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Original Article

A longitudinal study using parental cognitions based on the theory of planned behavior to predict childhood influenza vaccination

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ABSTRACT

Background: The World Health Organization recommends young children aged 6–59 months receive influenza vaccination (IV) annually. This study investigated the IV incidence in a 12-month follow-up period among 24–59 month-old children and identified its predictors based on the theory of planned behavior (TPB).

Methods: A population-based random telephone survey was conducted at baseline (March–June 2011) among Chinese parents of 24–59 month-old children in Hong Kong, China, and a follow-up survey was conducted 12 months afterwards ($N = 440$).

Results: The IV prevalence was 63.2% at follow-up (3% increased from baseline). The IV incidence during the follow-up period for all sampled, ever-vaccinated, and never-vaccinated children was 35.6, 58.5, and 7.7 per 100 person-years, respectively. Stratified analyses of logistic regression were performed for the ever-vaccinated and never-vaccinated children. After adjusting for significant socio-demographic variable(s), parental positive attitude, norm, and behavioral intention were significant predictors of IV at follow-up among ever-vaccinated children, while intention was the only significant predictor among never-vaccinated children.

Conclusions: Most of the IVs received during the follow-up period were re-vaccinations rather than first-time vaccinations. Efforts should target never-vaccinated children's parents, who reported low incidence and intention. TPB also worked less well among never-vaccinated children, and thus research for other predictors of never-vaccinated children's first-time vaccination are warranted. Promotion programs should consider segmentation by children's prior vaccination status.

Introduction

Influenza is a highly infectious respiratory illness characterized by various acute onset of mild symptoms including fever and cough, and can result in serious complications (e.g., pneumonia, dehydration, and encephalopathy) and even deaths, particularly among infants and children [1–3]. The estimated death toll in children was close to 600 in 2017–2018 flu season in the U.S. [3]. Influenza vaccination (IV) is the main and effective strategy for prevention and control of influenza and is shown to have consistently high levels of efficacy in reducing risk of influenza and related complications among children [4]. Side-effects include local reactions (e.g., swelling) and fever and are mostly mild in nature [5]. The World Health Organization (WHO) recommends special high risk groups (i.e., health-care workers, pregnant women, patients with chronic diseases, older people, and children aged between 6 and 59 months to take up IV annually [6] and many countries have adhered to the advice and implemented national government policies of IV (e.g., vaccine subsidy schemes) [7]. However, prevalence of IV among such children remains relatively low and varies across countries (e.g., 7.l% in U.K. and 36.2% in Finland among children aged <3 [8]; under 20% among children aged <18 years in Hong Kong [9]). Following the WHO's guidelines, the Hong Kong government recommends children aged 6–71 months to receive annual IV and subsidizes the vaccine [10]. Free IV is available to children of families covered by the Comprehensive Social Security Assistance (CSSA) scheme.

Cross-sectional studies showed that parental cognitions of IV, including knowledge, perceived threat, and beliefs regarding the vaccine's efficacy and safety, were significantly associated

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with childhood IV status [11–14]. However, cross-sectional cannot establish causality as the child's experience of IV would affect parental cognitions [15]; longitudinal studies guided by health behavior theories are warranted. The theory of planned behavior (TPB) [16] was used in this study to identify salient predictors of childhood IV. It postulates that individuals form an intention prior to performing health-related behaviors, and the intention is determined by related attitudes (possible consequences of the behavior of interest), perceived norm (whether their significant others support the behavior), and perceived behavioral control (whether they have control over performing the behavior) [16]. The theory has been supported by meta-analyses of longitudinal studies on a wide range of health-related behaviors [17–19]. Its constructs are modifiable. Understanding factors based on TPB would hence facilitate planning of effective interventions. TPB has also been applied to explain IV intention and behavior among adults in both cross-sectional [20–23] and longitudinal studies [24,25], but not childhood IV.

Prediction of IV should take into account past behaviors, which were predictive of the corresponding future behaviors [16,26,27]. In literature, such behaviors included childhood and adulthood IV [24,28,29]. The predictive relationships may reflect consistency of behaviors [16,26]. In our case, TPB may perform differently among ever-vaccinated and never-vaccinated children. Thus, we conducted stratified analysis to identify factors predicting IV among these two groups of children separately. Segmentation allows for designing tailored interventions that would increase effectiveness of health promotion [30].

We investigated incidence of IV during a 12-month period (2011/2012) among children aged 24–59 months in Hong Kong, and tested three hypotheses based on TPB, that: (1) baseline parental behavioral intention of the child's IV in the next 12 months would predict their actual IV within the 12-month follow-up period; (2) baseline parental attitude, perceived norm, and perceived behavioral control would be associated with baseline parental intention for child's IV, and predict child's actual IV within the follow-up period; (3) the prospective relationships between the three TPB constructs (i.e., baseline parental attitude, perceived norm, and perceived behavioral control) and the child's IV within the follow-up period would be mediated by baseline parental intention. It is the first longitudinal study testing these hypotheses among children aged less than six years using stratified analysis according to the child's past IV experience.

Materials and methods

Study design and procedures

The longitudinal study consisted of a baseline population-based telephone survey conducted during March to June 2011 and a follow-up telephone survey conducted 12 months afterwards; the same questionnaire was administered in the two surveys. Baseline inclusion criteria were: (1) parents with children aged 24–59 months, and (2) the index child and at least one of his/her parents being a Hong Kong resident.

