Parental perceptions of childhood seasonal influenza vaccination in Singapore: A cross-sectional survey

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Abstract

Purpose:

Seasonal influenza vaccination is recommended in children aged 6-59 months, but little is known about child vaccination coverage and determinants in Asian settings. We report the results of a survey of knowledge, attitudes, practices, and determinants of child influenza vaccination in Singapore.

Methods:

In December 2015-March 2016, we conducted a survey of 332 parents of children aged 6 months to 5 years attending pre-schools. We assessed child influenza vaccine coverage and parental knowledge, attitudes, and practices of child influenza vaccination. We used multivariable regression and structural equation models to identify factors associated with child influenza vaccination.

Results:

Knowledge about influenza, perceived benefit of vaccination, and willingness to vaccinate were high. However, only 32% of children had ever received influenza vaccine, and only 15% in the past year. Factors independently associated with child influenza vaccination included: being recommended influenza vaccine by a child's doctor (prevalence ratio (PR)=2.47, 95% CI: 1.75-3.48); receiving influenza vaccine information from a private general practitioner (PR=1.47, 95% CI: 1.05-2.04); regularly receiving pre-travel influenza vaccine (PR=1.64, 95% CI: 1.19-2.25); higher willingness to vaccinate (PR=1.58, 95% CI:1.24-2.04 per unit increase in willingness score); and feeling well-informed about influenza vaccine (PR=1.44, 95% CI: 1.04-1.99). Parents

who obtained influenza vaccine information from television were less likely to have vaccinated their child (PR=0.44, 95% CI: 0.23-0.85). Path analysis indicated that being recommended vaccination by a child's doctor increased willingness to vaccinate and self-efficacy (feeling well-informed about influenza vaccine). Median willingness-to-pay for a dose of influenza vaccine was SGD30 (interquartile range: SGD20-SGD50), and was higher in parents of vaccinated compared with unvaccinated children (SGD45 vs SGD30, p=0.0012).

Conclusion:

Knowledge and willingness to vaccinate was high in this parent population, but influenza vaccine uptake in children was low. Encouraging medical professionals to recommend vaccination of eligible children is key to improving uptake.

Word count: 299

Keywords

Influenza; influenza vaccine; child health; health survey; vaccination policy; vaccination coverage

Introduction

Influenza is a major cause of disease burden among children below 5 years of age, causing an estimated 870,000 hospitalisations and 10,200 deaths per year worldwide [1,2]. Most influenza-associated deaths occur in low-income countries, but there is a substantial disease burden in high-income countries, where an estimated 55 cases of influenza, 15 cases of influenza-associated lower respiratory infection, and 1 case of severe influenza infection occur per 1000 children below 5 years of age [3].

Influenza vaccine effectiveness varies between countries and across influenza seasons, but studies in Asia [4,5] and Europe [6,7] have shown good effectiveness of seasonal influenza vaccine among young children. As parents are the main healthcare decision makers for their young children, understanding parental perceptions towards influenza vaccination is important for informing interventions to encourage uptake. A survey carried out in England found that vaccine uptake was associated with parental perception that the influenza vaccine was effective and their child was susceptible to influenza [8]. Conversely, in the National Flu Survey in the United States, parents' perception that their child was not at risk for influenza or severe illness from influenza was the most common reason for not vaccinating their child [9]. In both studies, the perception that the vaccine was unsafe was associated with children not being vaccinated [8,9]. Perceived safety was also found to be significantly associated with parents' acceptance of an offer to vaccinate their child against influenza in a study carried out in Sydney, Australia [10].

Although several studies of parental perceptions regarding child influenza vaccination have been published, most of these have been conducted in Western settings. Parental perceptions that

influence uptake of child influenza vaccine are not well described in Asian settings, and no previous studies have been conducted in Singapore, where influenza epidemiology [11], vaccination policy and financing, healthcare structure, and patient-doctor dynamics are generally very different from Western settings.

In Singapore, a high-income country in the tropics, influenza circulates year-round with two main peaks in December and June coinciding with Northern and Southern Hemisphere epidemics. Between 2010 and 2012, influenza-associated hospitalisations were estimated at approximately 96 per 100,000 person-years among children aged 6 to 23 months and 64 per 100,000 person-years among children aged 2 to 4 years, corresponding to an excess in hospitalisations coded as pneumonia and influenza of 13% and 9% respectively [12].

The Singapore Ministry of Health recommends annual vaccination of children aged 6-59 months old with trivalent or quadrivalent inactivated influenza vaccine, but there is currently no universal childhood influenza vaccination programme. Financing of childhood vaccines in Singapore is complex and depends on the specific vaccine, residential status of the child, and whether vaccines are administered in the public or private sector. Vaccines included in the National Childhood Immunisation Schedule, such as those for tuberculosis (BCG); Hepatitis B; Diphtheria, Tetanus, Pertussis (DTaP); Measles, Mumps, Rubella (MMR); Poliovirus (IPV); and *Haemophilus influenza* type b (HiB), are available free of charge in the public sector for Singaporeans and subsidised for Permanent Residents [13,14]. The cost of other recommended vaccines that are not in the National Childhood Immunisation Schedule is not covered by the public health sector. These include the influenza vaccine, pneumococcal vaccine, chicken pox vaccine, and human papillomavirus vaccine. However, parents can choose to pay for their child's

influenza vaccine through a variety of ways: (i) their Medisave, a mandatory medical savings account for Singaporeans and Permanent Residents, (ii) their child's Baby Bonus cash gift, a one-time cash gift for children born on or after 1 January 2015, or (iii) savings in the Child Development Account, a special savings account for which the government will match the amount of savings for children born on or after 24 March 2016 [15,16]. In addition, influenza vaccine can be purchased out-of-pocket in the private sector. Administration of influenza vaccine is not universally documented on child electronic immunisation records, particularly for children vaccinated in the private sector, so reliable data on child influenza vaccination coverage in Singapore are lacking.

