Awareness, perceptions, and acceptance of human papillomavirus vaccination among parents in Hong Kong

Eddy WH Lam, Hextan YS Ngan, KY Kun, Dominic FH Li, WY Wan, Paul KS Chan *

ABSTRACT

Introduction: This study investigated the awareness, perceptions, and acceptance of human papillomavirus (HPV) vaccination for children among parents in Hong Kong. It also explored factors associated with, and differences in, vaccine acceptance and hesitancy between parents of girls and boys.

Methods: Parents of boys or girls in Primary 5 to 6 were invited to participate in an online survey through an established health and lifestyle e-platform.

Results: Overall, 851 parents completed the survey: 419 (49.2%) had daughters, 348 (40.9%) had sons, and 84 (9.9%) had children of both genders. Parents who enrolled their children into the Childhood Immunisation Programme were more likely to accept HPV vaccination (79.7% vs 33.7%, odds ratio [OR]=7.70; 95% confidence interval [CI]=5.39-11.01; P<0.001); parents of girls were more likely to accept than parents of boys (86.0% vs 71.8%, OR=2.40; 95% CI=1.67-3.46; P<0.001). Among parents of girls and boys, the main reasons for HPV vaccination acceptance were prevention of cancers (girls: 68.8% and boys: 68.7%), prevention of sexually transmitted diseases (girls: 67.3% and boys: 68.3%), and optimal timing before initiation of sexual activity (girls: 62.8% and boys: 59.8%). Vaccine hesitancy was mainly associated with concerns about serious side-effects (girls: 66.7% and boys: 68.0%) and the belief that their children were too young (girls: 60.0% and boys: 54.0%).

Conclusion: Parents in Hong Kong are hesitant about HPV vaccination for their sons. This barrier could be removed by providing information to correct vaccine safety misconceptions and offering a gender-neutral vaccination programme through the school-based Childhood Immunisation Programme.

Hong Kong Med J 2023;29:287–94
https://doi.org/10.12809/hkmj2210470

[1,2] **EWH Lam,** MB, BS, MMedSc
[1,3] **HYS Ngan,** MD, FRCOG
[1] **KY Kun,** MB, BS, MRCOG
[1] **DFH Li,** MB, BS, MRCOG
[1] **WY Wan,** MRCP, FHKCCM
[1,4] **PKS Chan ***, MD, FRCPath

[1] *HPV Prevention Alliance, Hong Kong SAR, China*
[2] *Department of Otorhinolaryngology, Head and Neck Surgery, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong SAR, China*
[3] *Department of Obstetrics and Gynaecology, Faculty of Medicine, The University of Hong Kong, Hong Kong SAR, China*
[4] *Department of Microbiology, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong SAR, China*

* Corresponding author: paulkschan@cuhk.edu.hk

This article was published on 6 Jul 2023 at www.hkmj.org.

New knowledge added by this study

- Awareness and acceptance of human papillomavirus (HPV) vaccination for children is lower among parents of boys than among parents of girls in Hong Kong.
- Parental misconceptions regarding vaccine safety and ideal vaccination age are major barriers to HPV vaccination for children.

Implications for clinical practice or policy

- The availability of no-cost gender-neutral HPV vaccination would increase parental acceptance.
- The myth that HPV vaccines are unsafe must be dispelled.
- The myth that children in Primary 5 to 6 are too young to receive the HPV vaccine must be dispelled.

Introduction

Human papillomavirus (HPV) is the most frequently encountered sexually transmitted infection worldwide[1]; most men and women become infected with HPV at some stages in their lives.[1] Although 90% of cervical HPV infections spontaneously resolve within 2 years,[2-4] persistent infections with high-risk, oncogenic types of HPV can result in invasive cervical cancer. Furthermore, HPV infection is associated with the development of cancers in other locations such as the anus, vulva, vagina, penis, and oropharynx.[5,6] Human papillomavirus vaccination is a safe and highly effective method for preventing cervical cancer and other HPV-related cancers.[7-10]

Increases in HPV vaccination uptake are particularly pertinent in Hong Kong, considering

