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## Prevalence and factors of influenza vaccination during the COVID-19 pandemic among university students in China



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### ABSTRACT

**Background:** Previous outbreaks of emerging infectious diseases (e.g., SARS) had increased the uptake of influenza vaccination (IV). It is uncertain whether such was also true for COVID-19. This study hence investigated prevalence of IV behavior/intention prior to and during the COVID-19 pandemic and associated cognitive factors.

**Methods:** A self-administered, online, and anonymous cross-sectional survey was conducted among 6,922 university students of five provinces in China during November 1–28, 2020 (response rate: 72.3%). **Results:** Of all the participants, 35.1% self-reported behavioral intention of IV (next 12 months), while 62.9% reported an increased intention of IV due to COVID-19. However, only 4.7% and 2.9% had taken up IV during the 12-month period prior to the outbreak (1/2019–12/2019) and during the COVID-19 outbreak (1–11/2020), respectively. Adjusted for the background factors, the multivariable logistic regression analysis showed that in general the COVID-19 related perceptions (perceived susceptibility, perceived severity, and perceived chance of having another wave of COVID-19 outbreak) were significantly and positively associated the IV behavior (during the COVID-19 outbreak) and intention of IV uptake in the next 12 months.

**Conclusions:** The COVID-19 pandemic may have influenced actual behavior and intention of IV uptake among university students during the pandemic. Efforts are warranted to reduce the intention-behavior gap of IV uptake; modification of perceived susceptibility and perceived severity regarding COVID-19 may help. Future longitudinal and intervention studies are needed to confirm the findings of this study and explore other factors affecting IV uptake during the COVID-19 period.

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## 1. Introduction

The COVID-19 pandemic has devastated the world tremendously and there is no clear sign of subsidence. Even in China where related measures and collective responses have been strong, there were sporadic COVID-19 outbreaks [1] that kept the country highly alert. Despite the expedited development and roll out of COVID-19 vaccination in many countries [2], issues such as vaccination hesitancy, availability, and distribution which determine

vaccine coverage and herd immunity [3] remain challenging and uncertain. The health systems of many countries have been overburdened by the pandemic [4], and the arrival of peak influenza seasons introduces additional concerns, as influenza shares similar symptoms with COVID-19 (e.g., fever and cough) [5]. A heavy load of influenza infections may increase the already over-stretched demand for COVID-19 related services [6]. Thus, health authorities worldwide have emphasized on the importance in increasing influenza vaccination (IV) during the pandemic period [7,8].

University students tend to have high risk of contracting and spreading influenza due to their large social networks, crowded living spaces, and frequent social activities [9]. Also, their frequent

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travels during semester breaks increase the likelihood of transmitting influenza to vulnerable people (e.g., the elderly and young children) [10]. Although older people are more vulnerable to severe negative consequences of influenza and COVID-19 [11], promotion of IV uptake among younger people is equally important because of their population size and less frequent use of preventive measure (e.g., social distancing) during the COVID-19 pandemic [12], and yet lower prevalence of IV uptake. A meta-analysis reported that the pooled prevalence of IV uptake was only 6.7% among people aged 18–59 in China, compared against the 26.7% among people aged  $\geq 60$  [13]. Prior to the COVID-19 pandemic, the prevalence of IV uptake among university students in China was 4.1%/9.2%/6.1% in 2009/2010/2011 [14]. University students have not been included as a priority group for free IV uptake in mainland China; they are recommended to take up IV at a cost of about RMB150 (USD25).

The COVID-19 pandemic may change people's intention to take up IV. Literature reported increases in prevalence of IV uptake during previous outbreaks of emerging infectious respiratory diseases (e.g., SARS and H1N1) [15,16]. Our literature review identified four studies that investigated prevalence of IV intention (not behaviors) conducted during the COVID-19 pandemic. The two studies conducted in Italy and U.K. found that about two-thirds of the adults participants had stronger intention of IV uptake due to COVID-19 [17,18], while a third study conducted in Greece reported that about one-third took up IV among elementary school and kindergarten teachers during 2019–2020 and over half of this population showed the intention of IV uptake during 2020–2021 [19]. Another study conducted in Hong Kong did not find a significant change among nurses [20]. To guide health promotion, more research is warranted.