We conducted a cross-sectional survey to (i) estimate influenza vaccine coverage among children aged 6 months to 5 years in Singapore, (ii) examine parental knowledge, attitudes, and practices regarding child influenza and influenza vaccination, and (iii) investigate factors associated with child influenza vaccination.

Methods

Sample

Between December 2015 and March 2016, we conducted a cross-sectional survey of parental perceptions of child influenza vaccination in Singapore. The study was conducted by medical students as part of a capstone community health project. We approached 102 pre-schools with students aged 6 months to 5 years, selected at random from a list of institutions registered with the Early Childhood Development Agency, a regulatory authority which oversees pre-schools in Singapore. Of these, 17 agreed to disseminate information about the study to parents and a link to an online survey. Due to time constraints, and because initial response was low, additional pre-schools from the list were recruited through convenience sampling. Overall, a total of 325 pre-schools were approached, of which 92 agreed to disseminate study information. 36 out of the 92 pre-schools also allowed the students to visit the pre-schools in pairs to recruit parents in person and invite them to complete the online questionnaire on site or at their own convenience with a link to the online survey for parents who did not have time to complete it at the child care centre.

Eligible parents were those with a child aged 5 years or below attending a pre-school included in the study. A target sample size of 385 was pre-determined based on the ability to estimate an influenza vaccine coverage of 50% +/- 5% with 95% precision.

Questionnaire

The anonymous, online survey questionnaire was developed using Qualtrics software (Qualtrics Labs, Inc.) and could be completed on mobile devices. The questionnaire consisted of 81 questions, assessing factors which were found to be associated with child vaccinations in the literature. These included cost of vaccine [17], place of vaccination [18], doctor's recommendation [19,20], government guidelines [21], parents' influenza vaccination status [19], and intention to travel [22]. Our survey questionnaire consisted of questions in seven domains: (i) Knowledge of Influenza and Influenza Vaccination, (ii) Perceptions of Influenza Severity and Susceptibility, (iii) Perceptions of Vaccination Barriers and Benefits, (iv) Willingness to Vaccinate, (v) Vaccination Practices, (vi) Self-efficacy, and (vii) Cues to Vaccination. Response options for questions in the Knowledge of Influenza domain were "True", "False", or "Not sure", while questions in the Willingness to Vaccinate domain were on a 5-point Likert scale. For the majority of other questions, responses were binary. On average, the questionnaire took 18 minutes to complete.

Data analysis

The main outcome measures were participant-reported child influenza vaccination prevalence in the past year, and at any time in the past. In addition, we conducted an analysis of factors associated with ever having vaccinated one's child against influenza. We framed our analysis around the Health Belief Model of health behaviour [23]. We hypothesised that children's vaccination status is influenced by parents' demographic characteristics and knowledge of influenza and influenza vaccine, their own influenza vaccination practices and willingness to vaccinate their children, their perceptions of the severity of influenza and their children's

susceptibility to it, their perceptions of influenza vaccination benefits and barriers, as well as external cues to action. A conceptual framework for this model is shown in Fig. 1.

Participants' knowledge was assessed using a 15-point knowledge score, with 1 point given for each correctly answered knowledge question. To assess constructs of perceived severity and susceptibility to influenza, and benefits of and barriers to vaccination, parents were presented with a series of statements with which they were asked to agree or disagree. Willingness to vaccinate was assessed using a series of 14 scenario questions. For each scenario, participants were asked if they would definitely vaccinate their child, probably vaccinate, probably not vaccinate, definitely not vaccinate, or were not sure. Each response was given a score ranging from -2 (definitely would not vaccinate) to +2 (definitely would vaccinate), with 'not sure' given a score of 0. The scores were averaged across all 14 scenarios to give a mean willingness score ranging from -2 to +2.

We analysed the data using a Poisson model with robust standard errors [24]. The outcome variable was ever having vaccinated the child against influenza. We estimated associations between independent variables and the outcome using the prevalence ratio and corresponding 95% confidence interval (CI). In single variable analysis, we first regressed each explanatory variable against the outcome and retained those for which there was moderate to strong evidence of an association ($p < 0.2$). Within each domain of our conceptual framework, we then identified the combination of variables that provided the best fit to the data, favouring the model with the lowest value for Akaike's Information Criterion (AIC). In the final stage, we first included demographic variables retained in the previous stage and sequentially added variables from each subsequent domain, at each stage retaining those variables that yielded the model with the

lowest AIC. We did this iteratively until no further variables could be included in or excluded from the model without resulting in an increase in the AIC. We did not explicitly test for effect modification, as we had no a priori hypotheses for interactions between variables.

In addition, we conducted path analysis using generalised structural equation models to better understand inter-relationships between variables. In particular, we fitted models to test two competing hypotheses: that willingness to vaccinate and self-efficacy (feeling well-informed about influenza vaccine) were influenced either by knowledge or by external cues (being recommended influenza vaccination by a doctor or receiving influenza vaccine information from a doctor's clinic).

