HUMAN VACCINES & IMMUNOTHERAPEUTICS
2022, VOL. 18, NO. 1, e2016006 (8 pages)
https://doi.org/10.1080/21645515.2021.2016006

Taylor & Francis
Taylor & Francis Group

RESEARCH PAPER

OPEN ACCESS Check for updates

Influenza vaccination uptake and its determinants during the 2019-2020 and early 2020-2021 flu seasons among migrants in Shanghai, China: a cross-sectional survey

Kaiyi Han[a,b]*, Mark R. Francis[c]*, Aichen Xia[a], Ruiyun Zhang[a], and Zhiyuan Hou[a,d]

[a]School of Public Health, Fudan University, Shanghai, China; [b]Department of Infectious Disease Epidemiology, London School of Hygiene & Tropical Medicine, London, UK; [c]Health Sciences Unit, Faculty of Social Sciences, Tampere University, Tampere, Finland; [d]NHC Key Laboratory of Health Technology Assessment, Fudan University, Shanghai, China

ABSTRACT

Influenza vaccination coverage has generally been low in mainland China. However, few studies have attempted to measure influenza vaccination coverage among internal migrants in China who are at an increased risk of influenza infections. This study assessed influenza vaccination coverage and the factors associated with vaccination uptake among internal migrants in Shanghai, China. We conducted a cross-sectional online survey among a sample of migrants residing in Shanghai during November 1–20, 2020, to investigate vaccination uptake during the 2019–20 and early 2020–21 flu seasons (September to November 2020). Multivariable logistic regression was used to examine the factors associated with influenza vaccination uptake for the two flu seasons. About a quarter, 26.3%, and 24.4% of respondents reported receiving an influenza vaccination during the 2019–20 and early 2020–2021 flu seasons, respectively. Respondents who were divorced or widowed, had more household members (2 or ≥ 3), and considered themselves in good health were more likely to receive an influenza vaccine, regardless of the season. Respondents who perceived that they were highly susceptible to influenza and COVID-19 and those who reported ever consulting a medical professional about COVID-19 were more likely to have received a flu vaccination in the early 2020–21 flu season. The uptake of influenza vaccination among internal migrants in Shanghai was suboptimal. We found a range of factors linked to influenza vaccination uptake, pointing to the need for more in-depth evaluations on the underlying reasons driving the vaccination uptake among vulnerable populations in China, especially during the COVID-19 pandemic.

ARTICLE HISTORY
Received 16 July 2021
Revised 26 November 2021
Accepted 5 December 2021

KEYWORDS
Influenza; COVID-19; vaccine; acceptance; China

Introduction

Seasonal influenza is a serious global health threat, with 290,000–650,000 influenza-associated respiratory deaths (4.0–8.8 deaths per 100 000 individuals) occurring annually from 1999 to 2015.[1] Influenza vaccination is a proven intervention to reduce the risk of influenza-related illness, hospitalization, and deaths.[2] The Chinese Center for Disease Control and Prevention recommends annual influenza vaccination for all residents aged 6 months or older who have no contraindications due to the constantly evolving nature of influenza viruses and as vaccination-induced immunity wanes over time.[3] Many countries have included the influenza vaccine in their national immunization programs. Influenza vaccination coverage among adults aged 18 years or older was 48.4% during the 2019–2020 season in the United States, which conducts annual national surveys to estimate vaccination coverage and improve the uptake of flu vaccines.[4] Influenza vaccination coverage in China based on available data is suboptimal; A national survey estimated that influenza vaccination coverage was only 1.5–2% during 2004 and 2014.[5] A recent survey in Shanghai reported a flu vaccination coverage of 11.8% during the 2018–2019 flu season.[6]

The coronavirus disease 2019 (COVID-19) pandemic and subsequent control measures have disrupted immunization programs worldwide.[7,8] The lack of effective vaccines and antiviral medicines in the early stage of the pandemic resulted in the rollout of non-pharmaceutical interventions, including avoiding mass gatherings, school closure, and travel bans, to control the further spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[9] Although these measures were crucial, the disruptions in immunization service provision may have resulted in a large proportion of missed or delayed vaccination doses for children and adults.[10–12] Several studies have investigated the provision of vaccines against measles, polio, diphtheria, pertussis for children during the COVID-19 pandemic,[7,8,13,14] but there is a lack of research on the uptake of influenza vaccines during the pandemic. Furthermore, no previous study has investigated the publics' uptake of influenza vaccination during the COVID-19 pandemic in China. Controlling the spreading of influenza and SARS-CoV-2 is essential to reduce the burden of influenza-related illnesses on the public health care system in the country.

