Multilevel determinants of COVID-19 vaccination uptake among South Asian ethnic minorities in Hong Kong: a cross-sectional online survey

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Abstract

Background: COVID-19 pandemic continues to have a disproportionate effect on ethnic minorities. Studies reported higher COVID-19 vaccine hesitancy among ethnic minorities.

Objective: This study investigated the prevalence of COVID-19 vaccination uptake among a sample of South Asians in Hong Kong. We examined the effects of factors including socio-demographics and all three levels of factors based on the socio-ecological model.

Methods: Participants were South Asian people aged 18 years or above living in Hong Kong, able to comprehend English, Hindi, Nepali or Urdu, and having access to a smartphone. Four community-based organization (CBO) providing services to South Asians in Hong Kong facilitated the data collection. CBO staff posted the study information in the WhatsApp groups involving South Asian clients, and invited them to participate an online survey. Logistic regression models were fit for data analysis.

Results: Among 245 participants, 33.1% (n=81) had taken up at least one dose of COVID-19 vaccination [one dose: n=62 (25.2%), and both doses: n=19 (7.9%)]. After adjusted for significant background characteristics, cultural and religious reasons for COVID-19 vaccine hesitancy were associated with lower COVID-19 vaccination uptake (AOR: 0.83, 95%CI: 0.71, 0.97, P=.02). On individual-level, having more positive attitudes toward COVID-19 vaccination (AOR: 1.31, 95%CI: 1.10, 1.55, P=.002), perceived support from significant others (AOR: 1.29, 95%CI: 1.03, 1.60, P=.03), and perceived higher behavioral control to receive COVID-19 vaccination (AOR: 2.63, 95%CI: 1.65, 4.19, P<.001) were associated with higher COVID-19 vaccination uptake, while a negative association was found between negative attitudes and the dependent variable (AOR: 0.73, 95%CI: 0.62, 0.85, P<.001). On interpersonal-level, higher exposure to information about deaths and other serious conditions caused by COVID-19 vaccination was associated with lower uptake (AOR: 0.54, 95%CI: 0.33, 0.86, P=.01), while knowing more peers who had taken up COVID-19 vaccination was associated with higher uptake (AOR: 1.39, 95%CI; 1.11, 1.74, P=.01).

Conclusions: One third of the South Asians in Hong Kong received at least one dose of COVID-19 vaccination. Cultural or religious reasons, perceptions, information exposure on social media, and influence of peers were determinants of COVID-19 vaccination uptake among South Asians. Future program should engage community groups, champions and faith leaders, and develop culturally competent interventions.

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Multilevel determinants of COVID-19 vaccination uptake among South Asian ethnic minorities in Hong Kong: a cross-sectional online survey

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Abstract

Background: The Coronavirus Disease 2019 (COVID-19) pandemic continues to have a disproportionate effect on ethnic minorities. Across countries, greater vaccine hesitancy was observed among ethnic minorities. After excluding foreign domestic helpers, South Asians make up the largest proportion of ethnic minorities in Hong Kong. It is necessary to plan for COVID-19 vaccination promotion that caters to unique needs of South Asians in Hong Kong.

Objectives: This study investigated the prevalence of COVID-19 vaccination uptake among a sample of South Asians in Hong Kong. We examined the effects of factors including socio-demographics and all three levels of factors based on the socio-ecological model.

Methods: A cross-sectional online survey was conducted on May 1-31, 2021. Participants were South Asian people aged 18 years or above living in Hong Kong, able to comprehend English, Hindi, Nepali or Urdu, and having access to a smartphone. Three community-based organizations (CBOs) providing services to South Asians in Hong Kong facilitated the data collection. CBO staff posted the study information in the WhatsApp groups involving South Asian clients, and invited them to participate an online survey. Logistic regression models were fit for data analysis.

Results: Among 245 participants, 33.1% (n=81) had taken up at least one dose of COVID-19 vaccination [one dose: n=62 (25.2%), and both doses: n=19 (7.9%)]. After adjusted for significant background characteristics, cultural and religious reasons for COVID-19 vaccine hesitancy were associated with lower COVID-19 vaccination uptake (AOR: 0.83, 95%CI: 0.71, 0.97, *P*=.02). On individual-level, having more positive attitudes toward COVID-19 vaccination (AOR: 1.31, 95%CI: 1.10, 1.55, *P*=.002), perceived support from significant others (AOR: 1.29, 95%CI: 1.03, 1.60, *P*=.03), and perceived higher behavioral control to receive COVID-19 vaccination (AOR: 2.63, 95%CI: 1.65, 4.19, *P*<.001) were associated with higher COVID-19 vaccination uptake, while a negative association was found between negative attitudes and the dependent variable (AOR: 0.73, 95%CI: 0.62, 0.85, *P*<.001). Knowing more peers who had taken up COVID-19 vaccination was

also associated with higher uptake (AOR: 1.39, 95%CI; 1.11, 1.74, *P*=.01). On interpersonal-level, higher exposure to information about deaths and other serious conditions caused by COVID-19 vaccination was associated with lower uptake (AOR: 0.54, 95%CI: 0.33, 0.86, *P*=.01).

Conclusion: One third (81/245) of our participants received at least one dose of COVID-19 vaccination. Cultural or religious reasons, perceptions, information exposure on social media, and influence of peers were determinants of COVID-19 vaccination uptake among South Asians. Future program should engage community groups, champions and faith leaders, and develop culturally competent interventions.