香港家長對子宮頸癌疫苗的認知、看法和接受程度

林偉雄、顏婉嫦、靳嘉仁、李福謙、尹慧兒、陳基湘

引言：本研究調查了香港家長對子女接種子宮頸癌疫苗的認知、看法和接受程度。研究亦探討了女童和男童父母之間對疫苗接受和顧慮的因素關聯及差異。

方法：小五及小六學童家長透過認可的健康與生活方式電子平台參與網上調查。

結果：共有851位家長完成了調查：419位（49.2%）有女兒，348位（40.9%）有兒子，84位（9.9%）有女兒和兒子。讓子女參加兒童免疫接種計劃的家長更有可能接受子宮頸癌疫苗接種（79.7% vs 33.7%，勝算比=7.70；95%置信區間=5.39-11.01；P<0.001）；女童家長比男童家長更容易接受（86.0% vs 71.8%，勝算比=2.40；95%置信區間=1.67-3.46；P<0.001）。只有女兒或兒子的家長中，接受子宮頸癌疫苗接種的主要原因是預防癌症（女童家長：68.8%，男童家長：68.7%）、預防性傳染病（女童家長：67.3%，男童家長：68.3%）和發生性行為前的最佳時機（女童家長：62.8%，男童家長：59.8%）。疫苗猶豫的主要原因是擔心嚴重副作用（女童家長：66.7%，男童家長：68.0%）以及認為他們的子女年齡太小（女童家長：60.0%，男童家長：54.0%）。

結論：香港的家長對為兒子接種子宮頸癌疫苗遲疑。可通過提供資訊以糾正疫苗安全誤解，並透過校本兒童免疫接種計劃為男女學童接種疫苗，藉此消除障礙。

that the age-standardised incidence of cervical cancer increased by an average of 1.2% annually between 2010 and 2020 (most recent available data).[11] In 2020, the age-standardised incidence of cervical cancer was 7.6 cases per 100 000 women.[11] Although a cervical screening programme for women aged 25-64 years was initiated in Hong Kong in 2004, this programme functioned primarily as a prospective record and recall database for women who presented for screening, rather than a programme for the proactive inclusion of eligible women.[12] Ten years later, the 2014/15 health survey by the Department of Health showed that only 59% of women in Hong Kong had ever been screened for cervical cancer, and only 47% had been screened within the previous 3 years.[13]

In Hong Kong, the use of the HPV vaccine was approved in 2008. Before its incorporation in the Hong Kong Childhood Immunisation Programme (CIP), HPV vaccination rates among female students remained low: 7% to 9% in school-aged girls[14-16] and 9.7% in university students.[17] However, when the HPV vaccine was offered to girls through a no-cost school-based programme in a feasibility study, the overall rates of vaccine uptake were 81.4% (1000/1229) for the first dose and 80.8% (993/1229) for the second dose.[18] These findings were consistent with a report that cost is a major barrier to vaccination.[14]

The associations of HPV infection with anal, penile, and oropharyngeal cancers, as well as genital warts,[5,6,9] have prompted 57 countries (including Germany, the United Kingdom, and Australia) to introduce gender-neutral vaccination into their national immunisation schedules to provide greater and more equitable prevention of HPV-related diseases in their respective populations, with the implementation as early as 2013 in Austalia.[19-21]

The HPV vaccine uptake in children and adolescents hinges on parental acceptance. Thus, this study investigated the awareness, perceptions, and acceptance of HPV vaccination for children among parents in Hong Kong. It also explored factors associated with, and differences in, vaccine acceptance and hesitancy between parents of girls and boys.

Methods

Study design

This cross-sectional study was initiated by the HPV Prevention Alliance, Hong Kong. Representatives from the HPV Prevention Alliance developed and approved a structured online questionnaire, which consisted of 26 questions that were designed to assess parental attitudes towards HPV vaccination for their children (Fig).

Parents answered general questions about their children, enrolment in the CIP, and plans to have their children vaccinated against HPV. At the time of this survey, only girls were eligible for HPV vaccination through the no-cost school-based CIP. Therefore, parents of girls answered questions about HPV vaccine acceptance/hesitancy and awareness of HPV inclusion within the CIP. Parents of boys answered similar questions about HPV vaccine acceptance/hesitancy, HPV vaccine availability and appropriateness for boys, and whether inclusion in the CIP would influence their decision making. Information was collected regarding parental socio-demographic and lifestyle characteristics (age, education level, monthly income, and expenses), as well as the age at which they expected their children to begin becoming sexually active. The survey was developed and conducted in Chinese; it was translated into English for presentation in this report.

Data collection

Parents with children in Primary 5 to 6 (aged 10-12 years) were invited to the online questionnaire via ESDlife, an e-commerce platform that delivers lifestyle content, products, and services relating to parenting and health to nearly 1 million people in Hong Kong. Participants were offered a HK$50 supermarket coupon to encourage completion of the survey. The survey was conducted between 1 and 7 February 2021.