Telephone surveys have been used in many international IV-related studies [31–34]. Telephone numbers were randomly selected from up-to-date local telephone directories. Screening questions were asked to confirm participants' eligibility (e.g., parent of a 24–59 month-old child) at baseline. For households with two or more such children, the child whose last birthday was closest to the date of the interview was selected as the index child. If both parents were available, the mother was invited to join the study. Prospective participants were briefed by experienced interviewers, who administered the survey, about the background of the study. They were informed about its anonymity and voluntary nature and that they could quit anytime if wanted. Verbal informed consent was obtained before commencement of the survey, which took about 15 min to complete. A HKD50 (USD6.4) supermarket coupon was mailed to the participants upon their completion of two surveys. Ethics approval was obtained from the affiliated institute of the corresponding author. We identified 787 households with an eligible participant; 540 completed the baseline survey (response rate = 68.8%); 440 completed the follow-up survey (follow-up rate = 81.5%).

Measures

The questionnaire was constructed by an expert panel consisting of psychologists and public health researchers. References were made to previous studies [14,21,31,32] and the items of TPB scales were listed in Table 1. Parental positive and negative attitudes toward the child's IV were measured by five and three items (α = .82 and .51), respectively (*agree*, *disagree*, and *unsure*). Perceived norms were assessed by four items regarding the spouse, family members, and peers of parents (α = .74). Perceived behavioral control over the child's IV was assessed by two items (*agree*, *disagree*, and *unsure*; α = .60). Behavioral intention regarding the child's IV in the next 12 months was assessed by one item, with Likert scales ranging from *very unlikely* to *very likely*. Besides participants' and the index child's socio-demographics, information about the child's baseline IV status (ever-/never-vaccinated) and whether he/she had taken up IV during the follow-up period were recorded. We pilot tested the questionnaire among 30 eligible participants twice (two weeks apart), and derived test–retest reliability statistics; the items' average kappa was .66, which is considered acceptable [35].

Statistical analysis

Stratified analyses were performed for the ever-vaccinated and never-vaccinated children. The first dependent variable was the binary variable of behavioral intention for the child's IV (intended [*Very likely*/*Likely*] and unintended [*Very unlikely*/*Unlikely*/*Neutral*]). Univariate odds ratios (ORu) were derived. The significant socio-demographic variables were adjusted for in subsequent analyses that used baseline attitude/norm/perceived behavioral control as independent variables; adjusted odds ratios (ORa) were obtained from multiple logistic regression models. Similar adjusted analyses were performed using actual IV during the follow-up period as the dependent variable, considering baseline TPB constructs as potential predictors.

The mediation hypothesis was tested by the procedures proposed by Baron and Kenny [36]. After examining the required associations among the variables, the corresponding ORa for each of the TPB constructs were obtained from the pair of logistic regression models with and without behavioral intention (i.e., potential mediator), and were compared. The Sobel test was conducted. Respective 95% confidence intervals (95% CI) were derived for all odds ratios. SPSS 21.0 for Windows was used, with $p < .05$ taken as statistically significant.

Results

Socio-demographic characteristics of the sample

Table 1 shows no significant differences in baseline characteristics between followed-up (n = 440) and loss-to-followed-up (n = 100), except for one negative attitude item (i.e., *This flu vaccine would have negative interactions with other vaccines*).

Among the followed-up participants of the ever-vaccinated and never-vaccinated groups (Table 2), about half were males, aged

Table 1
Characteristics of all participants by follow-up status.

	Followed-up (n = 440) %	Lost-to-follow-up (n = 100) %	p
Socio-demographic factors			
Sex			
Male	52.3	48.0	0.44
Female	47.7	52.0	
Parity			
First	46.1	53.0	0.23
Second	47.0	44.0	
Third and so forth	6.8	3.0	
Visited family doctor before			
No	15.2	14.0	0.76
Yes	84.8	86.0	
Primary care-taker			
Parents	65.5	71.0	0.40
Grandparents	14.8	15.0	
Maid/others	19.8	14.0	
Participant's age			
20-34	37.7	42.0	0.67
35-44	55.9	51.0	
45 or above	6.4	7.0	
Participant's highest education level			
Junior high school or below	8.2	11.0	0.37
Senior high school or above	91.8	89.0	
Participant's employment status			
Full-time	55.5	55.0	0.93
Part-time/Unemployed	44.5	45.0	
Recipient of CSSA			
No/Refuse to answer	94.8	98.0	0.17
Yes	5.2	2.0	
Child's baseline IV status			
No (never-vaccinated)	39.8	47.0	0.19
Yes (ever-vaccinated)	60.2	53.0	
TPB constructs			
Behavioral intention regarding the child's IV in follow-up period			0.73
Very unlikely	5.0	7.0	
Unlikely	28.4	31.0	
Neutral	16.8	14.0	
Likely	37.7	40.0	
Very likely	11.1	8.0	
Missing	0.9	0.0	
Positive attitude items			
IV is effective in preventing H1N1 influenza			0.49
Agree	53.6	49.0	
Disagree	13.6	12.0	
Unsure	32.7	39.0	
IV is effective in preventing other seasonal influenzas (not A/H1N1)			0.23
Agree	59.5	51.0	
Disagree	13.6	14.0	
Unsure	26.8	35.0	
IV is effective in reducing the risk of A/H1N1 influenza-induced complications			0.48
Agree	58.6	52.0	
Disagree	12.5	14.0	
Unsure	28.9	34.0	
IV is effective in reducing risk of other seasonal influenza-induced complications			0.09
Agree	64.1	53.0	
Disagree	12.0	13.0	
Unsure	23.9	34.0	
Current flu vaccine is more effective than previously available ones			0.27
Agree	31.4	25.0	
Disagree	30.0	28.0	
Unsure	38.6	47.0	
Negative attitude items			
This vaccine is not safer than the previous one			0.41
Agree	38.0	34.0	
Disagree	41.1	39.0	
Unsure	20.9	27.0	
My child is too young to receive this flu vaccine			0.49
Agree	66.8	66.0	
Disagree	24.8	22.0	
Unsure	8.4	12.0	
This flu vaccine would have negative interactions with other vaccines my child receives			<0.001
Agree	63.0	54.0	
Disagree	26.4	20.0	
Unsure	10.7	26.0	