Keywords: South Asian ethnic minorities; COVID-19 vaccination; uptake; cultural and religious reasons for vaccine hesitancy; perceptions; information exposure on social media; influence of peers; socio-ecological model; Hong Kong

Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic is an ongoing threat [1]. COVID-19 vaccination and other behavioural preventive measures can help to eradicate the pandemic. The Hong Kong government procures two types of COVID-19 vaccines (Sinovac-Biotech, and BioNTech-Fosun Pharama) and implements a free of charge territory-wide vaccination program to all Hong Kong residents aged 16 years or above. The vaccination services are provided through the community vaccination centers, designated public and private clinics, and outreach vaccination service at residential care homes or nursing homes [2]. The program aims to cover the entire Hong Kong population. During the study period (May 1-31, 2021), priorities to receive COVID-19 vaccination were given to the following groups of Hong Kong residents. They were: 1) Individuals aged 30 years or above and careers of elderly aged over 70 years; 2) Personnel in healthcare settings and those participating in anti-epidemic related work; 3) Residents and staff of residential care homes for the elderly/persons with disabilities; 4) Personal maintaining critical public services; 5) Those providing cross-boundary transportation or working at control points/ports; 6) Staff of food and beverage premises; 7) Staff of local public transportation operators; 8) Registered construction workers; 9) Staff of property management; 10) Teachers and school staff; 11) Staff of tourism industry; 12) Staff of scheduled premises under the Prevention and Control of Disease Regulation (e.g., staff of fitness centers and beauty parlous); 13) Students studying outside Hong Kong (aged 16 years or above), and 14) Domestic helpers [2]. The latest estimate pointed out at least 70% immune individuals would be necessary to achieve herd immunity for COVID-19 [3]. The number of people who received at least one dose of COVID-19 vaccine increased from 936,400 on May 1, 2021 to 1,379,400 on May 31, 2021, accounting for 12.3% and 18.2% of the entire population in Hong Kong. [4, 5]. However, it will take about one year for Hong Kong to achieve herd immunity based on the current progress.

Across countries, COVID-19 pandemic continues to have a disproportionate effect on ethnic minorities, with higher COVID-19 morbidity and mortality and greater adverse socioeconomic consequences [6]. With mass COVID-19 vaccination program in progress, disparities in its uptake may aggravate the vulnerability of ethnic minorities. Across countries, greater vaccine hesitancy was observed among people from some ethnic minorities [6-8]. In the U.K., vaccine hesitancy was higher among Black, Bangladeshi, and Pakistani people comparing with people from a White ethnic background [9]. Two other studies reported lower COVID-19 vaccination uptake rate among ethnic minorities who were over 80 years (20.5% among Black people versus 42.5% among White people) and those who were healthcare workers (70.9% in White, 58.5% in South Asians, and 36.8% in Black) [10, 11]. It is hence important to understand and address the disparities in COVID-19 vaccination among ethnic minorities.

In Hong Kong, the ethnic minority population increased significantly by 70.8% from 2006 to 2016 and accounted for 8.0% (n=584,383) of the entire population (Census, 2016) [12]. After excluding foreign domestic helpers (most of them are Filipinos and Indonesians), South Asians including Indians, Pakistani, Nepali, Bangladeshis, and Sri Lankans make up the largest proportion of ethnic minorities in Hong Kong (n=85,875, accounting for 1.2% of the entire Hong Kong population) [12]. A recent study found that lower health system responsiveness was reported by South Asians than Chinese participants for both outpatient and inpatient services in Hong Kong [13]. The largest disparity in responsiveness was shown in the communication barriers experienced by South Asians due to cultural and language differences in South Asians patients and local health care services provider [13]. During hospitalization inpatients South Asians perceived limited access to the community support in comparison with the Chinese [13]. There is also a lack of autonomy in decision-making and choice of healthcare provider experienced by South Asians [13]. Health professionals in Hong Kong also indicated barriers of their delivery of services to the ethnic minorities, including inadequate dissemination of appropriate information, insufficient provision of

cross-cultural care education and training, inadequate availability of public primary care services and presence of bias and discrimination among hospital staff [13]. Cultural differences between ethnic minorities and health service providers affect patient-provider interactions and health care quality, resulting result in mistrust of government and health authorities, which in turn become an obstacle for COVID-19 vaccination program [6]. With an increasing population of South Asians in Hong Kong, it is necessary to plan for COVID-19 vaccination promotion that caters to their unique needs.

This study applied the socio-ecological model as the conceptual framework, which considered determinants of a health behavior at the individual, interpersonal and social-structural levels [14]. An intervention addressing factors at multiple level are more likely to be successful in changing behavior [14]. On the socio-structural-level, previous studies pointed out the association between cultural/religious belief and COVID-19 vaccine hesitancy. A Malaysian study showed that 20.8% and 6.8% of ethnic minorities believed their COVID-19 vaccine hesitancy was caused by concerns regarding religious and cultural factors, respectively [15]. News reports also suggested that there were concerns among Muslims over the halal status of COVID-19 vaccine [16], and the belief that COVID-19 should be healed by God and body is scared were cited as reasons to refuse a COVID-19 vaccine [17]. Because a large percentage of South Asians in Hong Kong are also Muslim, there is a need to understand the effects of religious belief on COVID-19 vaccine uptake, so that policymakers can target this specific population for relevant COVID-19 vaccine promotional strategy. Limited evidence is available to date to inform us on the cultural effect of COVID-19 vaccine uptake in Hong Kong.

On the interpersonal-level, misinformation related to COVID-19 vaccination threatened vaccination uptake [18]. The government used to report deaths after COVID-19 vaccination regardless of the existence of direct causality evidence. Such information exposure might inhibit the motivation to receive COVID-19 vaccination among South Asians as they will associate COVID-19 vaccination directly with deaths. For example, public’s concerns about vaccine safety increased

substantially after media reported death after COVID-19 vaccination, which resulted in a drop in the proportion of people turning up for their vaccination appointment in Hong Kong (from >90% to 72%) [2]. On the other hand, communication with peers may be effective among South Asians due to higher level of rapport between people of same ethnicity [19]. The Social Learning Theory posits that observation of peers has a major influence on people's health behaviors [33]. Therefore, vaccinated peers may play important roles as volunteers in future programs promoting COVID-19 vaccination among South Asians by sharing their positive experience. Peers' experiences related to COVID-19 vaccination might have strong influence on South Asian's decision to receive such vaccination. Based on these observations, socialization, in terms of receiving vaccine-related information or interpersonal interaction, is assumed to affect vaccine uptake.