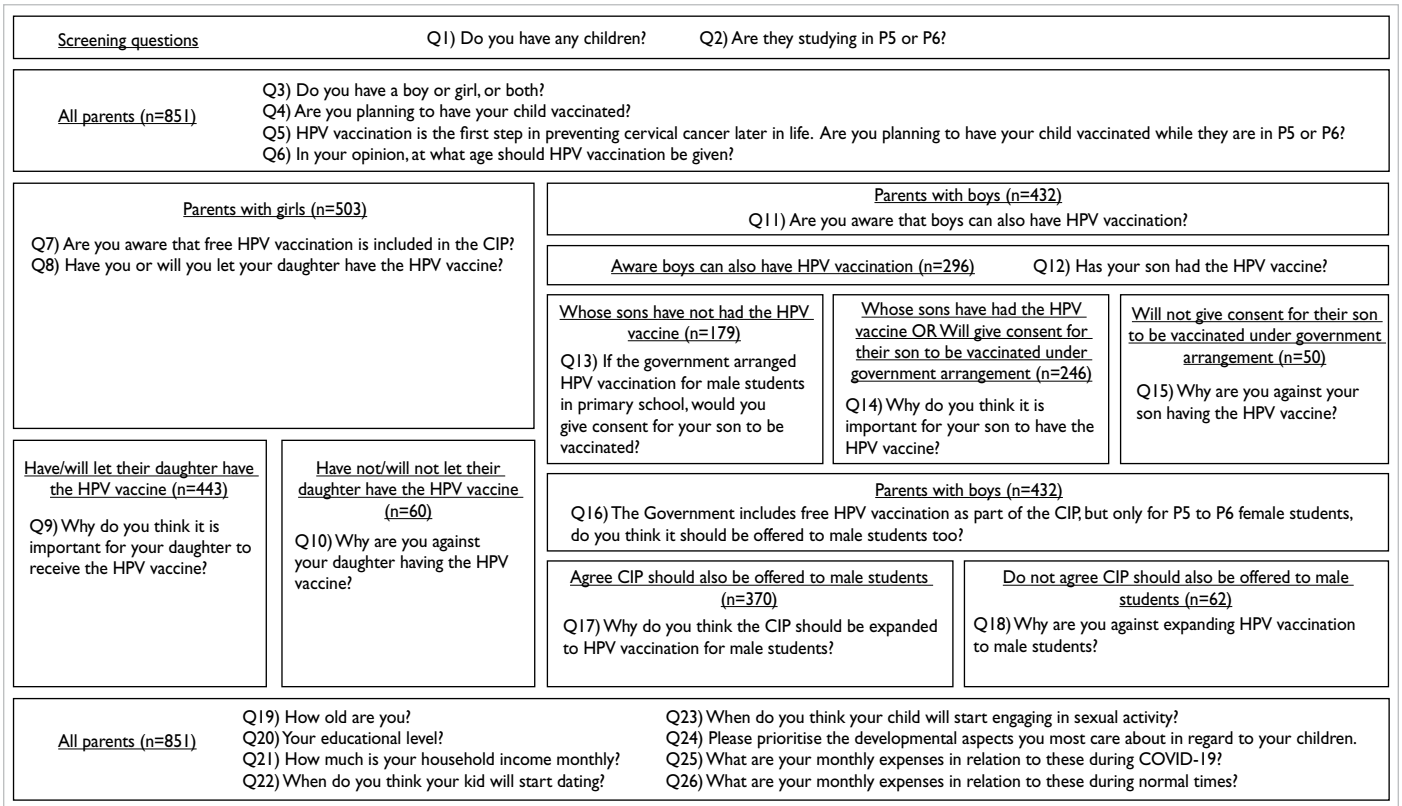

FIG. Outline of survey structure and questions

Abbreviations: CIP = Childhood Immunisation Programme; COVID-19 = coronavirus disease 2019; HPV = human papillomavirus; P5 = Primary 5; P6 = Primary 6; Q = question

Statistical analysis

Demographic and lifestyle variables including age, education level, and monthly income were expressed as numbers and percentages; these categorical variables were assessed by the Chi squared test. Childhood expenses before and during the coronavirus disease 2019 (COVID-19) pandemic for education, health, and leisure were regarded as continuous variables and assessed using *t* tests. Odds ratios (ORs) were calculated for various comparison groups to identify associations with vaccination. P values <0.05 were considered statistically significant. All statistical analyses were performed using SPSS software (Windows version 28; IBM Corp, Armonk [NY], United States).

