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Facilitators and barriers of human papillomavirus vaccine uptake in young females 18–26 years old in Singapore: A qualitative study

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ABSTRACT

Background: Around 70% of cervical cancers are caused by Types 16 and 18 of human papillomavirus (HPV). Vaccines against HPV have been shown to be safe and effective in preventing HPV and cervical cancer.
Objective: To explore the facilitators and barriers of HPV vaccination in young females aged 18–26 years in Singapore, and to describe their recommended strategies to improve the uptake of HPV vaccination.
Design: Qualitative, descriptive design guided by the socio-ecological model.
Participants: Young women studying in National University of Singapore (NUS), aged 18–26 (N = 40). Purposive sampling was used to recruit participants from various socio-economic levels and faculties, both vaccinated against HPV and unvaccinated.
Methods: In-depth interviews (IDIs) and focus group discussions (FGDs) were conducted with the participants. IDIs and FGDs were transcribed and coded using NVIVO software. Thematic data analysis was performed using an inductive approach.
Results: Barriers to HPV vaccination included lack of awareness, lack of perceived risk for cervical cancer, cost, lack of parental support, inconvenience of getting the vaccination, stigma associated with connection with sexual activity, and concern regarding safety. Facilitators include parental encouragement, protection of one's health, lack of logistical barriers, and perceived safety and efficacy of the vaccine. Participants recommended increasing awareness of HPV vaccination and cervical cancer, reducing cost of vaccination and making the vaccine compulsory to increase vaccine uptake.
Conclusion: Barriers and facilitators exist at different levels to influence vaccine uptake. Public education on cervical cancer and the vaccine should be stepped up to increase public awareness. A school-based national vaccination programme was proposed by the target group to increase the rate of uptake of HPV vaccination in Singapore.

1. Introduction

Globally, cervical cancer is the fourth most frequent cancer in women, representing 7.5% of all female cancers in 2012 [1]. In developed countries, there are effective screening programmes in place for early detection to reduce the mortality from cervical cancer [1]. However, there are also opportunities for primary prevention which avoids the development of cervical cancer further upstream through vaccination. Human papillomavirus (HPV) is the most common sexually transmitted infection, with 90% of cervical cancer cases caused by 9 high-risk strains of HPV [2,3]. Of these, types 16 and 18 account for nearly 70% of cervical cancer cases [2,3]. The first HPV vaccine became available in 2006 [1–3]. Today, there are three types of HPV vaccines: (a) the bivalent vaccine (types 16 and 18); (b) the quadrivalent vaccine (types 6, 11, 16 and 18); and (c) the nonavalent vaccine (types 6, 11, 16, 18, 31, 33, 45, 52, and 58) [1,3]. All these vaccines have been shown to be both safe and effective in decreasing the rates of HPV infection, cervical intra-epithelial neoplasia and cervical cancers [1–16]. This is particularly so when it is introduced at the population level with high coverage [4–16]. Therefore, increasing access to and uptake of HPV vaccination represents an opportunity to implement an intervention which is of public health significance.

Western countries such as Australia and the UK have implemented national school-based HPV vaccination programmes and have seen relatively high uptake of HPV vaccination [17–18]. In Australia, the uptake rate of HPV vaccination (completion of all 3

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doses) in 15 year old girls was 80.2% in 2017 [17]. In the UK, the rate of completion of 2 doses of HPV vaccination in 13–14 year old girls was 83.1% in 2016/2017 [18]. However, in Asia, where such national vaccination programmes mostly do not exist, the uptake rates of HPV vaccination are reported to be much lower [19]. A pooled analysis published in 2017 showed that coverage of HPV vaccination among the female population aged 10–20 years in Asia was 1.1%, compared to Europe (31.1%) and Oceania (35.9%) [19]. Although limited data was available on HPV vaccine uptake in specific Asian countries, there were two which have implemented national HPV vaccination programmes: Malaysia in 2010 and Japan in 2011 [20–22]. While Japan reported a vaccination rate of about 70.4% in 12–13 year old girls in 2012, its national programme has been terminated since 2013 [21]. For Malaysia, its vaccine uptake rates were reported to be sustained over 80% in cohorts of 13 year old girls from 2010 to 2017 [22]. Except these two countries, vaccine uptake in other countries in Asia were expected to be low considering the estimated pooled vaccine uptake in Asia was only 1.1% [19]. In keeping with this, a study by Zhuang et al in 2016 involving 255 young women aged 15–22 years old in Singapore found a vaccination rate of 9.8% [23]. At the time of data collection for this study, this vaccine did not fall under the national school-based vaccination programme in Singapore [24–26]. Instead, it was recommended on a voluntary basis for females aged 9–26 years old, where payment could be made through the compulsory national medical savings scheme known as Medisave [25–26]. In Hong Kong, which currently does not have a national school-based vaccination programme, rates of vaccine uptake have been reported to be between 2.4 and 9.1% [27].