On the individual-level, the Theory of Planned Behaviour (TPB) postulates that in order to perform a behaviour, one would evaluate the pros and cons of the behaviour (positive and negative attitudes), consider whether their significant others would support such behaviour (perceived subjective norm), and appraise how much control one has over the behaviour (perceived behavioural control) [27]. The TPB was commonly used to explain a health behaviour and guide the behavioural intervention [28, 29], it has been used to explain willingness to receive COVID-19 vaccination among Chinese people [26]. Studies conducted among Hong Kong general population identified perceived pros and cons that were associated with willingness to receive COVID-19 vaccination. Pros included perceived greater risk and severer consequences of infection, perceived higher effectiveness of COVID-19 vaccines, perceived greater impact of COVID-19 vaccination in pandemic control, perceived larger proportion of general public and acquaintance would take up such vaccination, being recommended by physicians and family members, and perceived higher behavioral control to take up the vaccination [20-23]. Concerns related to side-effects and access issues, as well as difficulties in choosing one out of the available COVID-19 vaccines were

commonly mentioned as cons against vaccination [20-23]. These perceptions were considered by this study.

To our knowledge, there was a dearth of study investigating determinants of COVID-19 vaccination uptake among ethnic minorities in Asian region. To address the knowledge gaps, this study investigated the prevalence of COVID-19 vaccination uptake among a sample of South Asians in Hong Kong. We examined the effects of factors including socio-demographics and all three levels of factors based on the socio-ecological model.

Methods

Study design

We conducted a cross-sectional online survey of 245 South Asian adults in Hong Kong, China on May 1-31, 2021.

Participants and data collection

Participants were South Asian people aged 18 years or above living in Hong Kong, able to comprehend English, Hindi, Nepali or Urdu, and having access to a smartphone. Three community-based organizations (CBO) in Hong Kong facilitated the data collection. These CBOs provide a wide range of services to ethnic minorities, including early childhood education, child rehabilitation, school social work, treatment and social rehabilitation for drug abusers, home care for elderly, employee assistance and development, health check-up and health education. However, their services do not include provision of COVID-19 vaccination. The CBOs keep a list of South Asian people using their services and WhatsApp groups involving CBO staff and these service users are established. There are around 1,050 active South Asian people in the WhatsApp groups held by the CBOs. CBO staff posted the study information in the WhatsApp groups, and invited South Asian people in these groups to participate the online survey.

A link to access an online self-administered survey was also posted in the WhatsApp groups. Through the link, participants first selected the language of the survey (English, Hindi, Nepali or

Urdu) and then assessed an electronic consent form. On the form, they read study information and a statement indicating that information collected by the survey was only used for scientific research purpose and would be kept strictly confidential. Participation was completely voluntary, and refusal would have no consequences. After clicking “I agree” on the electronic consent form, they could start the online survey. We developed the questionnaire using google form, a commonly used online survey platform. Each WhatsApp account was only allowed to access the online questionnaire once to avoid duplicate responses. The survey had about 100 items, which took about 20 minutes to complete. The google form performed a completeness check before each questionnaire was submitted. Participants were able to review and change their responses before submission. Participants were asked to leave an address at the end of the survey. The procedures of data collection were shown in Figure 1.

A supermarket coupon of HK$50 (US$6.5) was sent to the participants by mail upon completion. All data was stored in the online server of google form and protected by a password. Only the corresponding author had access to the database. Ethics approval was obtained from the Survey and Behavioral Research Committee of the Chinese University of Hong Kong (Reference No. SBRE-20-534).

Sample size planning

Our target sample size was 250. Given a statistical power of .80 and an alpha value of .05 and assuming the COVID-19 vaccination uptake in the reference group (without a facilitating condition) to be 10-20%, the sample size could detect a smallest odds ratios of 2.23 between people with and without the facilitating conditions (PASS 11.0, NCSS LLC).

Measurements

Development of the questionnaire

A panel consisted of public health researchers, social workers, health psychologists, representatives from South Asian communities, and CBO workers was formed to develop the questionnaire.

Bilingual researchers with master degrees translated the English version of the questionnaire into Hindi, Nepali or Urdu. The agreed versions were back-translated into English by independent bilingual researchers to ensure linguistic equivalence. The questionnaire was tested among 20 South Asians speaking English, Hindi, Nepali or Urdu on the readability and length. All participants in the pilot testing agreed that the wording of the questions were appropriate and easy to understand. However, 15 of them commented that the questionnaire was too long. The panel trimmed down the questionnaire from 130 items to 100 items. The participants were invited to comment on the length of the revised questionnaire, and they all agreed that the length was acceptable. The panel then finalized the questionnaire for actual survey.

Background characteristics

Participants were asked to report on sociodemographic, living arrangement (e.g., number of family members living with them, and whether they were living with children under 18 years or elderly aged over 60 years). Participants also reported compliance to personal preventive behaviors in the past month, including frequency of wearing facemasks when having close contact with others in workplace and other public spaces, and sanitizing hands after returning from public spaces or touching public installation (response categories: every time, often, sometimes, and never). Two physical distancing behaviors were also measured (whether they avoided social or meal gathering with people who they do not live with and crowed places in the past month). Same measurements of personal preventive behaviors and physical distancing were used in published studies [24-27].

COVID-19 vaccination uptake

Participants reported whether they had taken up any COVID-19 vaccination. Some supplementary information was collected from vaccinated participants, including number of doses and types of COVID-19 vaccines received, presence of side-effects and severity of such side-effects.

Individual-, interpersonal-, and socio-structural-level variables related to COVID-19 vaccination

On the individual-level, positive attitudes toward COVID-19 vaccination were measured by the validated Chinese version of the Positive Attitude Scale [27]. The original scale has five items, and the Cronbach's alpha was .84 [27]. The scale was adapted by replacing "China" in the original scale with "Hong Kong". Perceived subjective norm related to COVID-19 vaccination was measured by the validated Chinese version of the Subjective Norm Scale [27]. The Cronbach's alpha of the original 2-item scale was .85. We added on more item "your friends from South Asia would support you to receive COVID-19 vaccination" to the original scale. Regarding perceived behavioral control related to COVID-19 vaccination, we added one more item "you are confident to receive COVID-19 vaccination in the next six months if you want to" to the validated single-item measurement [27]. One scale (6 items) was constructed for this study to measure negative attitudes toward COVID-19 vaccination (e.g., 'The side-effects of COVID-19 vaccines in long run is unclear'). The response categories to the aforementioned scale items were: 1= disagree, 2=neutral, and 3=agree. In addition, one single item was constructed to measure descriptive norm related to COVID-19 vaccination "Among South Asians you know who are living in Hong Kong, how many of them have already taken up COVID-19 vaccines?" (Response categories: 1=none/not sure, 2=1-2, 3=3-5, 4=6-10, and 5=more than 10).