Few studies have examined the vaccination behavior of vulnerable populations, such as migrants, during the COVID-19 pandemic.[15] Since the 1980s, the number of internal migrants (persons who leave their birthplaces to seek jobs in the cities) has increased dramatically with the rapid urbanization in China, reaching approximately 286.5 million in 2017.[16] Previous studies from China have shown that the health of

CONTACT Zhiyuan Hou zyhou@fudan.edu.cn School of Public Health, NHC Key Laboratory of Health Technology Assessment, Fudan University, 130 Dong'an Road, Shanghai 200032, China

*Co-first authors.

migrants is often worse than non-migrants in urban areas because of their low socioeconomic status and limited access to public welfare services.[17–19] In addition, migrant's risk of influenza infections may be higher because many are employed in the service industry and have close and frequent contact with the general public.[20] Assessing influenza vaccination coverage and the factors associated with vaccination uptake among the internal migrants could help identify subgroups with low coverage for targeted intervention, thus protecting them from potentially severe illness and economic losses to their livelihood. Our study aimed to assess the uptake of influenza vaccines among internal migrants in Shanghai, China, during the 2019–2020 and early 2020–2021 (September to mid-November 2020) flu seasons and their determinants.

Methods

Study design

We conducted a cross-sectional, web-based survey among a representative sample of internal migrant workers in Shanghai during November 1–20, 2020. In Shanghai, internal migrants (9.78 million) account for 40 · 27% of the total population, and the service industry where most migrants work accounts for 72 · 74% of Shanghai's gross domestic product (GDP).[21] We used convenience sampling to recruit migrant workers for our survey. First, 21 communities were identified in the Pudong, Minhang, and Xuhui districts of Shanghai. Second, we contacted 1–2 workplaces with large numbers of migrant workers, including workers from food markets, supermarkets, hotels, caterers, and factories, in each community, until a total of 23 workplaces were identified as our study sites. All migrants in the selected workplaces were invited to complete a questionnaire after providing their informed consent and confirming if their residence registration was local or not. We also encouraged respondents who completed the survey to disseminate a link with the survey description, consent statement, and questionnaire to all their contacts.

Data collection

We developed a web-based questionnaire using "Questionnaire Star,"[22] a paid website that helps generate, distribute and retrieve electronic questionnaires. Respondents could access the questionnaire through WeChat, a social media application with over 1.1 billion active users in China.[23] Each WeChat account was allowed to fill in only one questionnaire to avoid data duplication. Respondents could also share the survey questionnaire via social media platforms to invite their colleagues or friends to participate. The questionnaire was pilot tested among ten respondents in a non-study community. The pilot testing revealed that it took approximately 5 minutes to complete the self-administered questionnaire, and respondents received electronic currency worth CNY 5 (US$ 0 · 7) as a gift after they completed the questionnaire.

In total, 3771 migrants initially accepted our invitation to participate in the survey. Among these respondents, 1174 questionnaires were from local residents (who were not migrants), and 471 questionnaires were completed in less than 100 seconds (the minimum time considered valid to complete our questionnaire in the pilot survey) or had missing data, and were excluded from the analyses. Thus, a total of 2126 respondents with valid data were included for analysis in our study (participation rate: 56 · 38%).