Results

In total, 851 parents completed the survey: 419 had daughters, 348 had sons, and 84 had children of both genders. There were no missing data because completion of each question was required before submission of the survey. Most (n=342, 40.2%) parents were aged between 35 and 45 years, 549 (64.5%) parents had at least tertiary education or equivalent, and 594 (69.8%) parents had a monthly income of ≤HK$50 000 (Table 1).

TABLE 1. Characteristics of parents who completed the survey (n=851)

Demographic variable	No. (%)
Age of parent, y	
≤34	166 (19.5%)
35-40	342 (40.2%)
41-45	202 (23.7%)
46-50	98 (11.5%)
≥51	43 (5.1%)
Sex of child	
Male	348 (40.9%)
Female	419 (49.2%)
Both	84 (9.9%)
Education level	
Below secondary	65 (7.6%)
Secondary	237 (27.8%)
Tertiary or above/equivalent	549 (64.5%)
Monthly income, HK$	
≤30 000	289 (34.0%)
30 001-50 000	305 (35.8%)
50 001-70 000	148 (17.4%)
≥70 001	109 (12.8%)

Abbreviation: HK$ = Hong Kong dollars

TABLE 2. Main reasons for parents in Hong Kong to accept human papillomavirus vaccination for their children

Reason	Parents of girls (n=443)	Parents of boys (n=246)
Prevents cancers		
Yes	305 (68.8%)	169 (68.7%)
No	138 (31.2%)	77 (31.3%)
Prevents sexually transmitted diseases		
Yes	298 (67.3%)	168 (68.3%)
No	145 (32.7%)	78 (31.7%)
Optimal timing before initiation of sexual activity		
Yes	278 (62.8%)	147 (59.8%)
No	165 (37.2%)	99 (40.2%)
No-cost programme		
Yes	204 (46.0%)	96 (39.0%)
No	239 (54.0%)	150 (61.0%)
Others		
Yes	1* (0.2%)	1† (0.4%)
No	442 (99.8%)	245 (99.6%)

* Via no-cost programme at Student Health Service Centre
† Arranged vaccination independently

TABLE 3. Main reasons for parents in Hong Kong not to accept human papillomavirus vaccination for their children

Reason	Parents of girls (n=60)	Parents of boys (n=50)
Potential serious side-effects		
Yes	40 (66.7%)	34 (68.0%)
No	20 (33.3%)	16 (32.0%)
Child too young		
Yes	36 (60.0%)	27 (54.0%)
No	24 (40.0%)	23 (46.0%)
Interference with growth		
Yes	33 (55.0%)	24 (48.0%)
No	27 (45.0%)	26 (52.0%)
Risk of infertility		
Yes	16 (26.7%)	4 (8.0%)
No	44 (73.3%)	46 (92.0%)
Child has not begun sexual activity		
Yes	12 (20.0%)	7 (14.0%)
No	48 (80.0%)	43 (86.0%)
Will encourage sexual activity		
Yes	10 (16.7%)	8 (16.0%)
No	50 (83.3%)	42 (84.0%)
Others		
Yes	0	3 (6.0%)
No	60 (100%)	47 (94.0%)

Parents' characteristics and vaccine acceptance

Parents enrolled in the CIP were more likely to consent to HPV vaccination, compared with parents who were not enrolled in the CIP (79.7% vs 33.7%; OR=7.70, 95% confidence interval [CI]=5.39-11.01, P<0.001); parents of girls were more likely to consent than parents of boys (86.0% vs 71.8%; OR=2.40, 95% CI=1.67-3.46, P<0.001). There were no significant differences between parents who accepted HPV vaccines and parents who refused HPV vaccines in terms of age (P=0.522), education level (P=0.122), or monthly income (P=0.691). Parents enrolled in the CIP who accepted HPV vaccination spent significantly less on healthcare, compared with parents who refused HPV vaccination (mean [standard deviation, SD] healthcare expenditures: HK$3246 [6753] vs HK$3853 [7384]; P=0.046).