On the interpersonal-level, frequency of exposing to negative information related to COVID-19 vaccination on social media (e.g., Facebook, Twitter, Flicker, Tiktok, etc.) in the past were measured (response categories: 0=almost never, 1= seldom, 2=sometimes, & 3=always). Participants were also asked about whether they heard about any South Asians who experienced serious side-effects after taking up COVID-19 vaccines.

On the socio-structural-level, five items measured cultural and religious reasons for COVID-19 vaccine hesitancy (e.g., 'You are concerned about the halal status of the COVID-19 vaccines' and 'The body is sacred, should not receive certain chemicals or blood or tissues from animals'). The Cultural and Religious Barrier Scale was constructed by summing up individual item scores. In

addition, two items measured how much confidence they had in Hong Kong's healthcare system and how much they trusted the Hong Kong government regarding COVID-19 control (response categories: from 1=not at all to 10=extremely).

Statistical analysis

Self-reported uptake of any COVID-19 vaccination as the dependent variable. Univariate logistic regression models first assess the significance of the association between background characteristics and the dependent variable. We fit a single logistic regression model to obtain adjusted odds ratios (AOR), which involved one of the independent variable of interest and all background characteristics with $p<0.05$ in univariate analysis. Same approach to obtain AOR was commonly used in published studies [24-28]. There was no missing value for participants who completed the survey. Therefore, missing value analysis was not performed. SPSS version 26.0 (IBM Corp) was used for data analysis, with $P<.05$ considered statistically significant.

Results

Background characteristics

Among 245 participants who completed the online survey, 83 (33.9%) were Indian, 89 (36.3%) were Pakistani, 52 (21.2%) were Nepali, and 21 (8.6%) were from other ethnicity groups. Majority of the participants were under 40 years, female, married or cohabited with a partner, and with tertiary education. About 30% were Hong Kong permanent residents and had a full-time job. Participants reported a good compliance with personal preventive behaviors and physical distancing behaviors in the past month. (Table 1)

Table 1 Background characteristics of South Asians who completed an online survey in Hong Kong on May 1-31, 2021 (n=245)

	n	%
Socio-demographics		
Age group, years		
18-29	83	33.9
30-39	100	40.8
40-49	55	22.4
≥50	7	2.9

Gender		
Male	83	33.9
Female	162	66.1
Relationship status		
Currently single	90	36.7
Married or cohabited with a partner	155	63.3
Ethnicity		
Indian	83	33.9
Pakistani	89	36.3
Nepali	52	21.2
Other ethnicity groups	21	8.6
Permanent residents of Hong Kong		
Yes	72	29.4
No	173	70.6
Highest education level attained		
Junior high or below	35	14.3
Senior high or equivalent	64	26.1
College or university	103	42.0
Postgraduate	43	17.6
Employment status		
Full-time	85	34.7
Part-time/self-employed/housewife/unemployed/retired/students	160	65.3
Number of family member living with the participant		
0	15	6.1
1-2	44	18.0
3-4	124	50.6
≥5	62	25.3
Living with an elderly aged ≥60 years		
No	69	28.2
Yes	176	71.8
Living with a child aged under 18 years		
No	181	73.9
Yes	64	26.1
Having at least one chronic condition		
No	221	90.2
Yes	24	9.8
Compliance to personal preventive behaviors and physical distancing		
Frequency of facemask wearing when you have close with other people in workplace		
Never/sometimes/often	20	8.2
Every time	225	91.8
Frequency of facemask wearing in public spaces/transportations other than workplaces		
Never/sometimes/often	46	18.8
Every time	199	81.2
Sanitizing hands after returning from public spaces or touching public installation		
Never/sometimes/often	60	24.5
Every time	185	75.5

Avoiding social/meal gathering with other people who do not live together		
No	65	26.5
Yes	180	73.5
Avoiding crowed places		
No	59	24.1
Yes	186	75.9

COVID-19 vaccination uptake

Among the participants, 33.1% (n=81) had taken up at least one dose of COVID-19 vaccination [one dose: n=62 (25.2%), and both doses: n=19 (7.9%)]. Among vaccinated participants (n=81), most of them chose mRNA vaccines manufactured by the BioNTech-Fosun Pararma, and received vaccination at community vaccination centers. Side-effects of the COVID-19 vaccination were reported by 64 participants (79%), most of the side-effects were very mild/mild. (Table 2)

Table 2 Perceptions and influences of social media and peers related to COVID-19 vaccination among South Asians who completed an online survey in Hong Kong on May 1-31, 2021

	n	%
Uptake of at least one dose of COVID-19 vaccination		
No	164	66.9
Yes	81	33.1
Individual-level factors		
Perceptions related to COVID-19 vaccination based on the TPB		
Positive attitudes toward COVID-19 vaccination (agree)		
COVID-19 vaccination is highly effective in protecting you from COVID-19	130	53.1
Taking up COVID-19 vaccination is highly effective in protecting your family members against COVID-19	136	55.5
Taking up COVID-19 vaccination can facilitate resumption of cross-boundary travelling	164	66.9
Taking up COVID-19 vaccination can contribute to the control of COVID-19 in Hong Kong	159	64.9
Hong Kong will have adequate supply of COVID-19 vaccination	178	72.7
Positive Attitude Scale [a], mean (SD)	*12.7*	*(2.3)*
Negative attitudes toward COVID-19 vaccination (agree)		
COVID-19 vaccines will have severe side-effects	69	28.2
The side-effects of COVID-19 vaccines in long run is unclear	104	42.4
The protection of COVID-19 vaccines will only last for a short time	54	22.0
It is difficult for you to register for COVID-19 vaccination	21	8.6
There is a lack of information related to the COVID-19 vaccination program in my mother tongue	79	32.2
You do not know which type of COVID-19 vaccine is most suitable for you	105	42.9
Negative Attitude Scale [b], mean (SD)	*11.9*	*(2.3)*