Table 1 (*Continued*)

	Followed-up (n = 440) %	Lost-to-follow-up (n = 100) %	p
Perceived norm items			
Many parents have arranged for their children of similar age to receive this flu vaccine			0.08
Agree	41.6	30.0	
Disagree	44.5	56.0	
Unsure	13.9	14.0	
Spouse supports child receiving the vaccine			0.50
Strongly disagree	12.2	10.7	
Slightly disagree	39.5	36.9	
Slightly agree	40.0	47.6	
Strongly agree	8.4	4.8	
Other family members support child receiving the vaccine			0.32
Strongly disagree	8.8	8.9	
Slightly disagree	43.0	40.5	
Slightly agree	42.4	49.4	
Strongly agree	5.8	1.3	
Perceived behavioral control items			
You would be able to get your child vaccinated if you desire to do so			0.06
Agree	96.1	92.0	
Disagree	2.5	3.0	
Unsure	1.4	5.0	
It is you and your spouse who decides whether your child would receive this IV			0.71
Agree	96.6	95.0	
Disagree	2.5	4.0	
Unsure	0.9	1.0	

35–44 years, and had had full-time jobs at baseline. Over 90% had attained senior high school education or above and were not receiving CSSA. The index children were mainly first/second born and had visited family doctors. These between-group differences were statistically non-significant ($p > .05$).

Cognitions related to the child's IV

The ever-vaccinated group was more likely than the never-vaccinated group to have reported baseline behavioral intention for the child's IV and agreed/very much agreed with the positive attitudinal/norm items, and were less likely to agree with the negative attitudinal items (see Table 2). The two items of perceived behavioral control did not show significant between-group differences ($p > .05$).

Prevalence and incidence of IV

Baseline and follow-up prevalence of vaccinated children were 60.2% (265/440) and 63.2% (278/440), respectively. Among ever-vaccinated and never-vaccinated children, 45.3% (120/265) and 7.4% (13/175) had received IV during the follow-up period, respectively. The incidences were 58.5, and 7.7 per 100 person-years (100PY), respectively (35.6 per 100PY among all children). When further stratified into three age groups (24-35/36-47/≥48months): the incidences were 71.0, 59.5, and 52.4 per 100PY respectively for the ever-vaccinated group, and 9.1, 14.3, and 1.7 per 100PY for the never-vaccinated group. The ever-vaccinated group was more likely than the never-vaccinated group to have taken up IV during the follow-up period (ORu = 10.31, 95%CI = 5.58, 19.07).

Factors associated with baseline behavioral intention for childhood IV in the next 12 months

Among never-vaccinated children

Two socio-demographic variables (participants' age and employment status) were significantly associated with behavioral intention (see Table 3). After adjusting for them, the scales of positive attitude ("3–5" versus "0": ORa = 7.11) and perceived norm ("1–2" versus "0": ORa = 3.94; "3" versus "0": ORa = 27.40) were significantly associated with the baseline behavioral intention.

Among ever-vaccinated children

After the three significant socio-demographic variables (see Table 3) were adjusted for, only the scales related to positive attitude ("3–5" versus "0": ORa = 5.28) and subjective norm ("1–2" versus "0": ORa = 2.90; "3" versus "0": ORa = 21.76) were significantly associated with baseline behavioral intention.

Baseline predictors of the children's IV during the follow-up period

Among never-vaccinated children

Table 4 shows that none of the socio-demographic characteristics significantly predicted the child's IV. Hence, subsequent analysis did not adjust for socio-demographic factors. Behavioral intention for the child's IV ("Likely" versus "Very unlikely/Unlikely": ORu = 6.06) was the only significant predictor of actual IV uptake during the follow-up period (Table 5).

Among ever-vaccinated children

After adjusting for the only significant socio-demographic variable (i.e., the child's sex; see Table 4), the scales of positive attitude ("3–5" versus "0": ORa = 3.74), perceived norm ("1–2" versus "0": ORa = 2.37; "3" versus "0": ORa = 3.55), and behavioral intention ("likely" versus "very unlikely/unlikely": ORa = 4.83; "very likely" versus "very unlikely/unlikely": ORa = 7.46) were significant predictors of actual IV uptake during the follow-up period (Table 5).

Mediation testing

Among never-vaccinated children

No mediation testing was conducted in this subsample, as no variable other than behavioral intention significantly predicted the child's IV uptake during the follow-up period.

