All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

PH Wong and EYT So are employees of Merck Sharp and Dohme (Asia) Ltd. Other authors have disclosed no conflicts of interest.

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Ethics approval

This study was approved by the Institutional Review Board of The University of Hong Kong/Hospital Authority Hong Kong West Cluster, Hong Kong (Ref No.: UW21-574). Participants provided informed consent via the online survey platform before survey completion.

Supplementary material

The supplementary material was provided by the authors and some information may not have been peer reviewed. Accepted supplementary material will be published as submitted by the authors, without any editing or formatting. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by the Hong Kong Academy of Medicine and the Hong Kong Medical Association.

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