Perceived subjective norm related to COVID-19 vaccination (agree)		
Doctors and nurse would support you to receive COVID-19 vaccination	121	49.4
Your family members will support you to receive COVID-19 vaccination	168	68.6
Your friends from South Asia would support you to receive COVID-19 vaccination	148	60.4
Subjective Norm Scale [c], mean (SD)	*7.4*	*(1.6)*
Perceived behavioral control related to COVID-19 vaccination (agree)		
Receiving COVID-19 vaccination is easy for you if you want to	188	76.7
You are confident to receive COVID-19 vaccination in the next six months if you want to	149	60.8
Perceived Behavioral Control Scale [d], mean (SD)	*5.2*	*(1.1)*
Among South Asians you know who are living in Hong Kong, how many of them have already taken up COVID-19 vaccines?		
0/not sure	54	22.0
1-2	34	13.9
3-5	51	20.8
6-10	29	11.8
>10	77	31.4
Interpersonal-level factors		
Frequency of exposure to the following information related to COVID-19 vaccination on social media (sometimes/always)		
Positive information related to COVID-19 vaccination (e.g., promising efficacy of the vaccines, and new vaccines will enter the market soon)	151	61.6
COVID-19 vaccination will cause deaths and other serious conditions	120	49.0
Many people in Hong Kong did not turn up for their appointment to receive COVID-19 vaccination	109	44.5
Influence of peers		
Did you hear about any South Asians who experienced serious side-effects after taking up COVID-19 vaccines?		
No	188	76.7
Yes	57	23.3
Socio-structural-level factors		
Cultural and religious reasons for COVID-19 vaccination hesitancy (agree)		
You are concerned about the halal status of the COVID-19 vaccines	66	26.9
You are concerned about that COVID-19 vaccines may not work well among South Asians, as they are developed by China and western countries	54	22.0
The body is sacred, should not receive certain chemicals or blood or tissues from animals	61	24.9
COVID-19 should be healed by God or natural means	54	22.0
Taking up vaccination is violating God's will	12	4.9
Cultural and Religious Barrier Scale [e], mean (SD)	*8.3*	*2.5*

Level of confidence in Hong Kong's health system, Mean (SD)	*7.2*	*(2.1)*
Level of trust of the Hong Kong government regarding COVID-19 control, Mean (SD)	*7.7*	*(2.1)*

[a] Positive Attitude Scale, 5 items, Cronbach's alpha:.77, one factor was identified by exploratory factor analysis, explaining for 52.3% of total variance
[b] Negative Attitude Scale, 6 items, Cronbach's alpha:.61, one factor was identified by exploratory factor analysis, explaining for 47.8% of total variance
[c] Subjective Norm Scale, 3 items, Cronbach's alpha:.60, one factor was identified by exploratory factor analysis, explaining for 56.9% of total variance
[d] Perceived Behavioral Control Scale, 2 items, Cronbach's alpha:.63, one factor was identified by exploratory factor analysis, explaining for 73.0% of total variance
[e] Cultural Barrier Scale, 5 items, Cronbach's alpha:.65, one factor was identified by exploratory factor analysis, explaining for 42.2% of total variance

Individual-, interpersonal-, and socio-structural-level variables related to COVID-19 vaccination

The Cronbach's alpha of the scales based on the TPB ranged from 0.60 to 0.77, single factors were identified by exploratory factor analysis, explaining for 47.8-73% of total variance. Among the participants, 31.4% (n=77) had at least 10 peers who had taken up COVID-19 vaccination. About half of the participants sometimes/always exposed to COVID-19 vaccination-related information on social media, such as positive information (e.g., promising efficacy of the vaccines, and new vaccines will enter the market soon), COVID-19 vaccination will cause deaths and other serious conditions, and many people in Hong Kong did not turn up for their appointment to receive COVID-19 vaccination.. Regarding socio-structural-level variables, the Cronbach's alpha of the Cultural and Religious Barrier Scale was 0.65, one factor was identified by exploratory factor analysis, explaining for 42.2% of total variance. (Table 2)

Factors associated with COVID-19 vaccination uptake

In univariate analysis, age group, ethnicity, relationship status, status as Hong Kong permanent residents, facemask wearing in public spaces/transportations other than workplaces, sanitizing hands after returning from public spaces or touching public installation, and avoiding social/meal gathering

with other people who do not live together were associated with COVID-19 vaccination uptake.

(Table 3)

Table 3 Associations between background characteristics and COVID-19 vaccination uptake among South Asians who completed an online survey in Hong Kong on May 1-31, 2021 (n=245)

	Participants who had taken up COVID-19 vaccination (n=81), n (%)	Participants who had not taken up COVID-19 vaccination (n=164), n (%)	cOR (95%CI)	*P* values
Socio-demographics				
Age group, years				
18-29	10 (12.3)	73 (44.5)	1.0	
30-39	42 (51.9)	58 (35.4)	5.29 (2.45, 11.43)	<.001
40-49	27 (33.3)	28 (17.1)	7.04 (3.02, 16.41)	<.001
≥50	2 (2.5)	5 (3.0)	2.92 (0.50, 17.11)	.24
Gender				
Male	24 (29.6)	59 (36.0)	1.0	
Female	57 (70.4)	105 (64.0)	1.34 (0.75, 2.37)	.32
Relationship status				
Currently single	20 (24.7)	70 (42.7)	1.0	
Married or cohabited with a partner	61 (75.3)	94 (57.3)	2.27 (1.26, 4.11)	.007
Ethnicity				
Indian	33 (40.7)	50 (30.5)	1.0	
Pakistani	16 (19.8)	73 (44.5)	0.33 (0.17, 0.67)	.002
Nepali	25 (30.9)	27 (16.5)	1.40 (0.70, 2.82)	.34
Other ethnicity groups	7 (8.6)	14 (8.5)	0.76 (0.28, 2.08)	.59
Permanent residents of Hong Kong				
Yes	36 (44.4)	36 (22.0)	1.0	
No	45 (55.6)	128 (78.0)	0.35 (0.20, 0.62)	<.001
Highest education level attained				
Junior high or below	11 (13.6)	24 (16.4)	1.0	
Senior high or equivalent	15 (18.5)	49 (29.9)	0.67 (0.27, 1.67)	.39
College or university	38 (46.9)	65 (39.6)	1.28 (0.56, 2.89)	.56
Postgraduate	17 (21.0)	26 (15.9)	1.43 (0.56, 3.65)	.46
Employment status				
Full-time	32 (39.5)	53 (32.3)	1.0	
Others	49 (60.5)	111 (67.7)	0.73 (0.42, 1.27)	.27
Number of family member living with the participant				
0	7 (8.6)	8 (4.9)	1.0	
1-2	19 (23.5)	25 (15.2)	0.87 (0.27, 2.82)	.81
3-4	39 (48.1)	85 (51.8)	0.52 (0.18, 1.55)	.24
≥5	16 (19.8)	46 (28.0)	0.40 (0.12, 1.27)	.12