While studies have been conducted to investigate the facilitators and barriers of vaccination, several gaps still exist. First, the main body of evidence on this topic comes from quantitative rather than qualitative studies [20,27–30]. In addition, there are few qualitative studies which have explored both facilitators and barriers to HPV vaccination [31–35]. Second, of the qualitative studies, most focused on the views of parents and healthcare providers towards vaccination rather than the views of young women who were the target recipients of the vaccine. In a systematic review of qualitative studies by Ferrer and colleagues [31], only 6 out of the 41 included studies focused on the barriers and facilitators to HPV vaccination from the perspective of young women. Of these 6 studies, only 2 focused on university-aged women compared to younger girls in secondary-level education [31]. There were thus few qualitative studies which explored barriers and facilitators of HPV vaccination from the perspective of young women as direct recipients of the vaccine [32–36]. Young women aged 18–26 years old are more independent to make health-related decisions compared to their primary/secondary school-going counterparts, for whom health-related decisions are more heavily influenced by parents. More information is needed for these women aged 18–26 years old so that specific targeted strategies could be developed for them to increase their HPV vaccine uptake.

Third, the few qualitative studies conducted to explore the barriers and facilitators to HPV vaccination in young women aged 18–26 years were mainly from Western countries [31–35]. In Asia, one qualitative study from Hong Kong among university-aged women reported major barriers to HPV vaccination including vaccine cost, lack of perception of risk from HPV and cervical cancer, lack of information and safety concerns about the vaccine [32]. The context in Hong Kong is slightly different from that of Singapore. The burden of cervical cancer was higher in Hong Kong, where the crude incidence rate was 12.7 per 100,000 female population in 2015 compared to 10.6 per 100,000 female population in Singapore [37,38]. In addition, Hong Kong launched a three-year "Cervical Cancer Vaccination Pilot Scheme" in 2016 to provide HPV vaccination for about 31,000 young females from low-income families, while such a similar scheme has never been rolled out in Singapore [39]. Aside from the study done in Hong Kong, to the best of our knowledge, there was a lack of qualitative studies exploring facilitators and barriers to HPV vaccination in the Asian context. A pilot qualitative study in Singapore reported barriers to vaccination for young women including fear of side effects, cost, and the lack of perception of risk of HPV-associated disease [36]. However, this study did not explore facilitators and barriers of HPV vaccination from the perspective of young women, but from the perspective of six senior clinicians in Dermatology or Obstetrics and Gynaecology [36]. These clinicians might not have accurately represented the perspective of young women as they were not the direct recipients of the vaccine. In addition, studies describing participants' views on the strategies that could be implemented to increase vaccine uptake were lacking [31–35]. Two quantitative studies in Singapore found that barriers to vaccination included vaccine cost, lack of information about the vaccine, and concern about side effects [23,40]. One of these studies assessed facilitators and barriers to HPV vaccination in young women aged 15–22 [23], whereas the other assessed facilitators and barriers to HPV vaccination in participants with a large age range from 25 to over 54 [40]. Participants were instructed to answer for themselves if they did not have a daughter aged 10–26, and they were instructed to answer for their daughter if they had one aged 10–26 [40]. Much like overseas studies, most studies in Singapore also focused on the facilitators and barriers of HPV vaccination from the perspective of parents and clinicians rather than the young women themselves [24,36,40].

Fourth, of the few qualitative studies which explored facilitators and barriers to HPV vaccination, most of them did not adopt behavioural science theories to assess the various influences on vaccine uptake [20,23,27–36,40]. Among the 41 qualitative studies included in the systematic review by Ferrer and colleagues, only 8 reported using theoretical frameworks or models [31]. These included the Health Belief Model (HBM) and the Theory of Planned Behaviour (TPB) [31]. The socio-ecological model (SEM) is another theoretical framework which recognises that social and environmental factors are important influences in health and disease and should be considered as factors in health promotion and disease prevention [41]. The model addresses five levels on which interventions can be considered: individual, interpersonal, organisational, community and policy [41]. It assumes that changes made in one or more of these levels would support behaviour change in individuals which leads to better health in the overall population [41]. To the best of our knowledge, there was a lack of studies which applied the SEM to explore facilitators and barriers to HPV vaccination [20,23,27–36,40].