Analyses were performed using Stata 14 (Stata Corporation).

Ethics statement

The study was approved by the Institutional Review Board of the National University of Singapore (NUS-IRB Reference Code B-15-284, approval number NUS 2838). Informed consent was obtained from participants at the beginning of the online questionnaire.

Results

A total of 447 responses to the online questionnaire were obtained. Of these 61 were excluded as they were largely incomplete, indicating that the respondent had stopped completing the questionnaire early on. Another 42 responses were excluded as the age of the child was <6 months. A further 12 responses were excluded because the respondent's age was above 45 years, making it more likely for them to be the grandparents of the children. The remaining 332 responses were included in the analysis.

Demographics

Among the 332 respondents, 59% were aged 35 years and above and 79% were female. Those of Chinese ethnicity comprised 82% of the sample, with Malays making up a further 6% and Indians 5%. In nearly three-quarters (72%) of responses, at least one of the parents had a university degree. Nearly two-thirds (63%) of respondents lived in 3- to 5-bedrooms public housing (Housing Development Board flats) and 28% lived in private condominiums (Table 1).

Vaccine coverage

Of the 332 respondents, 50 (15%; 95% CI: 11% - 19%) stated that their child had been vaccinated against influenza in 2015, while 105 (32%; 95% CI: 27% - 37%) reported that their child had received influenza vaccine at some point in the past.

Knowledge, attitudes, and practices

The median knowledge score was 12 out of 15, indicating that most parents were generally knowledgeable about influenza and influenza vaccine. 88% of respondents were aware that there was a vaccine for influenza.

Perceived susceptibility was high, with 83% of respondents believing that their child was susceptible to catching influenza from their peers. Perceived benefit of the influenza vaccine and severity of influenza were also relatively high; 70% of respondents believed that influenza vaccine was effective in preventing their child from getting influenza and 67% stated that influenza was a serious disease. However, a third of respondents felt that influenza was a mild disease. A similar proportion of respondents also felt that influenza was not serious enough for their child to warrant vaccination.

In addition, 5 potential barriers were evaluated. More than three-quarters of respondents were more likely to vaccinate their child if it was offered at school. In addition, 40% respondents were worried that their child had received too many vaccines, 39% were worried about the side effects of the influenza vaccine, 27% were worried that the influenza vaccine would affect other vaccinations, and 26% found the influenza vaccine to be too expensive. In addition, 64% of respondents stated that they would be less likely to vaccinate their child against influenza if they knew someone who had had a bad experience with the influenza vaccine.

Overall, willingness to vaccinate was high, with only 1.6% of parents stating that they would not vaccinate their child against influenza under any of the scenarios presented.

Among 105 previously vaccinated children, 56% had been vaccinated at a private general practice (GP) clinic, 19% at a government subsidised polyclinic, 16% at a private paediatric clinic, and 10% elsewhere. In contrast, when asked about their preferred locations for their child to receive influenza vaccine, 58% of respondents stated a private GP clinic, 55% their child's school, and 37% a polyclinic.

The most commonly stated sources of information about influenza vaccine were the internet (50%) and private GPs (47%). 33% of respondents had been recommended by a private GP or paediatrician to vaccinate their child against influenza.

Willingness to pay

The median willingness to pay for one dose of child influenza vaccine was SGD30 (range SGD0 - SDG300). Respondents whose child had been vaccinated in the past were generally willing to pay a higher amount for one dose of influenza vaccine for their child (median SGD45, range SDG0-SGD150) than respondents whose child had never been vaccinated (median SGD30, range SGD0-SGD300) (Mann-Whitney U test $p = 0.0012$). When asked who should pay for the majority of the cost for their child's influenza vaccine, 65% of respondents chose the government, 30% chose parents, and 3% stated an equal share between parents and the government.

Factors associated with child influenza vaccination

Single variable associations between history of influenza vaccination and explanatory variables are presented in supplementary table S1. In multivariable analysis, those recommended influenza

vaccination for their child by a private GP or paediatrician were 2.5 times more likely to have vaccinated their child against influenza in the past (PR = 2.47, 95% CI: 1.75 - 3.48). Other factors associated with increased vaccination prevalence were regularly taking pre-travel influenza vaccine (PR = 1.64, 95% CI 1.19 - 2.25), having higher willingness to vaccinate (PR = 1.58, 95% CI: 1.24 - 2.04 per unit increase in willingness score), receiving influenza vaccine information from a private GP clinic (PR = 1.47, 95% CI: 1.05 - 2.04), and feeling well-informed about influenza vaccine (PR = 1.44, 95% CI: 1.04 - 1.99). Receiving influenza vaccination information from television was associated with a lower prevalence of vaccination (PR = 0.44, 95% CI: 0.23 - 0.85) (Table 2). No associations between vaccination and demographic or socioeconomic variables were observed after adjusting for other variables.

Path analysis indicated that being recommended influenza vaccination by a private GP or paediatrician positively influenced willingness to vaccinate ($\beta = 0.31$, $p = 0.001$), self-efficacy (feeling well-informed about influenza vaccine; $\beta = 1.40$, $p < 0.001$) and regularly getting pre-travel influenza vaccine ($\beta = 0.51$, $p = 0.043$) (Fig. 2). The latter was also positively influenced by receiving influenza vaccine information from a private GP clinic ($\beta = 0.57$, $p = 0.018$). In contrast, higher knowledge score did not influence any of these variables and was not associated with vaccination after adjusting for other factors.