According to the Health Belief Model (HBM) [21], perceived susceptibility and perceived severity are determinants of health-related behaviors. People who feel susceptible to COVID-19 infection would like to reduce the risk. However, influenza would increase the risk of COVID-19 infection [22]. Furthermore, influenza patients may need to see doctors, while there are concerns in general that clinical visits may increase the risk of COVID-19 infection [23]. IV may be seen as a means of reducing the risk of COVID-19 infection through prevention of influenza. The present study contended that people with stronger perceived susceptibility of COVID-19 infection may have stronger motivation to take up IV as a means of reducing the already high level of perceived risk of contracting COVID-19.

Similarly, people perceiving severity of COVID-19 may try to avoid conditions that would increase the severity level of COVID-19 infection. Recent evidence shows that co-infection of influenza and COVID-19 worsened harms of COVID-19 (e.g., lung damages and mortality) [22,24]. A study conducted in Italy reported that those regions with higher proportion of adults  $\geq 65$  taking up IV tended to report less COVID-19 deaths [25]. Mental distress and stigma are severe psychological consequences of COVID-19 infection [26]; influenza symptoms may lead to similar negative psychological consequences during the pandemic [27]. As IV uptake can effectively reduce the risk of co-infection of influenza and COVID-19 [6], it may prevent elevation of the high level of perceived severity of COVID-19. Hence, the present study contended that people with stronger perceived severity would be more likely to take up IV to avoid worse negative consequences because of co-infection of influenza and COVID-19.

This study investigated the prevalence of a) IV behavior prior to the COVID-19 outbreak (from January to December 2019), b) IV behavior during the COVID-19 outbreak (from January 2020 till the survey date), c) intention of IV uptake (next 12 months), and d) self-reported increase in the intention of IV uptake due to

COVID-19. It also investigated three cognitive factors of IV behavior during the COVID-19 outbreak and intention of IV uptake in the next 12 months, including perceived susceptibility, perceived severity, and perceived chance of future outbreak regarding COVID-19 among university students in China. It is hypothesized that such factors would be positively associated with the two IV-related dependent variables.

## 2. Methods

### 2.1. Participants and data collection

An anonymous cross-sectional online survey was conducted during November 1–28, 2020 among university students who studied in five provinces in different parts of China, including Zhejiang (East), Yunnan (Southwest), Guangdong (South), Inner Mongolia (North), and Henan (Central) provinces. Five universities were conveniently selected from each province and participated in the study. The same methodology was presented in a published paper that investigated probable depression among a different sample [26]. In this study, 165 classes of various grades [e.g., Year 1 to 5 (medical students received five-year undergraduate training in China)] within the faculties of arts, sciences, social sciences, economics or management, engineering, and medicine or pharmacy of the participating universities were selected by convenience sampling. The collaborating teachers and student helpers sent an invitation message, the online survey link, and several reminders to all the students in the selected classes via WeChat groups that were being used for regular class administration. The inclusion criteria included being a full-time student and able to read and write Chinese. The online self-administered questionnaire took about 10–15 minutes to complete. It was explained in the invitation message and the online questionnaire that the participation was anonymous, voluntary, and confidential, and that the return of the completed questionnaire implied informed consent. Participants also clicked a button in the electronic questionnaire to provide informed consent. Upon completion, the participants could join a lottery draw which offered eight prizes of RMB10–50 (about USD1.5–7.5) and a symbolic “lucky money” of RMB1 for half of the participants in each participating university.

The study was approved by the research ethics committee of the corresponding author's affiliated institution (No. SBRE-20-094).

### 2.2. Measurement

*Socio-demographic information* was collected, including sex, age, ethnicity, study major, grade, and studied province.

Influenza vaccination (IV)-related variables.

- (1) IV prior to or during the COVID-19 outbreak: Two items assessed whether the participants had taken up IV during the 12-month period prior to the COVID-19 outbreak (i.e., January to December 2019) and during the COVID-19 outbreak (i.e., from January 2020 till the time of survey) (yes/no).
- (2) Intention of IV uptake in the next 12 months: One item assessed the participants' perceived chance of taking up IV in the next 12 months (“probably/definitely yes” versus “less likely”).
- (3) Perceived change in the intention of IV uptake due to COVID-19: The construct was assessed by one item (increase a lot/increase a bit/no change/decrease a bit/decrease a lot).