Living with an elderly aged ≥60 years				
No	61 (75.3)	120 (73.2)	1.0	
Yes	20 (24.7)	44 (26.8)	0.89 (0.49, 1.65)	.72
Living with a child aged under 18 years				
No	17 (21.0)	52 (31.7)	1.0	
Yes	64 (79.0)	112 (68.3)	1.75 (0.93, 3.28)	.08
Having at least one chronic condition				
No	74 (91.4)	147 (89.6)	1.0	
Yes	7 (8.6)	17 (10.4)	0.82 (0.33, 2.06)	.62
Compliance to personal preventive behaviors and physical distancing				
Frequency of facemask wearing when you have close with other people in workplace				
Never/sometimes/often	10 (12.3)	36 (22.0)	1.0	
Every time	71 (87.7)	128 (78.0)	2.00 (0.94, 4.26)	.07
Frequency of facemask wearing in public spaces/transportations other than workplaces				
Never/sometimes/often	1 (1.2)	19 (11.6)	1.0	
Every time	80 (98.8)	145 (88.4)	10.48 (1.38, 79.76)	.02
Sanitizing hands after returning from public spaces or touching public installation				
Never/sometimes/often	13 (16.0)	47 (28.7)	1.0	
Every time	68 (84.0)	117 (71.3)	2.10 (1.06, 4.16)	.03
Avoiding social/meal gathering with other people who do not live together				
No	15 (18.5)	50 (30.5)	1.0	
Yes	66 (81.5)	114 (69.5)	1.93 (1.01, 3.70)	.048
Avoiding crowed places				
No	14 (17.3)	45 (27.4)	1.0	
Yes	67 (82.7)	119 (72.6)	1.81 (0.93, 3.54)	.08

cOR: crude odds ratios
CI: confidence interval

After adjusted for significant background characteristics, perceived higher cultural and religious barriers to receive COVID-19 vaccination were associated with lower COVID-19 vaccination uptake (AOR: 0.83, 95%CI: 0.71, 0.97, *P*=.02). At individual-level, having more positive attitudes toward

COVID-19 vaccination (AOR: 1.31, 95%CI: 1.10, 1.55, *P*=.002), perceived support from significant others (AOR: 1.29, 95%CI: 1.03, 1.60, *P*=.03), and perceived higher behavioral control to receive COVID-19 vaccination (AOR: 2.63, 95%CI: 1.65, 4.19, *P*<.001) were associated with higher COVID-19 vaccination uptake, while a negative association was found between negative attitudes and the dependent variable (AOR: 0.73, 95%CI: 0.62, 0.85, *P*<.001). Knowing more peers who had taken up COVID-19 vaccination was also associated with higher uptake (AOR: 1.39, 95%CI; 1.11, 1.74, *P*=.01). At interpersonal-level, higher exposure to information about deaths and other serious conditions caused by COVID-19 vaccination was associated with lower uptake (AOR: 0.54, 95%CI: 0.33, 0.86, *P*=.01). (Table 4)

Table 4 Factors associated with COVID-19 vaccination uptake among South Asians who completed an online survey in Hong Kong on May 1-31, 2021

	Participants who had taken up COVID-19 vaccination (n=81)	Participants who had not taken up COVID-19 vaccination (n=164)	cOR (95%CI)	*P* values	AOR (95%CI)	*P* values
Individual-level factors, mean (SD)						
Positive Attitude Scale	13.6 (1.7)	12.2 (2.5)	1.31 (1.17, 1.56)	<.001	1.31 (1.10, 1.55)	.002
Negative Attitude Scale	10.9 (2.1)	12.4 (2.3)	0.74 (0.64, 0.84)	<.001	0.73 (0.62, 0.85)	<.001
Subjective Norm Scale	7.9 (1.3)	7.1 (1.7)	1.47 (1.21, 1.69)	<.001	1.29 (1.03, 1.60)	0.03
Perceived Behavioral Control Scale	5.7 (0.7)	4.9 (1.2)	2.70 (1.82, 4.00)	<.001	2.63 (1.65, 4.19)	<.001
Among South Asians you know who are living in Hong Kong, how many of them have already taken up COVID-19 vaccines?	3.9 (1.5)	2.8 (1.5)	1.60 (1.32, 1.95)	<.001	1.39 (1.11, 1.74)	.01
Interpersonal-level factors						

Frequency of exposure to the following information related to COVID-19 vaccination on social media, mean (SD)						
Positive information related to COVID-19 vaccination	1.8 (0.8)	1.6 (0.9)	1.32 (0.95, 1.82)	.10	1.16 (0.78, 1.72)	.46
COVID-19 vaccination will cause deaths and other serious conditions	1.3 (0.6)	1.5 (0.8)	0.67 (0.46, 0.98)	.04	0.54 (0.33, 0.86)	.01
Many people in Hong Kong did not turn up for their appointment to receive COVID-19 vaccination	1.3 (0.8)	1.3 (0.8)	0.99 (0.71, 1.37)	.94	0.98 (0.66, 1.56)	.92
Influence of peers, n (%)						
Did you hear about any South Asians who experienced serious side-effects after taking up COVID-19 vaccines?						
No	65 (80.2)	123 (75.0)	1.0		1.0	
Yes	16 (19.8)	41 (25.0)	0.74 (0.39, 1.42)	.36	0.69 (0.31, 1.52)	.35
Socio-structural-level factors, mean (SD)						
Cultural and Religious Barrier Scale	7.5 (2.1)	8.7 (2.6)	0.81 (0.72, 0.91)	.001	0.83 (0.71, 0.97)	.02
Level of confidence in Hong Kong's health system	7.4 (2.4)	7.2 (2.0)	1.06 (0.93, 1.21)	.36	0.95 (0.82, 1.11)	.53
Level of trust of the Hong Kong government regarding COVID-19 control	8.2 (1.9)	7.5 (2.2)	1.18 (1.03, 1.36)	.02	1.09 (0.92, 1.29)	.33

cOR: crude odds ratios
AOR: adjusted odds ratios, OR adjusted for significant background characteristics (age group, relationship status, ethnicity, permanent residents of Hong Kong, frequency of facemask wearing in public spaces/transportations other than workplaces, .
CI: confidence interval