This study aims to explore facilitators and barriers to HPV vaccination as well as to describe the recommendations made by young females themselves to increase HPV vaccine update using the SEM in Singapore. This would fill the gap in literature of qualitative studies on facilitators and barriers to HPV vaccination from the perspective of young women aged 18–26 years old in an Asian context like Singapore. The information would also be useful for public health practitioners and policymakers from other countries in Asia.

2. Methods

2.1. Design and setting

This was a qualitative descriptive study using in-depth interviews (IDIs) and focus group discussions (FGDs). A total of 40 female students, aged 18–26 years old studying at the National University of Singapore (NUS) were recruited by purposive sampling. While a homogeneous approach was taken for certain

demographic characteristics (participants were of one gender only, similar ages and educational status), we also allowed for heterogeneity in terms of vaccination status, faculty of study and socioeconomic status. Advertisements about the study were placed on the web-based learning portal for NUS students (which all students have access to), and those interested were invited to contact the first author. NUS is Singapore's oldest and largest (in terms of enrolment) university, with a wide range of disciplines including natural sciences, medicine and dentistry, law, engineering, arts and social sciences, business, and design and environment. The study was approved by the NUS Institutional Review Board (IRB) (ref S-17-211) in August 2017.

2.2. Data collection

Individuals were recruited from August-October 2017 after ethics approval. Participants were eligible for inclusion in the study if they were: (i) female; (ii) aged 18–26 years old; (iii) a student at NUS; (iv) a Singapore Citizen or Permanent Resident; (v) conversant in English; and (vi) free of cervical cancer. The FGDs were organised according to the vaccination status and the faculty of study. After grouping, participants were invited to join the FGDs. However, some of the participants declined to take part in an FGD and opted for an IDI instead, and this preference was accommodated. In addition, some of the questions were too sensitive to be asked in an FGD, hence it was more appropriate to collect such information through an IDI. Eighteen out of 40 participants underwent five FGDs with an average of 3–4 participants per group, and 22 participants underwent IDIs. Data saturation was reached.

On the day of the session, written informed consent was obtained from each participant. All participants were asked to fill in two questionnaires. One collected demographic information (such as age, ethnicity etc.) along with vaccination status, details of vaccination and source of information about the vaccine. The other questionnaire was a series of 37 statements about HPV, the HPV vaccine, and cervical cancer, for participants to mark as 'true', 'false' or 'unsure'. The questionnaire was adapted for this study from a validated questionnaire by Waller and colleagues to provide information on the participants' knowledge of HPV, HPV vaccination and cervical cancer [42]. To contextualise the questionnaire developed by Waller et al to Singapore, two additional domains were added: cervical cancer knowledge and local policy on HPV vaccination (e.g. whether there were any subsidies and whether vaccination was mandatory in Singapore). Relevant questions were crafted under each additional domain, with no additional questions crafted for the existing domains in the questionnaire developed by Waller et al. Therefore, there were a total of five domains in the questionnaire administered to participants in this study (HPV knowledge, HPV testing, HPV vaccination, cervical cancer knowledge, and local policy on HPV vaccination), and each domain was scored separately on a sub-scale.

The IDI and FGD topic guides were developed by the authors using the SEM as a framework and these were pilot-tested before use. The topic guides had the same base framework and questions, with the IDIs having additional questions on the timing of vaccination with sexual activity of an individual, the relationship between sexual activity and the perceived need for vaccination, as well as the intention of going for regular pap smears among those who were vaccinated. These questions were not included in the FGDs as they were of a more sensitive nature. Participants in the IDIs were advised that they did not need to answer this section if they preferred not to. IDIs and FGDs were conducted from September to November 2017. The FGDs lasted an average of 40 min whereas IDIs lasted about 30 min. Each session was carried out in meeting rooms in NUS, which provided a quiet environment with no disruptions. IDIs and FGDs were audio recorded with the consent of participants, and the files were destroyed after transcription of the interviews. All interviews were conducted by a single interviewer (first author) to ensure consistency of interviews.

2.3. Data analysis

Interviews were transcribed within 2 weeks of the interview being conducted, with coding completed within one week after transcription. An inductive approach was used to analyse the data. Thematic analysis was carried out to identify broad themes using NVIVO software. Two coders (the authors) coded the data line by line independently. Statements which expressed similar ideas were grouped under codes, and the codes were examined to group them into subthemes and then themes. Two rounds of coding by two separate coders were completed of the data, with the second round of coding occurring 2 months after the interviews concluded. Any discrepancy was resolved through consensus of the 2 authors. The coding was done according to vaccination status (a doer and non-doer analysis). Barriers were identified according to interviews from non-doers, and facilitators were identified according to interviews from doers, and both groups gave recommendations on how to increase uptake of HPV vaccination in Singapore.