Discussion

This is the first study to report influenza vaccination coverage among young children in Singapore. Our results indicate that vaccination coverage in this age group is low, with only a third of children aged 6 months to 5 years old having received influenza vaccine in the past and 15% in the previous season. Published data from other countries indicate that child influenza vaccination coverage in the Southeast Asia and Western Pacific regions is highly variable. Estimates from Hong Kong are slightly higher than that in our study (21.1% coverage in the 2015/16 season) [25]. In contrast, an analysis of data on publicly purchased influenza vaccine in Thailand found that about 3% and 1% of children aged 6-24 months had been vaccinated in 2010 and 2012 respectively [26], while a cross-sectional survey in Japan using an online panel indicated 58% coverage among children aged <6 years [27].

Respondents demonstrated good knowledge of influenza and influenza vaccine. Lack of convenience and perceived vaccine safety were identified as barriers to vaccination, indicating that most parents would be in favour of influenza vaccination in schools, and that providing authoritative information on the safety of the influenza vaccine could help address concerns regarding vaccine safety.

Despite good knowledge and high willingness to vaccinate one's child against influenza, vaccine uptake was low. This indicates that favourable knowledge and attitudes do not necessarily translate into favourable vaccination practice. External cues, in particular recommendations by medical professionals, are likely to be important for improving vaccine uptake. Being recommended influenza vaccination by a child's physician was the most important determinant

of a child's vaccination status in this study, and we found evidence that it also positively influences other determinants, including respondents feeling well-informed about the influenza vaccine and their willingness to vaccinate their child. Conversely, although better knowledge of influenza and influenza vaccine was initially associated with higher vaccination uptake, this effect was no longer apparent after adjusting for physician's recommendation and other factors. This indicates that enhancing cues from health care professionals, rather than simply providing information to the public about influenza vaccination, is likely to be more effective for improving uptake. Studies in Japan, Hong Kong, Thailand, US, and Turkey have all found physician's recommendation to be significantly associated with a child being vaccinated against influenza [27–33]. A nationally representative survey in Australia also found physicians to be the most influential and important source of information for child vaccinations [34]. Despite this, only a third of respondents in our study were recommended by a doctor to vaccinate their child against influenza. Factors influencing physicians' recommendations of influenza vaccination for high-risk groups have not been extensively studied and are poorly understood, particularly outside the Western context. Previous studies suggest that lack of awareness of the severity of influenza [35], lack of familiarity with vaccination guidelines [35,36], unfavourable perceptions of the risk and efficacy of influenza vaccines [36,37], and perceived low profitability of clinic-based influenza vaccination [38] are negatively associated with physicians' likelihood of recommending the vaccine to children and pregnant women. Confusion about vaccination guidelines may be compounded in tropical settings with year-round transmission, in which there may be additional uncertainty regarding vaccination timing and composition [39,40].

Receiving influenza vaccination information from television was negatively associated with vaccination. Respondents were not asked further about the exact source and type of information

obtained from television, and we are not aware of any formal campaigns through this medium. Further studies would be better able to determine whether this association is due to differences in the type of influenza-related information available on television and other media, or differences in characteristics of respondents who obtain information from television versus other means.

There were a number of limitations to this study. Firstly, our convenience survey sample was not a random sample of all parents with children ≤5 years in Singapore. Despite a high pre-school participation rate in Singapore, not all children attend pre-schools. Private pre-schools also charge generally higher fees, so parents sending children to these pre-schools tend to be of higher socioeconomic status than those who send children to publicly-funded pre-schools; 87 out of the 92 pre-schools who agreed to participate in this study were private pre-schools and around 70% of our survey respondents had at least a university education, compared to about half of new mothers in the Singapore Birth Registry [41]. Respondents of Chinese ethnicity were also over-represented in our sample. As the survey was designed to be administered online, and we had no information on how many parents had received and read the survey invitation, we could not estimate the response rate; it is possible that parents with a greater interest in influenza vaccine and those who had vaccinated their child in the past were more likely to respond to the survey. This could have resulted in an overestimation of vaccine coverage. Despite this, vaccine uptake was generally low and we did not find associations between any demographic or socioeconomic variables and vaccination uptake in our data, suggesting that these are not the primary determinants of vaccination in this population. Lastly, vaccination information was self-reported, so it is possible that some misclassification of vaccination status occurred. However, this is unlikely to have a significant impact on the results. Only a third of respondents were aware that

the child influenza vaccine is part of the Ministry of Health guidelines. Healthy adults are also not in the recommended groups for influenza vaccination. Thus, it is unlikely that social desirability bias resulted in respondents over-reporting their own or their child's positive vaccination status. Respondents could have potentially mistaken the *Haemophilus influenza type b* (Hib) vaccine for the influenza vaccine when reporting their child's vaccination status, but this misclassification would also be minimal as the Hib vaccine is given routinely in Singapore as part of a combination vaccine, more commonly known as the 4-in-1 or 5-in-1 vaccine. We also expect parents' reporting of their own vaccination status to be reasonably accurate, as receiving vaccinations is a rather rare event for adults and therefore likely to be memorable.

The typical cost of a single dose of inactivated influenza vaccine in Singapore ranges from SGD35 to SGD50 (USD25 – USD35). Based on individuals' willingness to pay, approximately 33%-39% of respondents would be prepared to pay that amount. However, it is unclear if respondents understood that this is a recurring annual cost until the child reaches the age of 5 years. In addition, the current recommendation is for previously unvaccinated children <9 years to receive two doses in the first season for maximum protection [42–44]. While we do not have direct evidence that cost is a barrier to vaccination, providing clearer messaging around options for covering vaccination costs, including through Medisave, could help improve uptake among parents who may be unaware of these options.