Overall, 443/503 (88.1%) parents of girls accepted HPV vaccination; among these 443 parents, 63 (14.2%) had been vaccinated and 380 (85.8%) were expected to undergo vaccination soon. Parents who were aware of the government's no-cost HPV vaccination programme for Primary 5 to 6 female students were more likely to have consented (or planned to consent) to HPV vaccination, compared with parents who were unaware of the programme (95.8% vs 79.6%; OR=5.9, 95% CI=2.98-11.61, P<0.001). Subgroup analysis of parents enrolled in the CIP (n=420) showed that parents who were aware of the government's no-cost HPV vaccination programme (n=361) were even more likely to accept HPV vaccination, compared with parents who were unaware of the programme (n=59) [63.4% vs 10.2%; OR=15.3, 95% CI=6.41-36.61, P<0.001].

Overall, 296/432 (68.5%) parents of boys were aware that boys were eligible for HPV vaccination. Among those 296 parents, only 117 (39.5%) had consented to HPV vaccination, resulting in an overall vaccination rate of 27.1% in boys. Among the 179 parents who had not initiated HPV vaccination, 129 (72.1%) stated they would give consent if the vaccine was provided through a no-cost programme. Parents who consented to no-cost HPV vaccination tended to spend less on healthcare both before and during the COVID-19, compared with parents who were hesitant to accept HPV vaccination (mean healthcare expenditures before COVID-19: HK$3453 [SD=6381] vs HK$6750 [SD=9743], P<0.001; during COVID-19: HK$2980 [SD=6499] vs HK$5458 [SD=7969], P=0.009). However, these subgroups of parents did not significantly differ in terms of age (P=0.899) or education level (P=0.439).

Drivers and barriers of vaccine acceptance

Most parents indicated that the main reason for their children to undergo HPV vaccination

was prevention of cancers (68.8% and 68.7% for parents of girls and boys, respectively), followed by prevention of sexually transmitted diseases (67.3% and 68.3% for parents of girls and boys, respectively). They also agreed that the optimal vaccine timing was before initiation of sexual activity (62.8% and 59.8% for parents of girls and boys, respectively) [Table 2]. The most common reason for vaccine hesitancy was the belief that side-effects could occur (66.7% and 68.0% for parents of girls and boys, respectively), followed by the belief that their children were too young (60.0% and 54.0% for parents of girls and boys, respectively), and the belief that the vaccine would interfere with growth (55.0% and 48.0% for parents of girls and boys, respectively) [Table 3].

Perceived age of sexual debut

Most parents (40.5%) reported expecting their child to begin dating at the age of 15 to 17 years, although 36.8% stated that they did not expect their child to date until at least 18 years of age; 4.9% stated that their child was dating before 9 years of age. Notably, 1.5% of parents reported their child had begun sexual activity before the age of 9 years; the corresponding percentages were 4.3% at the age of 9 to 14 years, 14.4% at the age of 15 to 17 years, and 79.8% at 18 years or older.

Discussion

To our knowledge, this is the first study to explore awareness, acceptance, and hesitancy in relation to HPV vaccination for children among parents of boys and girls in Hong Kong. Despite high awareness of HPV vaccination for girls, only 12.5% (63/503) of parents had consented to vaccination for their daughters at the time of the survey; another 75.5% (380/503) of parents planned to consent to vaccination soon. The resulting overall acceptance rate for parents of girls in Hong Kong (88.1%) is consistent with a report by Yuen et al,[18] which described acceptance rates of 81.4% (for the first dose) and 80.8% (for the second dose). The acceptance rates revealed in the present study and the study by Yuen et al[18] are considerably lower than the overall acceptance rate of 98% for CIP vaccines among children in Hong Kong.[22] There is a need to understand the barriers to HPV vaccination that affect >10% of parents in Hong Kong.

Barriers to vaccination

The two most common factors associated with HPV vaccine hesitancy among parents in this study were 'potential serious side-effects' and 'child too young'. The notion of poor HPV vaccine safety is one of the main myths that must be dispelled by communicating its safety profile, which has been validated by decades of clinical trials and post-licensure studies involving tens of thousands of participants.[23] Additionally, concerns about serious side-effects could be a response that conceals deeper underlying reasons (eg, religious, societal, and psychological issues). These reasons are potentially culture-specific; their exploration may require other forms of research rather than a questionnaire approach (eg, focus group interviews).[24]

The second major barrier identified in this study, 'child too young', is consistent with the observation that most parents did not expect their children to begin dating or engaging in sexual activity until the age of 16 years or older. However, in a survey of adolescents concerning sexual health and their first sexual encounter, 1% of respondents reported having sex for the first time at the age of 11 years, and 10% reported having sex at or before the age of 15 to 16 years.[25] Dating experience among secondary school children in Hong Kong has generally been consistent during the past 20 years, such that approximately 30% of 12- to 14-year-olds and 60% of 14- to 18-year-olds reported dating.[26]