3. Results

Table 1 shows the summary demographic characteristics of the 40 participants. Of the 11 participants who had received at least one dose of HPV vaccination, the age of vaccination initiation ranged from 15 to 24 years, with the median age being 19.5 years. All except one participant who had been vaccinated had the vaccination funded by either their parents' Medisave, or their parents had paid out of their pocket. One participant who had been vaccinated at 24 years old had paid for the vaccine from her own Medisave account.

3.1. Barriers to HPV vaccination

Table 2 gives a summary of the themes identified as barriers to vaccination, mapped to the corresponding level of the SEM.

3.1.1. Lack of awareness

There were various reasons for lack of awareness at the individual level of the SEM. Participants felt that there was inadequate publicity on HPV and cervical cancer. Some participants felt that while there were publicity efforts, these efforts did not catch their attention enough to motivate them to find out more information, let alone to change behaviour. The overarching theme of lack of awareness of cervical cancer, HPV and HPV vaccination for various reasons was a prominent barrier to vaccination.

> *"...like cervical cancer, some people don't even know which part of the body it is, for example. So it is not very well known compared to others."* –P35, 24yo, Medicine [IDI]
>
> *"It's either I wasn't very focused on the [HPV publicity] poster or like maybe it wasn't as informative... so it just slipped out of my mind."* –P18, 20yo, Medicine [IDI]

3.1.2. Lack of perceived risk

In general, participants felt that young people were not at risk of disease. They felt that young people around their age were less likely to go for health checkups and to be interested in preventive health than older people, since they saw themselves as being less susceptible to disease. Most of the young people did have a positive

Table 1
Demographic characteristics of the 40 participants.

Characteristic	No.	%	Characteristic	No.	%
Age			***Housing status***		
18–20	12	30.0	3-room HDB*	3	7.5
21–23	23	57.5	4-room HDB*	4	10.0
24–26	5	12.5	5-room HDB/EC*	13	32.5
Ethnicity			Private condo	16	40.0
Chinese	38	95.0	Landed property	4	10.0
Indian	1	2.5	***Faculty***		
Eurasian	1	2.5	Medicine^	19	47.5
Vaccination status			Arts and Social Sciences (FASS)	10	25.0
Unvaccinated	29	72.5	Business	2	5.0
Incomplete vaccination	4	10.0	Natural Science	9	22.5
Vaccinated	7	17.5			

* HDB refers to Housing Development Board housing, which is public housing (subsidised for Singapore citizens and Permanent Residents). An EC (Executive Condominium) is a hybrid type of housing between public and private housing.
^ Includes nursing students.

Table 2
Summary of barriers to vaccination identified from FGDs and IDIs.

Type of barrier	Themes identified (barrier)	Levels of socio-ecological model				
		Individual	Inter- personal	Community	Organisational	Policy
Perceptual	Lack of awareness	X				
	Lack of perceived risk	X				
	Concerns about side effects	X				
Socio-cultural	Connection with sexual activity	X	X			
	Lack of parental support		X			
Logistical	Cost			X		X
	Inconvenience	X		X		X

view of health checkups and health maintenance, but felt that it was something for the future. However, they did not have a concrete plan on when they would start having health checkups and preventive health measures such as HPV vaccination. Low risk perception of cervical cancer was an individual-level barrier in terms of the SEM as the participants did not see value in being vaccinated to protect against something they did not view as a risk.

"I guess people my age isn't as health conscious yet, because at our age we don't really get any serious health issues or anything. And our focus is not on health currently"' –P36, 24yo, Faculty of Arts and Social Sciences (FASS) [IDI]
"I'm pretty sure I will be getting [the vaccine]. It's a matter of when. Where I am now, it's sort of like I'm not that at risk now and in the future I'll be able to still protect myself." –P8, 22yo, Science [FGD]
"I think the disease just seems very far away... like not that important." –P4, 22yo, Science [FGD]

Another theme that emerged was that participants felt that they were not at risk of HPV and cervical cancer specifically since they were not sexually active.

"...for me personally, *because the main mode of transmission is through sexual activity, and I don't think I'll be so active in the future... So I also don't think I'll get [vaccinated]." –P40, 21yo, Science [IDI]*

Participants also held the view that cervical cancer was not a frequent or serious disease, mostly because it was not heard of often. Surprisingly, this was a view which was expressed even by medical students.