Conclusions

Our findings support the increasing body of evidence that encouraging doctors to recommend child influenza vaccination to parents is key to improving vaccine uptake. Additional studies to understand how physicians' own perceptions of influenza vaccine influence vaccination recommendations for patients, and to identify effective ways to encourage cues to vaccination from doctors would greatly inform interventions to increase influenza vaccination coverage in children.

Supplementary material: Supplementary Table S1

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Conflict of interest

The authors declare no conflict of interest.

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Author contributions

CCT conceived the idea for the study. HT, CH, JQL, SC, SL, RT, MC, YT, and JZL led the team of medical students who designed the study, developed the questionnaire, and carried out the survey. ML and CCT analysed the data and drafted the manuscript. MH and CCT guided the design of the study and survey questionnaire, and supervised the study. All authors read and approved the final manuscript.

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Tables for:

Parental perceptions of childhood seasonal influenza vaccination in Singapore: A cross-sectional survey

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Content:

Table 1

Demographic characteristics of 332 respondents to a survey of child influenza vaccination, Singapore 2016.

	n	%
Age-groups		
20-29 years old	33	9.9
30-34 years old	103	31.0
35-39 years old	132	39.8
40-45 years old	64	19.3
Sex		
Female	261	78.6
Male	71	21.4
Ethnicity		
Chinese	272	81.9
Malay	20	6.0
Indian	15	4.5
Other	25	7.5
Father-of-child's highest education		
Below A Level/Diploma	38	11.4
A Level/Diploma	54	16.3
Degree and above	238	71.7
Missing data	2	0.6
Mother-of-child's highest education		

Below A Level/Diploma	26	7.8
A Level/Diploma	67	20.2
Degree and above	239	72.0
Housing type		
Public flats	209	63.0
Condominium	93	28.0
Landed property	29	8.7
Missing data	1	0.3
Monthly household income (in SGD)		
<$6k	57	17.2
$6-10k	96	28.9
$10-14k	68	20.5
>$14k	111	33.4
Child's grade		
Infant care (2 – 18 months old)	31	9.3
Nursery 1 & 2 (19 months – 4 years old)	191	57.5
Kindergarten 1 & 2 (5 – 6 years old)	104	31.3
Missing data	6	1.8

Table 2

Factors associated with influenza vaccination among children aged 6 months to 5 years attending pre-schools in Singapore in 2016, multivariable analysis

Variable	PR[1]	95% CI	*p* value
Recommended by physician to vaccinate child against influenza			
Yes	2.47	(1.75 - 3.48)	<0.001
No	1		
Family took pre-travel influenza vaccination			
Yes	1.64	(1.19 - 2.25)	0.003
No	1		
Willingness to vaccinate child against influenza			
Per unit increase from -2 to 2	1.59	(1.24 - 2.04)	<0.001
Received influenza vaccine information from private GPs			
Yes	1.47	(1.05 - 2.04)	0.023
No	1		
Felt well-informed about influenza vaccine			
Yes	1.44	(1.04 - 1.99)	0.026
No	1		
Received influenza vaccine information from television			
Yes	0.44	(0.23 - 0.85)	0.015
No	1		

[1]PR: prevalence ratio

Figure 1 for:

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Figure 1 Conceptual framework on factors contributing to child being vaccinated against influenza previously. For variables under each domain, see supplementary table S1.

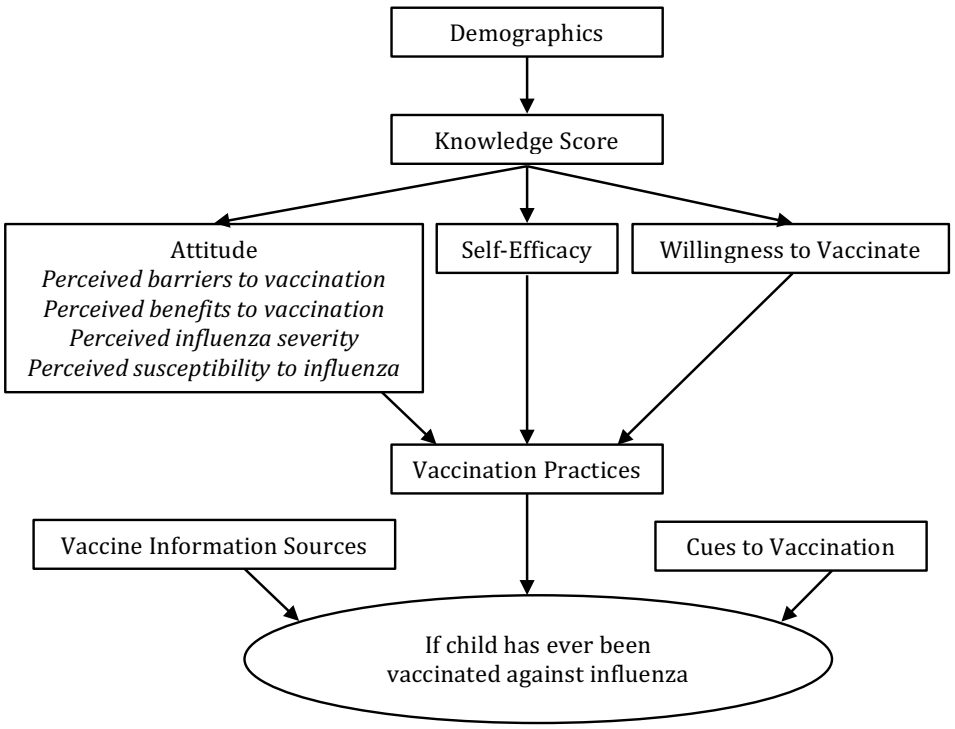

Figure 2 for:
Parental perceptions of childhood seasonal influenza vaccination in Singapore: A cross-sectional survey