Among ever-vaccinated children (Table 6)

Requirements for mediation testing was fulfilled as previous adjusted analyses showed that both the potential mediator (i.e., behavioral intention) and the two TPB constructs (i.e., positive attitude and perceived norm) were significantly associated with IV uptake during the follow-up period. Model 1 contained both the baseline variables of behavioral intention and positive attitude. Positive attitude remained statistically significant ("3–5" versus

Table 2
Characteristics of all followed-up participants (stratified by ever-vaccination status).

	Ever-vaccinated (n = 265) %	Never-vaccinated (n = 175) %	p
Socio-demographic factors			
Sex			0.49
Male	50.9	54.3	
Female	49.1	45.7	
Parity			0.71
First	46.4	45.7	
Second	46.0	48.6	
Third and so forth	7.5	5.7	
Visited family doctor before			0.52
No	14.3	16.6	
Yes	85.7	83.4	
Primary care-taker			0.09
Parents	69.4	59.4	
Grandparents	13.6	16.6	
Maid/others	17.0	24.0	
Participant's age			0.12
20-34	37.0	38.9	
35-44	54.7	57.5	
45 or above	8.3	3.4	
Participant's highest education level			0.13
Junior high school or below	9.8	5.7	
Senior high school or above	90.2	94.3	
Participant's employment status			0.12
Full-time	52.5	60.0	
Part-time/Unemployed	47.5	40.0	
Recipient of CSSA			0.42
No/Refuse to answer	95.5	93.7	
Yes	4.5	6.3	
TPB constructs			
Intention regarding the child's IV			<0.001
Very unlikely	2.7	8.6	
Unlikely	11.8	54.0	
Neutral	16.0	18.4	
Likely	51.1	18.4	
Very likely	18.3	0.6	
Positive attitude items			
IV is effective in preventing H1N1 influenza			<0.001
Agree	61.9	41.1	
Disagree	10.6	18.3	
Unsure	27.5	40.6	
IV is effective in preventing other seasonal influenzas (not A/H1N1)			<0.001
Agree	69.4	44.6	
Disagree	12.5	15.4	
Unsure	18.1	40.0	
IV is effective in reducing the risk of A/H1N1 influenza-induced complications			<0.005
Agree	65.7	48.0	
Disagree	11.3	14.3	
Unsure	23.0	37.7	
IV is effective in reducing risk of other seasonal influenza-induced complications			<0.001
Agree	72.8	50.9	
Disagree	10.6	14.3	
Unsure	16.6	34.9	
Current flu vaccine is more effective than previously available ones			<0.005
Agree	35.1	25.7	
Disagree	33.2	25.1	
Unsure	31.7	49.1	
Negative attitude items			
This vaccine is not safer than the previous one			<0.05
Agree	33.6	44.6	
Disagree	47.2	32.0	
Unsure	19.2	23.4	
My child is too young to receive this flu vaccine			<0.001
Agree	59.6	77.7	
Disagree	30.9	15.4	
Unsure	9.4	6.9	
This flu vaccine would have negative interactions with other vaccines my child receives			0.06
Agree	58.5	69.7	
Disagree	29.8	21.1	
Unsure	11.7	9.1	
Perceived norm items			
Many parents have arranged for their children of similar age to receive this flu vaccine			<0.001
Agree	48.7	30.9	
Disagree	37.0	56.0	
Unsure	14.3	13.1	

Table 2 (*Continued*)

	Ever-vaccinated (n = 265) %	Never-vaccinated (n = 175) %	p
Spouse supports child receiving the vaccine			<0.001
Strongly disagree	8.3	17.6	
Slightly disagree	25.8	58.8	
Slightly agree	52.5	22.2	
Strongly agree	13.4	1.3	
Others support child receiving the vaccine			<0.001
Strongly disagree	6.5	12.1	
Slightly disagree	27.9	64.5	
Slightly agree	56.2	22.7	
Strongly agree	9.5	0.7	
Perceived behavioral control items			
You would be able to get your child vaccinated if you desire to do so			0.57
Agree	96.6	95.4	
Disagree	1.9	3.4	
Unsure	1.5	1.1	
It is you and your spouse who decides whether your child would receive this IV			0.77
Agree	96.6	96.6	
Disagree	2.3	2.9	
Unsure	1.1	0.6	

Table 3
Predictors of parental behavioral intention regarding the child's IV[†] in the next 12 months among ever-vaccinated and never-vaccinated children.