Perceptions related to COVID-19.

- (1) The Perceived Susceptibility Scale comprised two items: 1) perceived chance of contracting COVID-19 in the next 12 months, and 2) perceived chance of contracting COVID-19 if not having taken up COVID-19 vaccination in the next 12 months (1 = extremely low to 5 = extremely high; Cronbach's alpha = 0.90).
- (2) The Perceived Severity Scale comprised two items about the perceived levels of negative impacts of COVID-19 infection on the participant's physical health/overall life (1 = extremely low to 5 = extremely high; Cronbach's alpha = 0.83).
- (3) Perceived chance of future COVID-19 outbreak in China: One item assessed the perceived chance of having a new wave of COVID-19 outbreak in the next 12 months in China (1 = extremely low to 5 = extremely high).

2.3. Statistical analysis

Univariable logistic regression analysis was conducted to test the associations between the background factors (socio-demographics and IV uptake prior to or during the COVID-19 outbreak) and the two IV-related dependent variables (IV behavior during the COVID-19 outbreak and intention of IV uptake in the next 12 months). Multivariable logistic regression analysis was conducted to test the associations between the COVID-19 related perceptions and the two IV-related dependent variables, adjusted for background factors; past IV behavior prior to or during the COVID-19 outbreak was also adjusted when intention of IV uptake was the dependent variable. Odds ratios (OR) and respective 95% confidence intervals (CI) were derived. The analysis was conducted by using SPSS 24.0. Statistical significance level was defined as two-tailed  $p < .05$ .

3. Results

3.1. Background statistics

A total of 9,593 invitations were sent out; 6,940 students returned the completed questionnaires (response rate of 72.3%), 18 of which were excluded due to low quality (i.e., there were over 20% of missing data in the questionnaire items); 6,922 participants were included in the final data analysis. Of all the participants, the mean age was 19.4 years (SD = 1.5; range = 15–36). The majority were Han ethnicity (86.8%). Close to or more than half of them were females (63.6%), first-year students (43.2%), and medical students (50.9%). The mean (SD; range) scores of perceived susceptibility, perceived severity, and perceived chance of future outbreak were 4.9 (1.7; 2–10), 7.5 (1.8; 2–10), and 2.7 (0.9; 1–5), respectively. (Table 1).

3.2. Prevalence of IV behaviors and intentions

Of all the participants, 4.7% had taken up IV prior to the COVID-19 outbreak in China (January to December 2019), while 2.9% had done so during the outbreak (January to November 2020); 5.6% had taken up IV prior to or during the outbreak. 35.1% expressed an intention to take up IV in the next 12 months. 62.9% indicated that COVID-19 had increased their intention of IV uptake.

3.3. Background factors of the two IV-related dependent variables

Participants who were males, non-Han ethnicity, and studying in some particular provinces (e.g., Inner Mongolia) were more likely than others to have taken up IV during the COVID-19 out-

**Table 1**  
Descriptive statistics (n = 6,922).

	n	%
<b>Sociodemographic variables</b>		
Sex		
Female	4,402	63.6
Male	2,520	36.4
Ethnicity		
Han	6,009	86.8
Others	913	13.2
Major		
Arts	896	12.9
Social sciences	363	5.2
Business	378	5.5
Science	703	10.2
Engineering	819	11.8
Medicine	3,525	50.9
Others	238	3.4
Grade		
Postgraduate	95	1.4
Fourth/final year	776	11.2
Third year	1,164	16.8
Second year	1,894	27.4
First year	2,993	43.2
Province of university		
Guangdong	555	8.0
Inner Mongolia	2,597	37.5
Henan	1,943	28.1
Zhejiang	931	13.4
Yunnan	896	12.9
<b>Influenza vaccination (IV)-related variables</b>		
IV prior to the COVID-19 outbreak*		
No	6,594	95.3
Yes	328	4.7
IV during the COVID-19 outbreak <sup>§</sup>		
No	6,724	97.1
Yes	198	2.9
Intention of IV uptake in the next 12 months		
Less likely	4,494	64.9
Likely	2,428	35.1
Perceived change in the intention of IV uptake due to COVID-19		
Decrease	85	1.2
No increase	2,480	35.8
Increase	4,357	62.9

Notes: COVID-19, coronavirus disease 2019; SD, standard deviation. \*, The period starts from January to December 2019. §, The period starts from January 2020 till the survey date (i.e., November 1–28, 2020).

break in China. Among those having taken up IV prior to the COVID-19 outbreak, 41.8% had taken up IV during the COVID-19 outbreak, whereas only 0.9% of those not having taken up IV prior to the outbreak had taken up IV during the COVID-19 outbreak. (Table 2).