Removal of the barrier 'child too young' requires providing parents with information regarding the norms and realities of sexual behaviour and encounters among teenagers in Hong Kong. Additionally, parents must receive information concerning the high prevalence of HPV infection worldwide and in Hong Kong,[27] as well as the high rate of HPV transmission via skin-to-skin and skin-to-mucosa contact during oral sex and non-penetrative genital contact.[28]

In addition to considering the potential for earlier-than-expected initiation of sexual activity, parents should recognise that there is a biological reason to vaccinate earlier. Data from clinical trials show that HPV antibody titres are both higher and more persistent among individuals who undergo vaccination at a younger age.[23,29-31]

Cost of vaccination

At the time of this study, HPV vaccination was unavailable to boys under the no-cost CIP; awareness of HPV vaccination was lower in parents of boys (68.5%), and HPV vaccine uptake in boys was 27.1%. The current market price for two doses of the HPV vaccine in Hong Kong is approximately HK$3000 to HK$5000; this could be a prohibitive cost for some families. Cost has been identified as a key factor in many studies.[32] Our findings indicate that, if the government provided no-cost HPV vaccination for boys, an additional 30% of the parents of boys would agree to vaccination. In addition to provision through a no-cost programme, incorporation of the HPV vaccine into the CIP may enhance parental confidence.[33] The present findings suggest that parents who spend more on healthcare are less likely to accept HPV vaccination, indicating

that preventive medicine is not a high priority for these families. This hypothesis merits further investigation; if confirmed, it must be addressed through public health measures.

Gender-neutral vaccination

We recommend the adoption of a gender-neutral HPV vaccination programme in Hong Kong. The government should fully support and implement such a programme for strong scientific and public health reasons as outlined above. Furthermore, a gender-neutral vaccination programme can achieve the goal of HPV eradication with a lower coverage rate of 55% to 70%, rather than the 80% to 90% coverage required when only girls are vaccinated.[34] In many advanced countries (eg, the United States, Germany, and France), HPV vaccination coverage rates remain low (20%-40%).[34] Therefore, girls-only vaccination programmes are unlikely to eliminate HPV-related diseases. A gender-neutral vaccination strategy must be universally implemented.

Limitations

There were some limitations in this study. First, although the questionnaire was designed by researchers with experience in surveys, HPV infection and vaccination, it was not validated in other studies. Nevertheless, the questionnaire was pilot tested before launch, and it was both context-specific and met the objectives of this study.

Second, the potential influence of healthcare providers was not assessed in this study, although previous studies have identified physician recommendations as key predictors of HPV vaccine uptake.[35-38] However, the provision of HPV vaccination through schools does not allow extensive discussion with physicians; alternative opportunities to engage healthcare providers must be explored.

Third, this study only targeted parents of children in Primary 5 to 6; thus, no information was available regarding HPV vaccine uptake in older teenagers. It may have been useful to distinguish between responses from mothers and fathers in this study, considering the finding by Waller et al[38] that, compared with fathers, mothers in England and Wales were more likely to agree to vaccinate.

Conclusion

The present findings suggest that raising awareness of HPV vaccination, particularly among parents of boys, is essential to increase the rate of vaccine uptake. The provision of no-cost, school-based, gender-neutral HPV vaccination through the CIP would serve as a major boost to vaccine uptake.

When HPV vaccination is provided via schools rather than healthcare clinics, clear and accessible information must be provided to parents because they are the key decision makers in this situation. The present findings suggest that parents need more information about vaccine safety to alleviate their concerns regarding serious side-effects. In the future, the differences in uptake between the HPV vaccine and other vaccines within the CIP may be eliminated.

Author contributions

Concept or design: HYS Ngan, PKS Chan.
Acquisition of data: KY Kun, DFH Li, WY Wan.
Analysis or interpretation of data: EWH Lam.
Drafting of the manuscript: EWH Lam, PKS Chan.
Critical revision of the manuscript for important intellectual content: All authors.

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

PKS Chan received honorarium and benefits in kind from human papillomavirus vaccine manufacturers including Merck Sharp & Dohme and GlaxoSmithKline as consultant, speaker, and study investigator.