"And who even gets cervical cancer? No one hears about cervical cancer." –P12, 22yo, Medicine [IDI]
"But cervical cancer I don't really get that same idea... I don't really see how it will affect me." –P1, 22yo, FASS [FGD]

3.1.3. Concerns about side effects

There was also a theme of concern regarding the safety profile of the vaccination as a barrier to being vaccinated.

"And then this vaccine, if I'm not wrong, has not been tested for a very long time, so hasn't been around for as long. So the long-term side effects actually is still unknown to us." - P23, 21yo, Business [FGD]

3.1.4. Connection with sexual activity

The theme of cervical cancer and HPV being stigmatised due to their connection with sexual activity also emerged during the FGDs and IDIs. Participants in this study felt that cervical cancer was rarely discussed as it was seen as a 'taboo' topic due to its connection with sexual activity, posing an individual and interpersonal barrier to vaccination. This extended to a belief which seemed relatively widely held, that if an individual had the vaccine, others would think that they were sexually active or even promiscuous (or at least planning to be). To avoid giving people this perception, participants avoided having the vaccination.

"People who have cervical cancer, they probably won't tell others, because it may be a bit shameful..." –P36, 24yo, Medicine [IDI]
"Because the expectation is that usually you take [the vaccine] then you are sexually active." –P43, 21yo, Medicine [FGD]

3.1.5. Lack of parental support

Some participants shared that they had not been vaccinated as their parents had not been keen or supportive of them being vaccinated. This was largely because parents were deterred by the cost of the vaccine as well as lack of awareness of any benefit from the vaccine. The theme of the young women tending to listen to their parents' advice with regards to this decision was identified,

particularly when their parents did not have positive views of HPV vaccination, was a significant interpersonal barrier to vaccination.

"And [my dad] said yeah, I didn't have it because it was expensive and he thinks there's no need to get it." –P4, 22yo, Science [FGD]

3.1.6. Cost

Participants cited the high cost of the vaccine as a significant barrier to vaccination. Most participants felt that the vaccine was too costly, even though a smaller proportion knew what the actual cost of the vaccine was. The cost of the vaccine was largely a community and policy barrier to vaccination.

"...heard it's S$100 per dose, so it's like S$300... for a university student, that's quite a lot." –P40, 21yo, Science [IDI]

3.1.7. Inconvenience

Many participants cited the inconvenience of getting the HPV vaccination as a barrier to vaccination. Participants felt it was troublesome to go back to the clinic for vaccination on 3 occasions, and did not seem motivated to take time out of their schedules for this, particularly if they were not strongly convinced of the benefits of the vaccine. The theme of perceived inconvenience of being vaccinated represented a barrier on intrapersonal, community and policy levels of the SEM.

"It's so troublesome... it's not like maybe 3 times a week you can get it over and done with. It's over more than a year, it's really long..." –P40, 21yo, Science [IDI]

3.2. Facilitators

Table 3 gives a summary of the themes identified as facilitators to vaccination, mapped to the corresponding level of the SEM.

3.2.1. Protection of their own health

Participants who had been vaccinated felt that it was important to take steps to prevent disease, and cited this as a reason that they had the HPV vaccination. The participants may not have had a good understanding of what cervical cancer was, but expressed similar notions that it was better to prevent disease than cure it.

"I don't really think I'm at risk now, but it's just good to prevent." –P30, 20yo, Medicine [FGD]

"It's always better to prevent than to not prevent." –P43, 21yo, Medicine [FGD]

3.2.2. The vaccine was perceived as safe and effective

Participants who had the vaccine felt that it was safe and effective, and therefore worth having due to the benefit it conferred. Their source of information usually came from a trusted individual, such as their parent or a healthcare professional. Few participants had sought their own information on the vaccine, but had been informed by someone else about the vaccine prior to having it. The overarching theme facilitating vaccination was receiving positive information regarding the vaccine. A subtheme was receiving this information specifically from a healthcare professional, as they were generally viewed as credible.

"I felt that it was risk-free, or at least it was positioned that way." –P39, 22yo, FASS [IDI]

"I think the doctor explained it and it sounded like there weren't many side effects." –P12, 22yo, Medicine [IDI]

3.2.3. Parental encouragement

Participants who had the vaccine expressed the notion that they had mostly been vaccinated due to their parents' encouragement or facilitation. This ranged from parents encouraging their daughters to have the vaccine, to making appointments for them, and paying for their vaccination. This mirrored the theme identified from the non-doers earlier, where the lack of parental encouragement was identified as a barrier to vaccination.