	Never vaccinated at baseline (n = 175) ORu (95% C.I.)	Ever vaccinated at baseline (n = 265) ORu (95% C.I.)
Socio-demographic characteristics		
Sex		
Male	1	1
Female	0.86 (0.40,1.85)	1.67 (0.98,2.86)
Parity		
First	1	1
Second	1.40 (0.62,3.15)	1.12 (0.64,1.94)
Third and so forth	3.72 (0.91,15.19)	0.67 (0.25,1.77)
Visited family doctor before		
No	1	1
Yes	1.56 (0.50,4.84)	2.35 (1.17,4.74)*
Primary care-taker		
Parents	1	1
Grandparents	2.05 (0.78,5.40)	0.41 (0.20,0.86)*
Maid/others	1.20 (0.48,3.05)	1.66 (0.75,3.68)
Participant's age		
20-34	1	1
35-44	0.86 (0.38,1.96)	0.80 (0.46,1.40)
45 or above	22.92 (2.45,214.41)**	2.61 (0.71,9.52)
Participant's highest education level		
Junior high school or below	1	1
Senior high school or above	0.32 (0.09,1.22)	0.87 (0.35,2.18)
Participant's employment status		
Full-time	1	1
Part-time/Unemployed	0.33 (0.14,0.82)*	0.73 (0.43,1.23)
Recipient of CSSA		
No/Refuse to answer	1	1
Yes	2.64 (0.73,9.62)	0.30 (0.09,0.96)*
TPB constructs (Baseline)	ORa[a] (95% C.I.)	ORa[b] (95% C.I.)
Positive attitude score		
0	1	1
1-2	1.73 (0.36,8.37)	1.92 (0.80,4.64)
3-5	7.11 (2.25,22.47)**	5.28 (2.57,10.85)***
Negative attitude score		
0	1	1
1-2	2.26 (0.46,11.09)	0.71 (0.33,1.54)
3-4	1.29 (0.24,6.78)	0.78 (0.35,1.76)
Perceived norm score		
0	1	1
1-2	3.94 (1.47,10.56)**	2.90 (1.51,5.59)**
3	27.40 (6.29,119.40)***	21.76 (7.63,62.04)***
Perceived behavioral control		
0-1	1	1
2	1.44 (0.22,9.45)	1.70 (0.55,5.26)

[†] The dependent variable was recoded into "intended" (very likely and likely) versus "unintended" (very unlikely, unlikely, and neutral).
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.
[a] Odds ratio adjusted (ORa) for the significant socio-demographic factors (i.e., respondents' age and employment status).
[b] Odds ratio adjusted (ORa) for the significant socio-demographic factors (i.e., experience of visiting family doctor, primary caregiver, and CSSA status).

Table 4
Socio-demographic characteristics as predictors of the child's IV during follow-up period.

	Never vaccinated at baseline (n = 175) ORu (95% CI)	Ever vaccinated at baseline (n = 265) ORu (95% CI)
Sex		
Male	1	1
Female	1.02 (0.33,3.17)	1.75 (1.07,2.85)*
Parity		
First	1	1
Second	0.94 (0.29,3.03)	1.24 (0.75,2.05)
Third and so forth	1.37 (0.15,12.71)	0.88 (0.34,2.31)
Visited family doctor before		
No	1	1
Yes	1.10 (0.23,5.25)	1.50 (0.74,3.05)
Primary care-taker		
Parents	1	1
Grandparents	2.22 (0.60,8.17)	1.00 (0.49,2.04)
Maid/others	0.69 (0.14,3.48)	0.62 (0.31,1.21)
Participant's age		
20-34	1	1
35-44	0.77 (0.25,2.40)	1.11 (0.66,1.87)
45 or above	N.A.	1.60 (0.63,4.05)
Participant's highest education level		
Junior high school or below	1	1
Senior high school or above	0.29 (0.05,1.51)	1.14 (0.50,2.59)
Participant's employment status		
Full-time	1	1
Part-time/Unemployed	0.93 (0.29,2.98)	1.06 (0.65,1.72)
Recipient of CSSA		
No/Refuse to answer	1	1
Yes	N.A.	0.39 (0.10,1.47)

* $p < 0.05$.

Table 5
TPB constructs as predictors of IV during the follow-up period for those who were never-vaccinated and ever-vaccinated at baseline.

	Never vaccinated at baseline (n = 175) ORu (95% CI)[a]	Ever-vaccinated at baseline (n = 265) ORu (95% CI)	Ever-vaccinated at baseline (n = 265) ORa (95% CI)
Behavioral intention regarding the child's IV in the next 12 months			
Very unlikely/Unlikely	1	1	1
Neutral	2.72 (0.57,12.83)	1.38 (0.47,4.10)	1.32 (0.44,3.92)
Likely	6.06 (1.59,23.04)**	5.14 (2.12,12.50)***	4.83 (1.98,11.80)***
Very likely	N.A.	8.08 (2.94,22.20)***	7.46 (2.70,20.65)***
Positive attitude score			
0	1	1	1
1-2	1.08 (0.19,6.24)	1.80 (0.72,4.52)	1.72 (0.68,4.33)
3-5	1.70 (0.47,6.08)	3.95 (1.89,8.25)***	3.74 (1.78,7.85)***
Negative attitude score			
0	1	1	1
1-2	1.13 (0.13,10.03)	0.62 (0.32,1.19)	0.61 (0.31,1.18)
3-4	1.57 (0.18,14.03)	0.56 (0.28,1.12)	0.53 (0.27,1.07)
Perceived norm score			
0	1	1	1
1-2	1.17 (0.35,3.85)	2.49 (1.33,4.65)**	2.37 (1.26,4.45)**
3	1.11 (0.13,9.79)	3.72 (1.93,7.19)***	3.55 (1.83,6.89)***
Perceived behavioral control			
0-1	1	1	1
2	0.36 (0.07,1.86)	3.52 (0.97,12.77)	2.94 (0.80,10.85)

ORu: univariate odds ratio.
ORa: Odds ratio adjusted by the significant socio-demographic factor (i.e., sex).
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.
[a] No significant socio-demographic variable needs to be adjusted.