Acknowledgement

The authors thank members of the HPV Prevention Alliance, Hong Kong other than those listed in the authorship for their support in this research, which was part of the activities approved by the Alliance.

Declaration

Part of the content has been presented in a press conference organised by the HPV Prevention Alliance in Hong Kong on 13 May 2021.

Funding/support

This research was supported by a research grant from Merck Sharp & Dohme (Asia) Limited. The funder had no role in study design, data collection, analysis, interpretation, or manuscript preparation.

Ethics approval

The research was endorsed by the ethics panel of the HPV Prevention Alliance, which has given due consideration to the ethical aspect of the study in the approval process.

References

1. World Health Organization. Cervical cancer. 2020. Available from: https://www.who.int/news-room/fact-sheets/detail/human-papillomavirus-(hpv)-and-cervical-cancer. Accessed 25 Nov 2021.
2. Brouwer AF, Campredon LP, Walline HM, et al. Incidence and clearance of oral and cervicogenital HPV infection: longitudinal analysis of the MHOC cohort study. BMJ Open 2022;12:e056502.
3. Kreimer AR, Pierce Campbell CM, Lin HY, et al. Incidence and clearance of oral human papillomavirus infection in men: the HIM cohort study. Lancet 2013;382:877-87.

4. Wong MC, Vlantis AC, Liang M, et al. Persistence and clearance of oral human papillomavirus infections: a prospective population-based cohort study. J Med Virol 2020;92:3807-14.
5. International Agency for Research on Cancer. IARC Monographs on The Evaluation of Carcinogenic Risks to Humans. Volume 90: Human Papillomaviruses. Lyon, France: International Agency for Research on Cancer, World Health Organization; 2007.
6. Shiels MS, Kreimer AR, Coghill AE, Darragh TM, Devesa SS. Anal cancer incidence in the United States, 1977-2011: distinct patterns by histology and behavior. Cancer Epidemiol Biomarkers Prev 2015;24:1548-56.
7. Centers for Disease Control and Prevention, United States Government. Human Papillomavirus (HPV) vaccine: safety information. 9 Sep 2020. Available from: https://www.cdc.gov/vaccinesafety/vaccines/hpv-vaccine.html. Accessed 7 Jun 2022.
8. Choi SE, Choudhary A, Huang J, Sonis S, Giuliano AR, Villa A. Increasing HPV vaccination coverage to prevent oropharyngeal cancer: a cost-effectiveness analysis. Tumour Virus Res 2022;13:200234.
9. Drolet M, Bénard É, Boily MC, et al. Population-level impact and herd effects following human papillomavirus vaccination programmes: a systematic review and meta-analysis. Lancet Infect Dis 2015;15:565-80.
10. Kudo R, Yamaguchi M, Sekine M, et al. Bivalent human papillomavirus vaccine effectiveness in a Japanese population: high vaccine-type-specific effectiveness and evidence of cross-protection. J Infect Dis 2019;219:382-90.
11. Hong Kong Cancer Registry, Hospital Authority. Cervical cancer in 2020. Available from: https://www3.ha.org.hk/cancereg/pdf/factsheet/2020/cx_2020.pdf. Accessed 6 Mar 2023.
12. Wu J. Cervical cancer prevention through cytologic and human papillomavirus DNA screening in Hong Kong Chinese women. Hong Kong Med J 2011;17(3 Suppl 3):20-4.
13. Hong Kong SAR Government. Community Care Fund to roll out pilot scheme on subsidised cervical cancer screening and preventive education for eligible low-income women. 12 Dec 2017. Available from: https://www.info.gov.hk/gia/general/201712/12/P2017121200366.htm. Accessed 25 Nov 2021.
14. Choi HC, Leung GM, Woo PP, Jit M, Wu JT. Acceptability and uptake of female adolescent HPV vaccination in Hong Kong: a survey of mothers and adolescents. Vaccine 2013;32:78-84.
15. Lee A, Ho M, Cheung CK, Keung VM. Factors influencing adolescent girls' decision in initiation for human papillomavirus vaccination: a cross-sectional study in Hong Kong. BMC Public Health 2014;14:925.
16. Li SL, Lau YL, Lam TH, Yip PS, Fan SY, Ip P. HPV vaccination in Hong Kong: uptake and reasons for non-vaccination amongst Chinese adolescent girls. Vaccine 2013;31:5785-8.
17. Chen JM, Leung DY. Factors associated with human papillomavirus vaccination among Chinese female university students in Hong Kong. Am Int J Soc Sci 2014;3:56-62.