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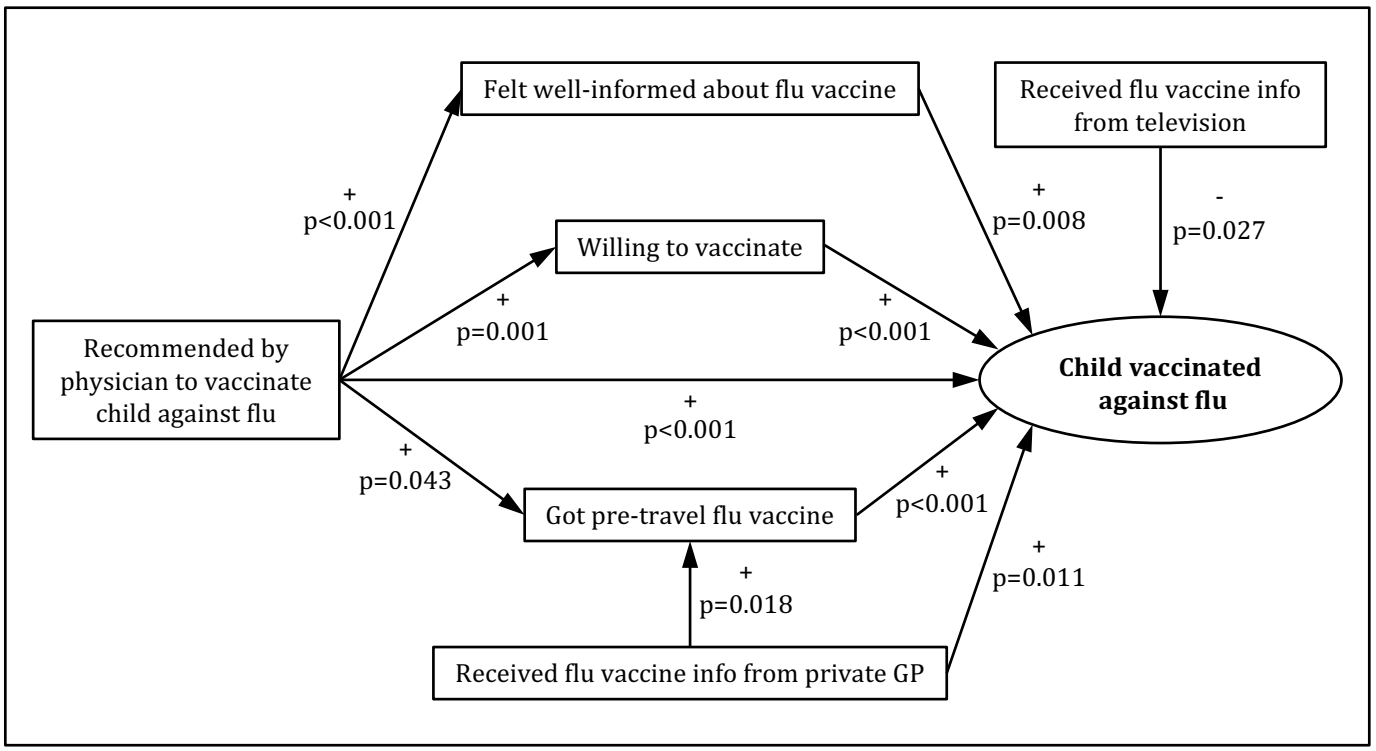
Fig. 2. Relationships between determinants of child influenza vaccination among children aged 6 months to 5 years attending pre-schools in Singapore in 2016; results from structural equation modelling. (+) signs indicate positive associations, (-) signs indicate negative associations.



Supplementary material for:

Parental perceptions of childhood seasonal influenza vaccination in Singapore: A cross-sectional survey

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Content:

Table S1

Factors associated with influenza vaccination among children aged 6 months to 5 years attending pre-schools in Singapore in 2016, single variable results

	Vaccinated		Total		*p* value [c]
	n	row % [a]	n	col % [b]	
Demographics					
Respondent's age					0.264
20-29 years old	8	24.2%	33	9.9%	
30-34 years old	36	35.0%	103	31.0%	
35-39 years old	46	34.8%	132	39.8%	
40-45 years old	15	23.4%	64	19.3%	
Respondent's sex					0.060
Female	76	29.1%	261	78.6%	
Male	29	40.8%	71	21.4%	
Respondent's Race					0.765
Chinese	87	32.0%	272	81.9%	
Non-Chinese	18	30.0%	60	18.1%	
Father's highest education					0.074
Below A Level/Diploma	17	44.7%	38	11.5%	
A Level/Diploma	12	22.2%	54	16.4%	
Degree and above	76	31.9%	238	72.1%	
Missing values			2		
Mother's highest education					0.310
Below A Level/Diploma	9	34.6%	26	7.8%	
A Level/Diploma	16	23.9%	67	20.2%	
Degree and above	80	33.5%	239	72.0%	
Housing type					0.722
Public flat	63	30.1%	209	63.1%	
Private condominium	32	34.4%	93	28.1%	
Landed property	10	34.5%	29	8.8%	