"0": ORa = 2.38) but its ORa decreased from 3.74 to 2.38 (Sobel test = 3.809, $p < .001$). The finding indicated that baseline positive attitude predicted the child's IV partially via baseline behavioral intention (a partial mediator). Model 2 contained both the baseline variables of behavioral intention and perceived norm. Perceived norm became statistically non-significant ("1–2" and "3" versus "0": ORa = 1.64 and 2.04 respectively) when behavioral intention for the child's IV was present in the model (Sobel test = 3.915, $p < .001$). The finding indicated that baseline perceived norm predicted the child's IV fully via baseline behavioral intention (a full mediator). In both Models 1 and 2, the baseline behavioral intention (mediator) remained statistically significant in predicting the child's IV. As negative attitude and perceived behavioral control were not significantly associated with the child's IV, the corresponding mediation hypotheses were not tested.

Table 6
TPB constructs as predictors of IV during the follow-up period for those who were ever-vaccinated at baseline ($n = 265$).

	Model 1 ORa (95% CI)	Model 2 ORa (95% CI)
Behavioral intention regarding the child's IV in the next 12 months		
Very unlikely/Unlikely	1	1
Neutral	1.10 (0.36,3.35)	1.25 (0.42,3.75)
Likely	3.60 (1.42,9.11)**	3.68 (1.43,9.46)**
Very likely	5.49 (1.90,15.84)**	6.10 (2.16,17.24)**
Positive attitude score		
0	1	–
1-2	1.35 (0.50,3.64)	–
3-5	2.38 (1.07,5.26)*	–
Perceived norm score		
0	–	1
1-2	–	1.65 (0.84,3.24)
3	–	2.04 (0.97,4.27)

Model 1: odds ratio in multivariate model which included intention, positive attitude score and the significant socio-demographic factor (i.e., sex).
Model 2: odds ratio in multivariate model which included intention, subjective norm score and the significant socio-demographic factor (i.e., sex).
* $p < 0.05$.
** $p < 0.01$.

Discussion

The prevalence of IV among children aged 24–59 months was moderate and only increased very slightly over time in this study. It suggests that not many children of this cohort received first-time IV during the follow-up period, i.e., very few of them had initiated IV during 60 and 72 months. Consistently, the age-specific 12-month incidence of the 48–59-month-old at baseline never-vaccinated group was extremely low, compared to the higher incidences of the 24–35 and 36–47-month-old groups, suggesting relatively few first-time IV uptake after age 60 months. As the prevalence of IV was only 11.5% among 12–23 month-old children in Hong Kong [37] while this study showed that about two-third of those aged 24–59 months were vaccinated and incidences of the 24–35 and 36–47-month-old groups were higher than that of 48–59-month-old group, we contend that first-time childhood IV mainly takes place between 24–59 months of age. Although children aged 6 months or older have been recommended to take up IV annually in Hong Kong, parents of children younger than two years might feel that their children were too young for IV. Most of the vaccination would occur before the age of five. Given that no study has been conducted for the entire trajectory of ≤6-year-old children's first-time IV, further proof is warranted. Our findings suggest that health promotion for young children's first-time IV may be more effective if targeting parents of 24–59 month-old children than those younger or older than that age range.

The incidences of IV during the 12-month follow-up period for ever-vaccinated were seven times higher than that for never-vaccinated. It is clear that most of the IV taken during the follow-up period were re-vaccinations instead of first-time vaccinations. It is important to highlight that about 40% of the sampled children aged 36–71 months remained unvaccinated. Efforts should target parents of never-vaccinated children.

Among ever-vaccinated children, positive attitude, norm, and behavioral intention were significant predictors of their IV uptake during the follow-up period. We found that consistent with the TPB specifications, the predictive relationships between positive attitude/perceived norm and future IV were mediated by behavioral intention for IV. Interestingly, positive but not negative attitude (e.g., "this vaccine is not safer than the previous one") toward IV significantly predicted ever-vaccinated children's IV during the follow-up period, although previous cross-sectional studies showed that parental safety concerns (e.g., side effect of IV) were significant correlates of IV among all children (ever-vaccinated and never-vaccinated) aged 6–23 months [14,37]. As that analysis involved re-vaccination among older (>23 months) ever-vaccinated children, the parents of such children might be less anxious about potential side-effects of IV compared to those of the other studies that included parents of younger and never-vaccinated children. The finding suggests that it may be more effective to emphasize on the beneficial instead of negative effects of IV in interventions targeting ever-vaccinated children of this age range.

Perceived norm, but not perceived behavioral control, was another significant predictor of IV among ever-vaccinated children. Perceived norm was associated with IV intention among Chinese adults [21,25,31]. In the collectivistic Chinese culture, establishment of a related norm about children's annual IV through mass media and in different settings (e.g. kindergartens, clinics), and exertion of proper social pressure for conformity with the norm for IV are potentially effective means for interventions to promote IV among young ever-vaccinated children. The non-significance of perceived behavioral control is plausibly explained by the ceiling effect, as 96% of the participants were self-efficacious, possibly due to availability of financial and logistic support provided by the government.

Parental intention, as proposed by TPB, was highly predictive of the index child's IV. The finding applied to both the ever-vaccinated and never-vaccinated groups. It is especially important to increase parental behavioral intention in the never-vaccinated group, in which only 19.0% showed such an intention. The TPB performed better in the ever-vaccinated subsample than the never-vaccinated sub-sample, as attitudes and perceived norms were significant predictors of intention and IV in the former but not the latter group. Our findings have practical implications that extra efforts targeting parents of never-vaccinated parents are required, including those that may increase their motivation (e.g., motivational interviewing) and hence behavioral intention.