Similarly, participants who were males, younger age, studying in particular majors (e.g., business) and provinces (e.g., Henan) and the past IV behaviors prior to or during the COVID-19 outbreak in China were more likely than others to show an intention of IV uptake in the next 12 months. Notably, the differences in the two IV-related dependent variables between medical and non-medical students were statistically non-significant (results not tabulated).

When all the background variables were entered into a multi-variable logistic regression model, very similar results were found; the results are hence not shown in the tables.

3.4. Adjusted associations between the COVID-19 related perceptions and the two IV-related dependent variables

The analysis adjusted for the background factors. First, higher levels of perceived susceptibility and perceived chance of future COVID-19 outbreak in China, but not perceived severity, were

**Table 2**  
The associations between background factors and the two IV-related dependent variables (n = 6,922).

	IV uptake during the COVID-19 outbreak ORu (95% CI)	Intention of IV uptake in the next 12 months ORu (95% CI)
Sex		
Female	1	1
Male	2.29 (1.72, 3.04)***	1.26 (1.14, 1.40)***
Age	0.92 (0.83,1.02)	0.96 (0.93,0.99)*
Ethnicity		
Han	1	1
Others	1.59 (1.11, 2.28)*	1.15 (0.99, 1.32)
Study major		
Arts	1	1
Social Sciences	0.84 (0.42,1.69)	1.04 (0.81,1.35)
Business	0.96 (0.50,1.85)	1.34 (1.05,1.72)*
Science	0.75 (0.42,1.34)	1.04 (0.85,1.28)
Engineering	0.61 (0.34,1.09)	0.98 (0.80,1.19)
Medicine	0.76 (0.50,1.14)	1.01 (0.86,1.18)
Others	1.06 (0.50,2.26)	0.92 (0.68,1.25)
Grade		
Postgraduate	1	1
Fourth/final year	0.85 (0.25, 2.92)	1.08 (0.68, 2.16)
Third year	0.73 (0.22, 2.45)	1.13 (0.72, 1.78)
Second year	0.71 (0.22, 2.34)	1.13 (0.73, 1.77)
First year	1.10 (0.34, 3.54)	1.39 (0.89, 2.16)
Studied province		
Guangdong	1	1
Inner Mongolia	2.54 (1.23, 5.26)*	1.22 (1.00, 1.49)*
Henan	1.58 (0.74, 3.39)	1.28 (1.04, 1.57)*
Zhejiang	1.96 (0.88, 4.37)	1.14 (0.91, 1.43)
Yunnan	2.12 (0.96, 4.71)	1.28 (1.02, 1.60)*
IV during the 12-month period prior to the COVID-19 outbreak <sup>‡</sup>		
No	1	–
Yes	76.82 (54.99,107.31)***	–
Past IV behavior prior to or during the COVID-19 outbreak <sup>‡</sup>		
No	–	1
Yes	–	1.98 (1.61,2.43)***

Notes: ORu, univariable odds ratio; CI, confidence interval; IV, influenza vaccination. \*, p <.05; \*\*, p <.01; \*\*\*, p <.001. †, The period starts from January to December 2019. ‡, The period starts from January 2019 till November 2020.

**Table 3**  
The adjusted associations between independent variables and the two IV-related dependent variables (n = 6,922).

	IV uptake during the COVID-19 outbreak ORa (95% CI)	Intention of IV uptake in the next 12 months ORa (95% CI)
Perceived susceptibility	1.17 (1.07,1.28)***	1.13 (1.09,1.16)***
Perceived severity	0.94 (0.86,1.03)	1.17 (1.14,1.21)***
Perceived chance of future outbreak	1.37 (1.14,1.66)**	1.08 (1.02,1.15)*

Notes: IV, influenza vaccination; ORa, adjusted odds ratio; CI, confidence interval. \*, p <.05; \*\*, p <.01; \*\*\*, p <.001. The models were adjusted background factors, including sex, age, ethnicity, study major, grade, studied province, and IV behavior prior to or during the COVID-19 outbreak (this variable was only adjusted for the intention outcome).

significantly associated with IV behavior during the COVID-19 outbreak. Second, the aforementioned three types of COVID-19 related perceptions were all significantly and positively associated with the intention of IV uptake.(Table 3).