Discussion

To our knowledge, this is one of the first studies investigating the determinants of COVID-19 vaccination uptake using the socio-ecological perspective among ethnic minorities. About one third of the participants received at least one dose of COVID-19 vaccination. Factors at individual level (perceptions related to COVID-19 vaccination), interpersonal level (influence of social media), and socio-structural level (cultural belief) were determinants of COVID-19 vaccination uptake. Using the socio-ecological model allows us to understand COVID-19 vaccination behaviors from a comprehensive perspective.

Participants aged 30-49 years reported highest COVID-19 vaccination uptake, such finding was different from that of the Chinese population [20-23]. Married or cohabited with a partner was also associated with higher COVID-19 vaccination uptake. Future studies should confirm whether protecting one's partner is a motivation to receive COVID-19 vaccination. In addition, South Asians who are not Hong Kong permanent residents reported lower COVID-19 vaccination uptake. Non-permanent residents might be less familiar with the healthcare system in Hong Kong and should receive more support in future programs. As for COVID-19 preventive behaviors, similar to previous studies [26, 27], higher compliance to personal preventive behaviors (e.g., consistent facemask wearing in public spaces and hand hygiene) and physical distancing behaviors (e.g., avoiding social/ meal gathering) was associated with higher uptake.

Culturally, our findings also showed that Pakistani reported significantly lower COVID-19 vaccination uptake comparing to Indians. Difference in religious belief might partially explain the variation. Islam is the major religion for Pakistani, and news reported concerns about the halal status of COVID-19 vaccines among Muslims [14]. Our findings suggested that some unique strategies

should tailor to South Asians to address cultural and religious reasons for COVID-19 vaccination hesitancy. The results confirmed that concerns about the halal status of COVID-19 vaccines was a barrier for South Asians to take up the vaccines [16]. The government should work with the vaccine manufacturers to clarify whether gelatin, which has been commonly used as a stabilizers to ensure vaccines remain safe and effective during storage and transportation, is a part of the available COVID-19 vaccines. In order to address other cultural or religious issues, future program should engage community groups, champions and faith leaders, and develop culturally competent interventions.

On the individual-level, South Asians shared some similar facilitators to receive COVID-19 vaccination as local Chinese population, including perceived efficacy of COVID-19 vaccination in protecting themselves and their family members, perceived impacts of COVID-19 vaccination on pandemic control, perceived support from significant others, and perceived behavioral control of taking up COVID-19 vaccination [20-23]. Concerns about side-effects and difficulties in choosing a most suitable COVID-19 vaccine were common barriers [20-23]. Therefore, the same health promotion strategies might be useful for both South Asians and Chinese in Hong Kong. In order to prevent “choice overload” [29], efficacies and side-effects of different COVID-19 vaccines available in Hong Kong can be compared in a table, which makes it easy for participants to compare features across products [29]. Laymen’s terms in participants’ mother tongue should be used to emphasize that severe side effects of COVID-19 vaccination are rare, and pros of vaccination outweighs its cons. Testimonials of people who received different types of COVID-19 vaccines regarding side-effects are presented. Health communication messages should also demonstrate that the procedures to receive vaccination are easy and convenient to reduce concerns regarding vaccination procedures. Recommendation made by healthcare providers is a strong facilitator of COVID-19 vaccination uptake [20-23]. Performing outreach vaccination services in South Asian communities is also useful to enhance their perceived behavioral control. The results also supported a significant influences of

peers on COVID-19 vaccination uptake among South Asians. Updated information about how many South Asians had taken up COVID-19 vaccination should be disseminated to this group. On the interpersonal-level, exposure to negative information about COVID-19 negatively affect vaccine uptake. Health authorities in Hong Kong should identify and address common misinformation in a timely manner. It is encouraging that the government had started to clarify these misinformation on the vaccination program webpage.

Findings of this study should be interpreted in light of some limitations. First, a direct measure of perceived behavioral control should assess self-efficacy and perceived controllability [30, 31]. Previous studies have suggested these two constructs were differently associated with behavioral intention and actual behaviors [30, 31]. In this study, the scale measuring perceived behavioral control was adapted from a validated tool [27]. Due to the limited length of the questionnaire, the measurement only had two items and mainly covered self-efficacy. Failure to measure perceived controllability together with self-efficacy was on major limitation of this study. Second, in the absence of sampling frame, participants were recruited conveniently online. Similar to other online surveys, the response rate was relatively low (about 25%). We were not able to obtain characteristics of active WhatsApp contacts who did not respond to our invitation or refused to complete the survey. Therefore, we were not able to compare the characteristics of respondents and non-respondents. Selection bias existed. Generalizations should be made cautiously to South Asians in Hong Kong. Yet, because ethnic minorities is a special population in Hong Kong, using traditional randomly sampling method of telephone or mail survey was not feasible for to administer the questionnaire to this targeted population. Third, some items and scales used in this study were single item, self-constructed or modified from those used in published studies in the general population. We purposely decided not to use standardized western scale measurements to account for the cultural variations experienced by ethnic minority in Hong Kong. Self-constructed or modified scale that is designed to suit the local context of Hong Kong is more suitable. Furthermore, the use of single-item scale will

significantly decrease the burden of respondents who need to take time to complete the survey. Moreover, this was a cross-sectional study and could not establish causal relationships.