"I was more pressured *by my mom... she was just like ok, sure, for the sake of my daughter I'll sponsor the vaccine. Just let her go for it, at least she gets some coverage."*–P24, 22yo, FASS [IDI]

"I think my mom's wanting me to get it played a significant role in me getting it." –P30, 20yo, Medicine [FGD]

3.3. Knowledge level of participants

Generally, there was a wide range of knowledge level on cervical cancer and HPV, with a diverse range of scores for each domain (HPV knowledge, HPV testing, HPV vaccination, cervical cancer and local policy), as shown in Table 4**.** Common misconceptions about HPV (i.e. questions where at least half of the participants answered incorrectly or gave the option of 'unsure') are shown in Table 5. The common misconceptions were in the domains of HPV knowledge, HPV testing and cervical cancer. Participants generally scored higher for the questions on local policy regarding HPV vaccination compared to those on the aetiology of cervical cancer as well as the frequency and reasons for HPV vaccination.

3.4. Recommendations

Table 6 gives a summary of the themes which emerged in terms of recommendations to increase vaccine uptake.

3.4.1. Create more awareness

The overarching theme was that publicity of the HPV vaccine should be increased to increase uptake of vaccination. In particular, participants felt that publicity should focus efforts on informing people that they were at risk of cervical cancer and how it would affect their lives.

"Talk about future effects and make people think about how it will affect their life... and also how it will affect their friends or family." –P9, 22yo, Science [IDI]

Interestingly, a sub-theme that was identified was that publicising the 'age cut-off' (that is, the recommended age range of 9–26 years for HPV vaccination) would create urgency to have the vaccination and therefore would increase uptake.

Table 3
Summary of facilitators to vaccination identified from FGDs and IDIs.

Type of facilitator	Themes identified (facilitator)	Levels of socio-ecological model				
		Individual	Inter- personal	Community	Organisational	Policy
Perceptual	Protection of one's health	X				
	The vaccine perceived as safe & effective	X	X	X		
Socio-cultural	Parental encouragement		X			

Table 4
Scores for knowledge questionnaire by knowledge domain.

Domain	Total no. of statements	Range	Median score (% score)
HPV knowledge (includes statements on HPV aetiology, risk factors, prevalence)	16	2–16	11 (68.8%)
HPV testing	6	1–6	3 (50%)
HPV vaccination	7	1–7	5 (71.4%)
Cervical cancer	5	1–5	4 (80%)
Local policy on HPV vaccination and cervical cancer	3	1–3	3 (100%)

"I think as people reach the age of 26, they'll feel a greater sense of urgency." –P45, 22yo, Business [IDI]

A subtheme for increasing publicity of the vaccine was that publicity efforts should be delivered specifically through schools to increase exposure to HPV vaccination in young women. Participants also recommended that parents be educated regarding the HPV vaccination, since in the Singapore context, parents play a large role in decision-making for their children, even up to 26 years of age.

"I think maybe the school can also help to promote, like during health checks." –P40, 21yo, Science [IDI]

"I think it's important for parents to know also so they can advise their children. In Singapore 9-26 is still *probably under their parents, so their parents can influence them." – P11, 22yo, Medicine [IDI]*

3.4.2. Make the vaccine compulsory

The theme of policy change to increase vaccine uptake, specifically making the vaccine compulsory, was also identified. Participants did not think there would be much resistance from the population if the vaccine were to be made compulsory. There was a high level of trust expressed in the government.

"There's a lot of trust in the government so if they recommend or make it compulsory people will do it." –P3, 22yo, Science [FGD]

3.4.3. Subsidise the vaccine

Not surprisingly, participants felt that subsidising the vaccine would increase uptake of the vaccine.

"Definitely subsidising it would help tremendously." –P12, 22yo, Medicine [IDI]

3.4.4. Increase accessibility

Participants felt that if the vaccine were more accessible to them, it would increase their chances of getting it. The theme of increasing convenience was a recurrent one to facilitate vaccination. For the participants, who were studying on campus, increasing accessibility meant making the vaccine available on campus. However, most of the participants did not seem aware that the vaccine was already available (at an unsubsidised rate) at the University Health Centre (UHC) on campus.