18. Yuen WW, Lee A, Chan PK, Tran L, Sayko E. Uptake of human papillomavirus (HPV) vaccination in Hong Kong: facilitators and barriers among adolescent girls and their parents. PLoS One 2018;13:e0194159.
19. Cheung TH, Cheng S, Hsu D, et al. Public health and economic impact of gender-neutral nonavalent vaccination and catch-up vaccination in Hong Kong. Poster presented at: 37th Annual Meeting of the European Society for Paediatric Infectious Diseases; 2019 May 6-11; Ljubljana, Slovenia.
20. Kmietowicz Z. Boys in England to get HPV vaccine from next year. BMJ 2018;362:k3237.
21. Takla A, Wiese-Posselt M, Harder T, et al. Background paper for the recommendation of HPV vaccination for boys in Germany. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 2018;61:1170-86.
22. Chan D. Immunisation coverage for children aged two to five: findings of the 2015 immunisation survey. 2018. Available from: https://www.chp.gov.hk/files/pdf/cdw_compendium_2017_revised.pdf. Accessed 21 Jun 2022.
23. Bednarczyk RA. Addressing HPV vaccine myths: practical information for healthcare providers. Hum Vaccin Immunother 2019;15:1628-38.
24. Siu JY, Lee A, Chan PK. Schoolteachers' experiences of implementing school-based vaccination programs against human papillomavirus in a Chinese community: a qualitative study. BMC Public Health 2019;19:1514.
25. Hong Kong AIDS Foundation. A survey on "First Sex and Sexual Health". 2018. Available from: https://www.aids.org.hk/?p=8856. Accessed 25 Nov 2021.
26. The Family Planning Association of Hong Kong. Report on Youth Sexuality Study 2016. 2017. Available from: https://www.famplan.org.hk/en/media-centre/press-releases/detail/fpahk-report-on-youth-sexuality-study. Accessed 25 Nov 2021.
27. Chan PK, Chang AR, Cheung JL, et al. Determinants of cervical human papillomavirus infection: differences between high- and low-oncogenic risk types. J Infect Dis 2002;185:28-35.
28. Petca A, Borislavschi A, Zvanca ME, Petca RC, Sandru F, Dumitrascu MC. Non-sexual HPV transmission and role of vaccination for a better future (review). Exp Ther Med 2020;20:186.
29. Dobson SR, McNeil S, Dionne M, et al. Immunogenicity of 2 doses of HPV vaccine in younger adolescents vs 3 doses in young women: a randomized clinical trial. JAMA 2013;309:1793-802.
30. Markowitz LE, Dunne EF, Saraiya M, et al. Human papillomavirus vaccination: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2014;63:1-30.
31. Romanowski B, Schwarz TF, Ferguson L, et al. Sustained immunogenicity of the HPV-16/18 AS04-adjuvanted vaccine administered as a two-dose schedule in adolescent girls: five-year clinical data and modeling predictions from a randomized study. Hum Vaccin Immunother 2016;12:20-9.
32. Lee A, Wong MC, Chan TT, Chan PK. A home-school-doctor model to break the barriers for uptake of human papillomavirus vaccine. BMC Public Health 2015;15:935.
33. Leask J, Chapman S, Hawe P, Burgess M. What maintains parental support for vaccination when challenged by anti-vaccination messages? A qualitative study. Vaccine 2006;24:7238-45.
34. Lehtinen M, Baussano I, Paavonen J, Vänskä S, Dillner J. Eradication of human papillomavirus and elimination of

HPV-related diseases—scientific basis for global public health policies. Expert Rev Vaccines 2019;18:153-60.
35. Gamble HL, Klosky JL, Parra GR, Randolph ME. Factors influencing familial decision-making regarding human papillomavirus vaccination. J Pediatr Psychol 2010;35:704-15.
36. Radisic G, Chapman J, Flight I, Wilson C. Factors associated with parents' attitudes to the HPV vaccination of their adolescent sons: a systematic review. Prev Med 2017;95:26-37.
37. Walker TY, Elam-Evans LD, Yankey D, et al. National, regional, state, and selected local area vaccination coverage among adolescents aged 13-17 years—United States, 2018. MMWR Morb Mortal Wkly Rep 2019;68:718-23.
38. Waller J, Forster A, Ryan M, Richards R, Bedford H, Marlow L. Decision-making about HPV vaccination in parents of boys and girls: a population-based survey in England and Wales. Vaccine 2020;38:1040-7.