Missing values			1		
Monthly household income (in SGD)					0.039
<$6k	15	26.3%	57	17.2%	
$6-10k	22	22.9%	96	28.9%	
$10-14k	23	33.8%	68	20.5%	
>$14k	45	40.5%	111	33.4%	
Household size					0.397
2-3 household members	17	27.4%	62	18.7%	
4 household members	35	33.0%	106	32.0%	
5 household members	20	27.8%	72	21.8%	
6 household members	15	30.0%	50	15.1%	
≥7 household members	17	41.5%	41	12.4%	
Missing values	1		1		
Number of children below 5 years old					0.508
1	57	30.2%	189	56.9%	
≥2	48	33.6%	143	43.1%	
Father as main caregiver?					0.284
Yes	51	34.7%	147	44.3%	
No	54	29.2%	185	55.7%	
Mother as main caregiver?					0.916
Yes	79	31.5%	251	75.6%	
No	26	32.1%	81	24.4%	
Grandparent as main caregiver?					0.112
Yes	33	26.4%	125	37.7%	
No	72	34.8%	207	62.3%	
Maid as main caregiver?					0.306
Yes	31	36.0%	86	25.9%	
No	74	30.1%	246	74.1%	
Any smoker in family?					0.660
Yes	20	29.4%	68	20.5%	
No	85	32.2%	264	79.5%	
Frequency of family travelling overseas					0.042
1-2 times a year	37	25.7%	144	43.4%	
3-4 times a year	68	36.2%	188	56.6%	
Child's sex					0.936
Female	49	31.4%	156	47.0%	
Male	56	31.8%	176	53.0%	

Child's grade					0.386
Infant care	9	29.0%	31	9.3%	
Nursery 1/2	63	33.0%	191	57.5%	
Kindergarten 1/2	33	31.7%	104	31.3%	
Not schooling	0	0.0%	6	1.8%	
Knowledge Score [d]					
Knowledge score on flu and flu vaccine					0.001
Low scorers (<8 out of 15)	11	18.3%	60	18.1%	
Mid scorers (8-11 out of 15)	44	27.8%	158	47.6%	
High scorers (>11 out of 15)	50	43.9%	114	34.3%	
Attitude					
Perceived barrier - I worry that my child has been given too many vaccines.					0.006
Agree	31	23.1%	134	40.4%	
Disagree	74	37.4%	198	59.6%	
Perceived barrier - I worry about the side effects of the influenza vaccine (e.g. post-vaccine illness, sore arm).					0.014
Agree	31	23.8%	130	39.2%	
Disagree	74	36.6%	202	60.8%	
Perceived barrier - I am worried that the influenza vaccine might affect previous or future vaccinations (e.g. interactions, poorer efficacy).					0.147
Agree	23	25.6%	90	27.1%	
Disagree	82	33.9%	242	72.9%	
Perceived barrier - The influenza vaccine is too expensive (cost S$35-$50).					0.258
Agree	23	26.7%	86	25.9%	
Disagree	82	33.3%	246	74.1%	
Perceived barrier - I am more likely to vaccinate my child if it is offered at his/her school.					0.036
Agree	87	34.7%	251	75.6%	
Disagree	18	22.2%	81	24.4%	
Perceived benefit - I think that the influenza vaccine is effective in preventing influenza in my children.					<0.001
Agree	87	37.7%	231	69.6%	
Disagree	18	17.8%	101	30.4%	
Perceived severity - Influenza is a mild disease and is not serious.					0.012
Agree	25	40.3%	62	18.7%	
Disagree	73	32.9%	222	66.9%	
Not sure	7	14.6%	48	14.5%	
Perceived severity - I do not think that influenza is a serious enough disease to let my children take the vaccine.					<0.001

Agree	20	17.2%	116	34.9%	
Disagree	85	39.4%	216	65.1%	
Perceived susceptibility - I consider my children vulnerable to catching influenza from their peers.					0.242
Agree	91	33.0%	276	83.1%	
Disagree	14	25.0%	56	16.9%	
Self-Efficacy					
Perceived knowledgeability - I am well informed about the influenza vaccine.					<0.001
Agree	55	51.9%	106	31.9%	
Disagree	50	22.1%	226	68.1%	
Willingness to Vaccinate [e]					
Willingness to vaccinate child in various scenarios					<0.001
Unwilling (Score of -2 to 0)	1	2.9%	34	10.7%	
Willing (Score of 0 to 1)	32	26.7%	120	37.7%	
Very willing (Score of 1 to 2)	69	42.1%	164	51.6%	
Missing values	3		14		
Vaccination Practices					
Frequency of family getting travel flu vaccination					<0.001
Never	43	20.3%	212	63.9%	
Sometimes/Always	62	51.7%	120	36.1%	
Respondent's last flu vaccination					<0.001
Less than 1 year ago	30	58.8%	51	16.1%	
1-2 years ago	18	40.9%	44	13.9%	
3-4 years ago	5	38.5%	13	4.1%	
More than 4 years ago	12	33.3%	36	11.4%	
Never vaccinated	32	18.5%	173	54.6%	
Missing values	8		15		
Vaccine Information Sources					
Internet as a source of information					0.036
Yes	43	26.1%	165	49.8%	
No	61	36.7%	166	50.2%	
Missing values	1		1		
GPs as a source of information					<0.001
Yes	69	44.8%	154	46.5%	
No	35	19.8%	177	53.5%	
Missing values	1		1		
Polyclinics/Hospitals as a source of information					0.950
Yes	34	31.2%	109	32.9%	
No	70	31.5%	222	67.1%	