"Maybe it should be offered in the UHC. It's very convenient and would be targeting the age group that might be having it."–P11, 22yo, Medicine [IDI]

4. Discussion

This study found that barriers to HPV vaccination among young women aged 18–26 years in Singapore included lack of awareness, low risk perception of HPV and cervical cancer, concerns about side effects of the vaccination, the stigma of connection of HPV and cervical cancer with sexual activity, lack of parental support, high cost of the vaccine and inconvenience of being vaccinated. Facilitators included the individual being motivated to protect her own health, the perception of the vaccine as safe and effective, and parental encouragement for vaccination.

4.1. Comparison of findings with international studies

Most barriers such as lack of awareness, lack of perceived risk and cost, as well as facilitators such as protection of one's health were similar to findings from other studies [20,23,27–35,40]. Some of the findings which came up more prominently in this study compared to other studies included parental encouragement as a facilitator to vaccination, and the urgency to be vaccinated if people knew there was a 'recommended age limit' to be vaccinated. The finding that there was some stigma associated with HPV vaccination due to the connection of HPV infection with sexual activity was not surprising. This was a consistent finding not only in Asian studies but was also highlighted in 2 USA studies [23,32,34,35]. The theme of safety concerns regarding the vaccine as a barrier to vaccination was not as recurrent in our study

Table 5
Common participant misconceptions about HPV and cervical cancer.

Statement *(correct answer)*	Knowledge domain	% who answered this statement incorrectly or gave the option of 'unsure'
HPV usually does not need any treatment *(True)*	HPV knowledge	82.5
Most sexually active people will get HPV at some point in this lives *(True)*	HPV knowledge	62.5
There is no cure for cervical cancer *(False)*	Cervical cancer	62.5
If a HPV test shows that a woman does not have HPV her risk of cervical cancer is low *(True)*	HPV testing	52.5
Having sex at an early age increases the risk for HPV *(True)*	HPV knowledge	50.0

Table 6
Summary of recommendations to improve vaccination uptake identified from FGDs and IDIs.

Themes identified (recommendation)	Levels of socio-ecological model				
	Individual	Inter- personal	Community	Organisational	Policy
Create more awareness	X	X	X		X
Make the vaccination compulsory					X
Subsidise the vaccination					X
Increase accessibility			X		X

compared to other studies which had indicated that it was a significant barrier [20,23,27–35].

4.2. Public health and policy implications

There are 2 levels of public health and policy implications of this study: short-term, which includes education and promotion of awareness of HPV and cervical cancer; and long-term, which includes changing vaccination behaviour by making changes on a community or policy level based on the SEM.

4.2.1. Short-term implications

The results showed that to increase uptake of HPV vaccination, raising awareness of HPV vaccination and cervical cancer could be considered. School-based education has been effective in other countries such as Australia and the UK. A similar approach can be taken in Singapore with efforts to increase awareness about HPV and cervical cancer in schools. In Scotland and Australia, national HPV vaccination programme websites have been set up so that there is a reliable source of consolidated information on HPV and cervical cancer to educate the public [43–44]. Given that there were several common misconceptions about HPV and cervical cancer among the study participants despite them being relatively well-educated, there is an urgent need to increase awareness and risk perception of these young women regarding HPV and cervical cancer.

To achieve this, consideration of the target population for education as well as the content of education are equally important. Parents play a role in whether their daughters are vaccinated against HPV [30–35]. In the Singapore context, filial piety is highly valued, and this involves the children obeying and honouring their parents' wishes [45]. Although young adults are subjected to external influences, it is still a common practice for them to consider their parents' opinions in many situations [45]. This is not surprising given that 97% of single young adults continue to live with their parents, according to the 2013 data released by the Singapore Statistics Bureau [46]. As such, education efforts should also be extended to parents. This could be carried out in different contexts, such as schools, workplaces, healthcare institutions and other public spaces. Educational materials which are designed for parents, and helpful conversation starters and tips on how to discuss this issue with their daughters could be made available to facilitate parents to talk to their daughters about HPV vaccination. Parents would be receptive to measures which were positioned as beneficial or protective for their daughters. If they were convinced that HPV vaccination would reduce their daughters' risk of having cervical cancer without significant side effects, they would be more willing to facilitate this, particularly for younger school-going children. Most of the participants in this study who had been vaccinated were 17 years and over at the time of vaccination, hence there is room to reduce the age of vaccination. This has public health and policy implications given that females who are over 17 years old may have already initiated sexual activity and thus they may have already been exposed to HPV. This means that vaccinating this group against HPV may not be as beneficial, compared to vaccinating a younger age group before the age of initiation of sexual activity.

Healthcare professionals should also be engaged to educate patients about HPV vaccination, both parents and young women. Many participants had been informed about HPV vaccination by a healthcare professional (such as a doctor or a nurse) and seemed to trust and give credence to information given about the benefits or safety of vaccination when the information came from a healthcare professional.