Using the socio-ecological model, results of this study offered an overview for us to identify tapping points that can encourage COVID-19 vaccine uptake among South Asians population in Hong Kong. Because they shared a dissimilar cultural and social orientations than local Chinese in Hong Kong, current empirical evidence offered a guide on how promotional strategy can be customized for this population. We recommended religion targeted, outreach community and peer based program to enhance COVID-19 vaccine uptake rate among South Asian of Hong Kong. To further customize the promotion, these program can be co-designed, shared, and endorsed by the South Asian communities, such as non-profit groups, champions and faith leaders to develop culturally competent interventions.

Multimedia Appendix 1: English version of the survey questionnaire

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Ethics approval and consent to participate

Informed consent was obtained from all subjects involving in the study. Ethics approval was obtained from the Survey and Behavioral Research Committee of the Chinese University of Hong Kong (Reference No. SBRE-20-534).

Authors' contributions

Conceptualization: A.S., A.H.Y.L., Z.W., E.K.Y.; Methodology: A.S., A.H.Y.L., J.W., S.A., P.S.F.C., Z.W.; Data curation: A.S., A.H.Y.L., J.W., Z.W.; Formal analysis: A.S., A.H.Y.L., Z.W.; Project administration: A.S., A.H.Y.L., Z.W.; Resources: A.H.Y.L., Z.W., E.K.Y.; Supervision: A.H.Y.L., Z.W., E.K.Y; Writing-original draft preparation: A.S., A.H.Y.L., P.S.F.C., Z.W.; Writing-review and

editing: A.S., A.H.Y.L., J.W., S.A., P.S.F.C., Z.W., E.K.Y.; Funding acquisition: A.H.Y.L., Z.W., E.K.Y. All authors have read and agreed to the manuscript.

Competing interests

The authors declare that they have no competing interests.

List of abbreviations

AOR: adjusted odds ratio

CBO: community-based organizations

CI: confidence interval

cOR: crude odds ratio

NGO: non-government organizations

TPB: Theory of Planned Behaviour

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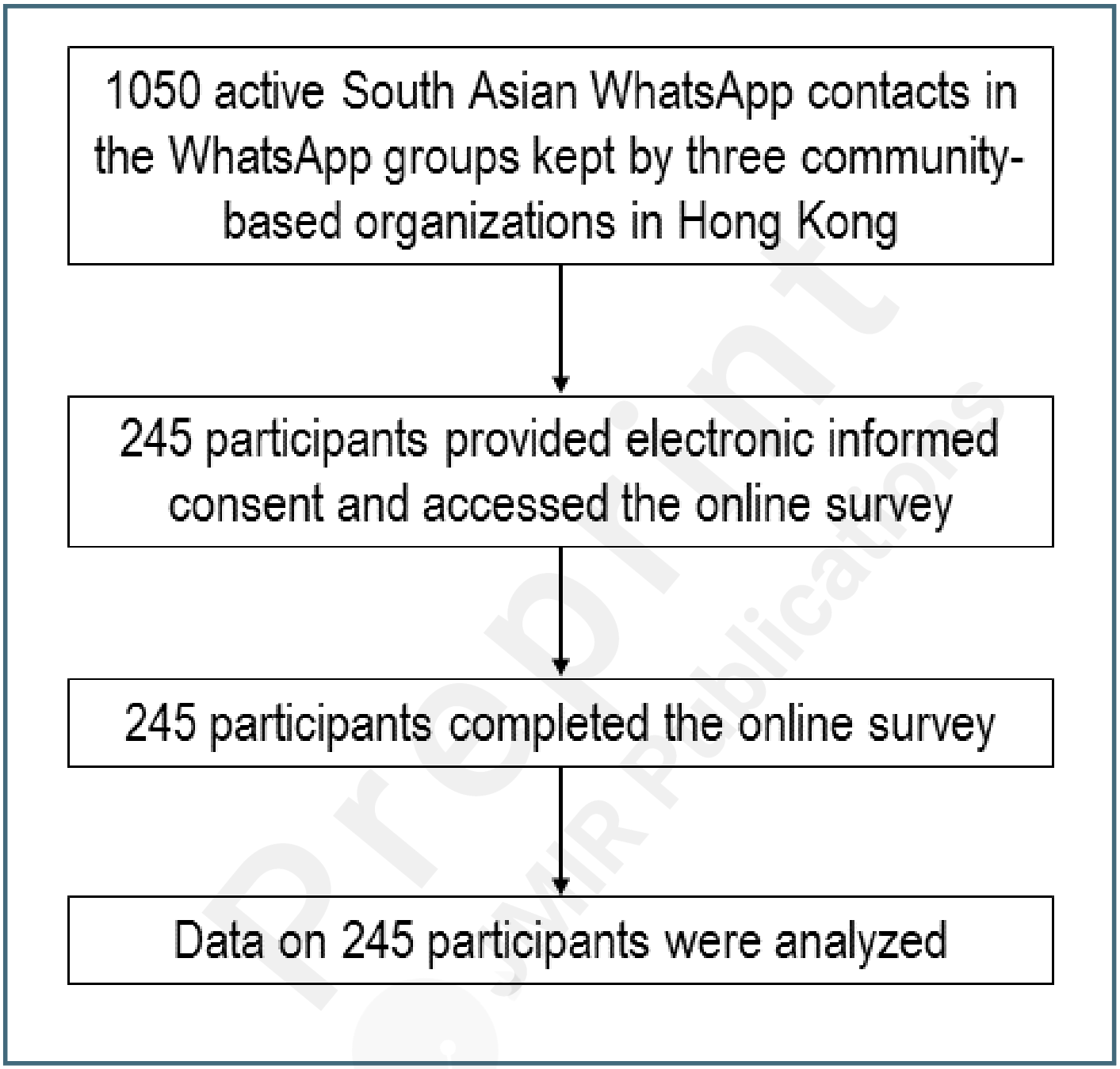
Supplementary Files

Figures

Flowchart of data collection.



Multimedia Appendixes

English version of the survey questionnaire.
URL: http://asset.jmir.pub/assets/e88b9de292ce498648ce70cd504eb41a.docx