The findings also have theoretical implications, that TPB may be less applicable for predicting a new behavior than the same repeated health-related behavior, as we found that some factors might be significant for the latter but not the former. The developers of the TPB pointed out that an individual may alter his/her TPB constructs during the course of executing a behavior, due to personal experience such as experiencing unanticipated consequences and/or obstacles [16]. The resultant TPB constructs may become more well-developed and realistic, and hence allow for a more accurate prediction of the future behavior [38,39]. In the context of childhood IV, it is possible that positive attitudes of those ever-vaccinated children's parents had been confirmed or even reinforced via satisfaction by the child's previous IV experience, leading to a stronger predictive power to future IV. Research on IV and other repeatable health-related behaviors (e.g., regular dental check-ups) should thus keep in mind the potential differences between initiation and maintenance of behaviors, and perform stratified analysis like those performed in this study.

The study has some limitations. Firstly, the response rate of the telephone survey was about 70%. Also, the sampling method may lead to selection bias. Validated scales were not used because they were not available, but other IV studies used similar items. The effective sample size of ever-vaccinated and never-vaccinated groups was only moderate (265 and 175 respectively). However, the large difference in ORs between the two subgroups suggested that the between-group differences were not results of low statistical power. Lastly, other theories might have been used. For instance, the health belief model reported significant correlations between perceived susceptibility and/or cues to action (from medical professionals) and parental intention regarding child's IV

[29,40]. Longitudinal research based on other theories is highly warranted.

Conclusion

It was the first attempt to apply TPB to understand childhood IV in a longitudinal study that involved stratification by baseline IV status. These findings highlighted that both the incidence rate and parental intention regarding young children's IV were much lower among never-vaccinated than ever-vaccinated children. We found that TPB worked better for predicting actual IV in ever-vaccinated than never-vaccinated children as TPB variables, other than behavioral intention, predicted IV among ever-vaccinated children but not never-vaccinated children. It is warranted to conduct randomized controlled trials to evaluate efficacy of TPB-based interventions for promotion of IV among young ever-vaccinated children aged 24–59 months.

Given low behavioral intention and self-efficacy, it would be an uphill battle to increase IV among the sizeable never-vaccinated group, but such efforts are greatly warranted. Our findings suggest that commonly used strategies based on TPB (e.g. changing attitudes, perceived norm, and perceived behavioral control), might not work for this group as such factors were not significant predictors of never-vaccinated child's IV uptake. New strategies (e.g., motivational interviewing and encouraging first IV among infants by medical professionals) need to be developed. Finally, research and health promotion of IV among young children need to segment according to the child's prior vaccination status.

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Conflict of interest

None declared.

Authors' contribution statement

JL was the principal investigator of the project. He designed the proposal, study, and questionnaire. He was responsible for the entire project, monitored the progress of the project, and finalized the manuscript. AW conducted literature searches, interpreted the findings, and prepared the manuscript. YM and KC conducted data analysis and were involved in result interpretation. ML participated in coordination and implementation of the project as well as data analysis. All authors contributed to and approved the final manuscript.