**4. Discussion**

Corroborating a previous study reporting prevalence of IV uptake among university students in China during 2009–2011 of 4.1% to 9.2%, this study reported prevalence of IV behavior prior to the COVID-19 outbreak close to 5%. It is plausible that university students are not a priority group for promotion of IV during normal time. Considering that influenza would overload the health systems during the COVID-19 pandemic [8], the U.S. CDC recommends that routine annual IV should be taken up by all persons aged ≥ 6 months who do not have contraindications for the 2020–2021 flu season (i.e., during the COVID-19 pandemic) [28].

As it was not habitual for university students in China to take up IV, health promotion is greatly warranted for this population.

It is encouraging that the prevalence of intention of IV uptake was reasonably high (about 1/3). However, the actual prevalence of IV behavior during the COVID-19 outbreak was only about 3%, which was not higher than that of the pre-pandemic 12-month period. In literature, behavioral intention is commonly used in vaccination studies, including those of IV [17–20] and COVID-19 vaccination [29–33]. Behavioral intention is known to be one of the strongest predictors of vaccination behavior [34]. Its significance and usefulness have been illustrated in the commonly used Theory of Planned Behavior, which postulates that behavioral intention mediates between the determinants of the behavior of interest (i.e., attitude, subjective norm, and perceived control) and the outcome variable of health-related behavior [34]. In simpler words, factors of vaccination uptake need to change intention first; intention would then determinate the behavioral outcome. Nonetheless, the apparent inconsistency between the higher level of intention

but low actual IV rate might be partially explained by the fact that health-related intention is not always translated into actual behavior [35]. It is also plausible that regular IV services might be disrupted during the COVID-19 pandemic, the initial period in particular. Another plausible explanation is that IV uptake in China is conducted at community healthcare centers. People's tendency to avoid receiving medical services during the COVID-19 period [4] might have stopped some people from translating the intention of IV uptake into action during the COVID-19 period. To alleviate worries about clinic visits, provision of IV services on campus may increase the prevalence of IV uptake; the setting may also increase IV uptake through strengthening subjective norms and observational learning, according to the Theory of Planned Behavior [34] and the Social Cognitive Theory [36].

The history of IV behavior prior to the COVID-19 outbreak exhibited a large OR in its association with IV behavior during the COVID-19 period, implying that most of those vaccinated during the COVID-19 period were those who used to take up IV. Thus, most of these who intended to take up IV in the future had not been vaccinated in the past; their IV intention might be 'newly formed' during the COVID-19 pandemic. Furthermore, about 60% of the participants acknowledged that they had an increased intention of IV uptake due to COVID-19. Hence, COVID-19 may have a positive effect on the intention of IV uptake. As COVID-19 has now been put under control in China, a follow-up study is required to see if the increased intention would be translated to actual IV behavior. Future studies are also needed to understand better specific facilitators and barriers that would affect the translation of their intention into vaccination behaviors among those who do not usually take up IV.

This study may inform the design of interventions promoting IV uptake among university students in China, which is warranted because of their lower prevalence of IV uptake and higher risk of influenza. Perceived susceptibility of COVID-19 infection and perceived chance of future COVID-19 outbreak were found to be positively associated with the IV behavior and intention, which corroborates the finding of a positive association between perceived risk of COVID-19 and intention of IV uptake among adults in U.K. [18]. Supporting the study's hypothesis, perceived severity of COVID-19 was also associated with intention of IV uptake (next 12 months). According to the Protection Motivation Theory of fear appeal (PMT) [37], perceived threat refers to the co-existence of perceived susceptibility and perceived severity. Those who feel more threatened by COVID-19 are expected to have higher intention of IV uptake, as the fear induced by the perceived threat would trigger off danger control responses (i.e., actions to remove the danger such as IV) [37]. The fear appeal approach has frequently been used in social marketing for health promotion [38]. Thus, health promotion may emphasize on the high risk and severity regarding COVID-19 (physically, emotionally, and socially) in the context of university life, and also, how IV uptake would be able to reduce such risk and severity, i.e., removing the threat of COVID-19. It is interesting that although perceived severity was associated with the intention of IV uptake, it was not significantly associated with IV behavior during the COVID-19 period, possibly because history of IV uptake was the dominant factor in this case.