Content that should be emphasised in education about HPV vaccination would include reducing the stigma associated with HPV vaccination, and increasing the risk perception of HPV and cervical cancer. In any education efforts, HPV vaccination should be positioned as a preventive measure to protect long-term health rather than the way it is perceived now, which is a measure taken by those who are either sexually active or contemplating sexual activity soon. Awareness of the vaccine should be increased so that young women would view it as a necessity to protect their future health, rather than a measure that was associated with sex and sexuality. This was consistent with a recommendation from a study by Beavis et al in the USA, which was that emphasis should be placed on increasing awareness, safety and health promotion of HPV vaccination rather than on sexuality and sexual activity to reduce HPV vaccine hesitancy [47]. This would also remove the stigma associated with HPV vaccination, and potentially increase vaccine uptake. Education efforts should also be stepped up such that younger women are aware that the HPV vaccination is most effective before the commencement of sexual activity, since many participants expressed that they would delay the vaccine until they became sexually active.

4.2.2. Long-term implications

In the longer term, a change in policy regarding the administration of the HPV vaccine would be the key to improving uptake of HPV vaccination—such as a significant reduction in the cost of the vaccine, implementing a national school-based programme, or making the vaccine compulsory. Apart from increasing the awareness of the benefits of vaccination, a school-based programme would potentially remove many of the above-mentioned barriers and increase the accessibility of vaccination. School-based programmes have been reported to increase both accessibility of the vaccine and awareness of the vaccine, and if administered together with an either heavily-subsidised or free vaccine, would most likely increase uptake rates of HPV vaccination. The data on uptake of HPV vaccination in Australia and the UK after implementation of their national school-based HPV vaccination programmes has shown that national school-based vaccination has been a highly efficient strategy [9,16–18]. A local study in 2018 showed that universal HPV vaccination in 12-year old females was a cost-effective strategy in Singapore, with the bivalent vaccine dominating the quadrivalent vaccine [48].

At the time of writing, the Ministry of Health in Singapore has begun to offer free HPV vaccination as part of a national school-based HPV vaccination programme [49–51] from April 2019 onwards for 13-year-old females. The vaccination would not be mandatory but administered on an opt-in basis. Further monitoring and evaluation of vaccine uptake and incidence of HPV-related disease after the programme is more established would be needed.

4.3. Strengths and limitations of the study

The strengths of this study were that it filled a gap in the existing literature of qualitative studies that studied both facilitators and barriers of HPV vaccination among young Asian females who were direct recipients of the vaccine. Data saturation was reached with a sample of 40, and concrete recommendations were given by participants on how to improve the uptake of HPV vaccination.

Limitations of the study were that the study only included university students. This could mean that the perspectives given were limited to females who were relatively well-educated. The perspectives of young women who are working might differ. In addition, the majority of the participants were from healthcare or science related faculties. Given their field of study, this might have affected the knowledge component of the study results considering that they might have had more knowledge in this area compared to students from Engineering or Arts and Social Sciences. As such, the

study findings may not be completely transferable to the general population of young women in tertiary education. Transcripts were also not checked and confirmed with interviewees, however they were audio-recorded in a quiet environment and so the responses were clearly captured and transcribed verbatim. In addition, the questionnaire assessing HPV and cervical cancer knowledge had not been validated in the young female population in Singapore. However, this was not the focus of this study and served mainly as a tool for the researchers to gauge the knowledge level of the participants. This study also did not address HPV vaccination for younger males, where there is increasing evidence calling for the vaccine to be extended to males as part of school-based programmes [52–54]. Countries such as Australia and the UK have already implemented this [53,54]. Further studies on feasibility and cost-effectiveness of extending the school-based programme to younger males in Singapore are needed.

4.4. Reflexivity

The first author, who conducted the interviews and focus group discussions, was a female doctor who has been vaccinated against HPV. While this might have influenced her views on the vaccine, she followed the topic guide closely and framed the questions in a neutral tone. Efforts were also made to take notes and memos during the interviews and focus group discussions so that the participants' perspectives were accurately reflected.

5. Conclusion

This qualitative study has shown that barriers and facilitators exist at different levels of the SEM to influence vaccine uptake. Public education on cervical cancer and the vaccine should be stepped up to increase public awareness. A school-based national vaccination programme was proposed by the target group to improve vaccine uptake in the longer-term, and such a programme has recently been implemented in April 2019 in Singapore. Further studies are required to evaluate and refine the success of this programme at the medium- and long-term.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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