Missing values	1		1		
Friends as a source of information					0.719
Yes	26	29.9%	87	26.3%	
No	78	32.0%	244	73.7%	
Missing values	1		1		
Health Promotion Board as a source of information					0.385
Yes	19	27.1%	70	21.1%	
No	85	32.6%	261	78.9%	
Missing values	1		1		
Newspapers as a source of information					0.010
Yes	11	17.7%	62	18.7%	
No	93	34.6%	269	81.3%	
Missing values	1		1		
Family as a source of information					0.840
Yes	16	32.7%	49	14.8%	
No	88	31.2%	282	85.2%	
Missing values	1		1		
Television as a source of information					0.004
Yes	6	13.0%	46	13.9%	
No	98	34.4%	285	86.1%	
Missing values	1		1		
School as a source of information					0.002
Yes	4	10.3%	39	11.8%	
No	100	34.2%	292	88.2%	
Missing values	1		1		
Magazines as a source of information					0.104
Yes	6	18.8%	32	9.7%	
No	98	32.8%	299	90.3%	
Missing values	1		1		
Books as a source of information					0.605
Yes	8	36.4%	22	6.6%	
No	96	31.1%	309	93.4%	
Missing values	1		1		
Cues to Vaccination					
Cue - Has your child's general practitioner or paediatrician recommended flu vaccination?					<0.001
Yes	68	61.8%	110	33.1%	
No	37	16.7%	222	66.9%	

Social norm - If I knew someone who has had a bad experience with the influenza vaccine, I would be less likely to vaccinate your child against influenza.					0.004
Agree	55	26.1%	211	63.6%	
Disagree	50	41.3%	121	36.4%	

[a] Percentages are row percentages, i.e. vaccinated/total.
[b] Percentages are column percentages.
[c] All *P*-values are based on chi-square test.
[d] Refer to Table S2 for questions to assess knowledge.
[e] Refer to Table S3 for questions to assess willingness to vaccinate.

Table S2

List of statements to assess parental knowledge on influenza and the influenza vaccine

No.	Statement	Correct Response
1	Influenza is the same as common cold.	False
2	Influenza viruses are constantly changing and evolving.	True
3	Influenza can spread via droplets when the infected person speaks, sneezes or coughs.	True
4	Influenza can spread indirectly via sharing of food with an infected person.	True
5	Influenza can be spread via contact with virus-containing surfaces (e.g. doorknob, MRT handle) and then touching one's mouth or nose.	True
6	Influenza can lead to severe complications such as lung, middle ear and even brain infections.	True
7	Children with long term medical conditions like asthma are more susceptible to serious complications of influenza.	True
8	Children between 6 months to 5 years are less susceptible to serious complications of influenza.	False
9	The peak flu season in Singapore is generally from December to February and May to July.	True
10	Is there an influenza vaccine available?	Yes
11	The influenza vaccine is a vaccine that is a part of the MOH vaccination guidelines.	True
12	The influenza vaccine provides lifelong protection against influenza virus.	False
13	The protective effects of the influenza vaccine take place immediately after administration.	False
14a*	The side effects of the influenza vaccine include post-vaccine fever.	True
14b*	The side effects of the influenza vaccine include sore arm.	True
14c*	The side effects of the influenza vaccine include headache.	True
14d*	The side effects of the influenza vaccine include autism.	False
14e*	The side effects of the influenza vaccine include nausea and vomiting.	False
14f*	The side effects of the influenza vaccine include allergy.	False
15	The side effects of the influenza vaccine are usually serious.	False

* For statements 14a-14f, each correct response is worth one-sixth of a point.

Table S3

List of statements to assess parental willingness to vaccinate child against flu under each scenario

No.	Statement	Mean score*
1	If an influenza vaccine against a new worldwide influenza pandemic is made available.	1.32
2	If the Health Promotion Board offers annual influenza vaccinations free of charge as part of the Primary School Health Screening.	1.28
3	If an influenza outbreak has occurred in your child's school or childcare centre.	1.25
4	If there is strong evidence that influenza vaccination is effective in protecting your children from catching influenza.	1.25
5	If your child's doctor recommends your child to be vaccinated against influenza.	1.17
6	If annual influenza vaccination is now free of charge at government polyclinics.	1.09
7	If the government encourages the public to let their children take regular influenza vaccinations.	0.94
8	If the influenza vaccination is offered at a place close to your home.	0.79
9	If the influenza vaccine is delivered through a nose spray rather than an injection.	0.75
10	If households, where all their family members get their influenza vaccination regularly, will get some vouchers or discounts for purchases.	0.63
11	If you have other young children below the age of 5 at home.	0.63
12	If you have elderly parents living together at home.	0.55
13	If most of your child's friends have not taken the influenza vaccine.	0.35
14	If most of your own friends have not vaccinated their children against influenza.	0.29

* Mean willingness-to-vaccinate score for each scenario based on a 5-point Likert scale scored -2 (definitely would not vaccinate) to +2 (definitely would vaccinate)