Furthermore, the Transtheoretical model (TTM) may be applied to bridge the potential intention-behavior gap of IV uptake. It has been used effectively to promote vaccination behaviors (e.g., IV and HPV vaccination) [39]. According to the TTM, people need to go through the pre-contemplation stage, the contemplation stage, and the preparation stage before reaching the action stage that results in behavioral change [40]. In our case, about 1/3 of the sampled university students reported intention of IV uptake and are thus in the contemplation stage of change. Self-efficacy and goal setting are important to advance people of this stage to the prepa-

ration and action stages [40]. The action-based models (e.g., the Health Action Process Approach) have similarly proposed that working through planning process (e.g., designating where, when and how to perform the behavior and overcome anticipated barriers) would translate intention into action [41,42]. Such strategies may be considered in relevant health promotion of IV uptake.

This study has several limitations. First, as it was a cross-sectional survey, causal relationship cannot be inferred. Second, social desirability bias may be involved as IV behavior/intention may be considered socially desirable. Third, although the response rate of this study was relatively high (>70%) and the sample covered different regions of China, it might not be representative to the overall university student population in mainland China as there were 1,272 universities in mainland China when the study was conducted. The convenience sampling also requires caution in making generalization to other populations/regions. Besides, the participants may be over-represented by students majoring in medicine who tend to have higher prevalence of IV behavior/intention [43]. Last, this study only focused on three cognitive factors of IV, which are important ones. Perceived severity and perceived susceptibility of COVID-19 are among the strongest drives for COVID-19 vaccination [33,44]. In IV research, perceived severity and susceptibility regarding influenza were also frequently investigated [45–47]. We included perceived chance of having future outbreak in China as COVID-19 was quite well controlled in China. Yet, the participants' worry about the future was still relevant and might be a significant factor. It is, however, a limitation of this study that other potential factors had not been included in this study, such as other factors of the HBM (perceived barrier, self-efficacy, and cue to action). For instance, the cost of IV uptake is a potential barrier against IV that may reduce self-efficacy. Future studies may look at other factors of IV uptake.

In conclusion, this study observed a moderately high prevalence of behavioral intention of IV uptake in the next 12 months and perceived increase in intention of IV uptake due to COVID-19, despite low prevalence of IV behavior prior to and during the COVID-19 outbreak. The associations between perceived risk/severity and intention of IV uptake further supports the claim that the COVID-19 pandemic may have influenced the IV uptake among university students. Such findings are novel. It is, however, uncertain whether the elevated intention would be translated into action. Efforts are greatly warranted to reduce the potential intention-behavioral discrepancy. Applications of behavioral health theories (TTM and fear appeal approaches) are potentially useful. Although this study brings some insights, it is preliminary and exploratory. Regarding future studies, it is important to understand whether the findings can be applied to other populations and investigate other factors related to IV uptake and COVID-19 vaccination. Future longitudinal and intervention studies are also warranted to confirm and validate the findings of this study. In sum, it is important to understand how to utilize the 'opportunity' arising during the COVID-19 pandemic for health promotion of IV uptake.

## 5. Statement of ethical approval

The study was approved by the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong (No. SBRE-20-094).

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### CRediT authorship contribution statement

**Yanqiu Yu:** Conceptualization, Methodology, Software, Formal analysis, Data curation, Writing – original draft, Writing – review & editing. **Yee-ling Ma:** Formal analysis. **Sitong Luo:** Investigation, Data curation. **Suhua Wang:** Investigation. **Junfeng Zhao:** Investigation. **Guohua Zhang:** Investigation. **Lijuan Li:** Investigation. **Lip-ling Li:** Investigation. **Joseph Tak-fai Lau:** Conceptualization, Methodology, Data curation, Validation, Resources, Writing – original draft, Writing – review & editing, Supervision, Funding acquisition.

### Declaration of Competing Interest

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

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