References

[1] Ampofo K, et al. Epidemiology, complications, and cost of hospitalization in children with laboratory-confirmed influenza infection. Pediatrics 2006;118(6):2409–17.
[2] Cowling BJ, et al. The effectiveness of influenza vaccination in preventing hospitalizations in children in Hong Kong, 2009–2013. Vaccine 2014;32(41):5278–84.
[3] Centers for Disease Control and Prevention (CDC). Children and influenza (Flu) (Oct 23, 2019). Available from: https://www.cdc.gov/flu/highrisk/children.htm (accessed 04.04.20).
[4] Osterholm MT, Kelley NS, Sommer A, Belongia EA. Efficacy and effectiveness of influenza vaccines: a systematic review and meta-analysis. Lancet Infect Dis 2012;12(1):36–44.
[5] Michiels B, Govaerts F, Remmen R, Vermeire E, Coenen S. A systematic review of the evidence on the effectiveness and risks of inactivated influenza vaccines in different target groups. Vaccine 2011;29(49):9159–70.
[6] WHO. Vaccines against influenza, WHO position paper–November 2012. Wkly Epidemiol Rec 2012;87:461–76.
[7] Members of the Western Pacific Region Global Influenza Surveillance Response System, Dwyer D, Barr I, et al. Seasonal influenza vaccine policies, recommendations and use in the World Health Organization's Western Pacific Region. Western Pacific Surveill Resp J 2013;4(3):51–9.
[8] de Lataillade C, Auvergne S, Delannoy I. 2005 and 2006 seasonal influenza vaccination coverage rates in 10 countries in Africa, Asia Pacific, Europe, Latin America and the Middle East. J Public Health Policy 2009;30(1):83–101.
[9] Chan YD, Wong ML, Au KW, Chuang SK. Seasonal influenza vaccine effectiveness at primary care level, Hong Kong SAR, 2017/2018 winter. Hum Vaccin Immunother 2019;15:97–101.
[10] Center for Health Protection. Protect yourself from seasonal influenza-influenza vaccination helps (2013/2014). Available from: http://www.chp.gov.hk/en/exhibition_details/2740/0.html. (Archived as http://www.webcitation.org/6SWiMYmEO on September 12, 2014).
[11] Akıs S, Velıpasaoglu S, Camurdan AD, Beyazova U, Sahın F. Factors associated with parental acceptance and refusal of pandemic influenza A/H1N1 vaccine in Turkey. Eur J Pediatr 2011;170(9):1165–72.
[12] Chen MF, et al. Using the health belief model to understand caregiver factors influencing childhood influenza vaccinations. J Commun Health Nurs 2011;28(1):29–40.
[13] Cooper Robbins SC, Leask J, Booy R. Parents' attitudes towards the influenza vaccine and influencing factors. J Paediatr Child Health 2011;47(7):419–22.
[14] Lau JTF, Mo PKH, Cai YS, Tsui HY, Choi KC. Coverage and parental perceptions of influenza vaccination among parents of children aged 6 to 23 months in Hong Kong. BMC Public Health 2013;13(1):1026.
[15] Gerrard M, Gibbons FX, Benthin AC, Hessling RM. A longitudinal study of the reciprocal nature of risk behaviors and cognitions in adolescents: What you do shapes what you think, and vice versa. Health Psychol 1996;15(5):344–54.
[16] Fishbein M, Ajzen I. Predicting and changing behavior: The reasoned action approach. NY: Taylor & Francis; 2011.
[17] Armitage CJ, Conner M. Efficacy of the theory of planned behaviour: a meta-analytic review. Br J Soc Psychol 2001;40(4):471–99.
[18] McEachan RRC, Conner M, Taylor NJ, Lawton RJ. Prospective prediction of health-related behaviours with the Theory of Planned Behaviour: a meta-analysis. Health Psychol Rev 2011;5(2):97–144.
[19] Sheeran P. Intention—behavior relations: a conceptual and empirical review. Eur Rev Soc Psychol 2002;12(1):1–36.
[20] Agarwal V. A/H1N1 vaccine intentions in college students: an application of the theory of planned behavior. J Am Coll Health 2014;62(6):416–24.
[21] Lau JT, Yeung NC, Choi KC, Cheng MY, Tsui HY, Griffiths S. Factors in association with acceptability of A/H1N1 vaccination during the influenza A/H1N1 pandemic phase in the Hong Kong general population. Vaccine 2010;28(29):4632–7.
[22] Myers LB, Goodwin R. Using a theoretical framework to determine adults' intention to vaccinate against pandemic swine flu in priority groups in the UK. Public Health 2012;126:S53–6.
[23] Myers LB, Goodwin R. Determinants of adults' intention to vaccinate against pandemic swine flu. BMC Public Health 2011;11(1):15.
[24] Godin G, Vezina-Im LA, Naccache H. Determinants of influenza vaccination among healthcare workers. Infect Cont Hosp Ep 2010;31(7):689–93.
[25] Liao Q, Cowling BJ, Lam WW, Fielding R. Factors affecting intention to receive and self-reported receipt of 2009 pandemic (H1N1) vaccine in Hong Kong: a longitudinal study. PLoS One 2011;6(3):e17713.
[26] Ajzen I, Ajzen I. Constructing a TPB questionnaire: Conceptual and methodological considerations. Storrs, CT: Unversity of Connecticue; 2002.
[27] Ouellette JA, Wood W. Habit and intention in everyday life: the multiple processes by which past behavior predicts future behavior. PB 1998;124(1):54–74.
[28] Bish A, Yardley L, Nicoll A, Michie S. Factors associated with uptake of vaccination against pandemic influenza: a systematic review. Vaccine 2011;29(38):6472–84.
[29] Chen CH, Chiu PJ, Chih YC, Yeh GL. Determinants of influenza vaccination among young Taiwanese children. Vaccine 2015;33(16):1993–8.
[30] Slater MD. Theory and method in health audience segmentation. J Health Commun 1996;1(3):267–83.
[31] Lau JT, Kim JH, Yang X, Tsui HY. Cross-sectional and longitudinal factors predicting influenza vaccination in Hong Kong Chinese elderly aged 65 and above. J Infect 2008;56(6):460–8.
[32] Lau JTF, Kim JH, Choi KC, Tsui HY, Yang X. Changes in prevalence of influenza vaccination and strength of association of factors predicting influenza vaccination over time-Results of two population-based surveys. Vaccine 2007;25(49):8279–89.
[33] Setbon M, Raude J. Factors in vaccination intention against the pandemic influenza A/H1N1. Eur J Public Health 2010;20(5):490–4.
[34] Singleton JA, Santibanez TA, Wortley PM. Influenza and pneumococcal vaccination of adults aged >= 65: racial/ethnic differences. Am J Prev Med 2005;29(5):412–20.
[35] Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33(1):159–74.
[36] Baron RM, Kenny DA. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J Pers Soc Psychol 1986;51(6):1173.

[37] Lau JTF, Ng CSM, Wu AMS, Ma YL, Lau MMC. Low coverage of influenza vaccination among Chinese children aged 12–23 months: prevalence and associated factors. PloS ONE 2018;13(10):e0205561.
[38] Norman P, Conner M, Bell R. The theory of planned behaviour and exercise: evidence for the moderating role of past behaviour. Brit J Health Psych 2000;5(3):249–61.
[39] Ajzen I. Residual effects of past on later behavior: habituation and reasoned action perspectives. Pers Soc Psychol Rev 2002;6(2):107–22.
[40] Flood EM, et al. Parents' decision-making regarding vaccinating their children against influenza: a web-based survey. Clin Ther 2010;32(8):1448–67.