Measures

Vaccination uptake during the 2019–2020 and early 2020–2021 (September-November 2020) flu seasons were the outcomes of interest, measured with the questions: *"Were you vaccinated against influenza in the second half of last year (2019) and the first half of this year (2020)?"* and *"Have you been vaccinated against influenza since September 2020?"* Possible responses to these questions were either "Yes" or "No." As potential predictors of influenza vaccination uptake, we assessed the respondents' perceived susceptibility to influenza on a five-point Likert scale with the following response options: very high, high, not sure, low, very low. We also assessed the respondents' perceived susceptibility to COVID-19 (on the previously mentioned Likert scale) and whether they or their family members had consulted a doctor during the COVID-19 pandemic. Socio-demographic characteristics of participants such as age, gender, marital status, education, monthly income, and the number of household members were also collected in the study questionnaire.

Statistical analysis

We calculated means and standard deviations or percentages to describe the study sample on unweighted data. We then performed univariate analyses using the Pearson chi-square test to investigate associations between the socio-demographic characteristics of participants, their perceived susceptibility to influenza and COVID-19, and if they consulted a doctor during the COVID-19 pandemic, and influenza vaccination uptake during the 2019–2020 and early 2020–2021 flu seasons. All study variables were analyzed categorically. The age of respondents was categorized into the following groups: ≤25 years old, 26–35 years old, 36–45 years old, >45 years old, and the number of household members was divided into the following groups: 1, 2,≥3 members. In addition, the self-rated health status of respondents was dichotomized as "fair or poor" (fair, poor, very poor) and "good" (very good, good), and their perceived susceptibility to influenza and COVID-19 was classified as "low" (not sure, low, very low) and "high" (very high, high). Next, we performed multivariate logistic regression to examine the factors associated with influenza vaccination uptake during the 2019–2020 and early 2020–2021 flu seasons, adding independent variables in two stages (irrespective of statistical significance in the univariate analyses). First, "basic" regression models were developed to examine the associations between the respondent's socio-demographic characteristics (such as age, gender, marital status, education, and monthly income), self-rated health status, and influenza vaccination uptake (for both flu seasons). Subsequently, "additional" regression models were used to examine associations between

respondents' perceived susceptibility to influenza and COVID-19, ever consulting a medical professional during the pandemic, and influenza vaccination uptake during the early 2020–21 flu season, controlling for their socio-demographic characteristics and self-rated health status. The findings of these multivariate regression models are presented as Adjusted odds ratios (aORs) and 95% confidence intervals (CIs). All analyses were performed using STATA, version 14.0 (Stata Corp, College Station, TX, USA).

Results

Sample characteristics

Among the 2126 respondents who formed the analytical sample, nearly half were female (49.67%) and aged 26–35 years old (46.43%) (Table 1). Around 70% of internal migrants lived in families with more than one member (64.86%). Nearly half of the migrants had a university or bachelor level education (46.57%), and 71.26% had a monthly income of less than CNY 7500 (US$ 1160). In addition, a majority (80.2%) of the respondents considered their health status to be good.

Influenza vaccination and perceived susceptibility to influenza and COVID-19

Around a quarter (26.25%) of the respondents reported that they were vaccinated against influenza in the 2019–2020 flu season, and a similar proportion (24.41%) were vaccinated during the early 2020–2021 flu season (during September to mid-November 2020). In addition, 70.41% of respondents were not vaccinated in either of the flu seasons, while 21.07% were vaccinated in both seasons. Less than a third (29.16%, n = 620) of the respondents perceived that they were "very highly" or "highly" susceptible to influenza, while only 14.86% (n = 316) considered themselves susceptible to COVID-19 (Table 1). Slightly less than half (45.53%) of the respondents reported that they had consulted a medical professional about COVID-19 during the pandemic.

Factors associated with influenza vaccination

The results of the univariate analyses are presented in Table 1. These findings suggested that the uptake of influenza vaccination in the 2019–2020 and early 2020–2021 influenza seasons was higher among younger respondents (<45 years), those who were divorced or widowed, who had families with more than one member, those with higher education (high school and above) and monthly income (CNY 5000 or higher), and those working in the service industry including catering and home deliveries. Respondents who rated their health status "good" were also more likely to report a flu vaccination during the 2019–2020 and early 2020–2021 flu seasons than those who rated their health as "poor" or "fair" (Table 1). During the early 2020–2021 flu season, higher uptake of influenza vaccination was observed among migrants who perceived themselves to be highly susceptible to influenza and COVID-19 and among those who reported consulting a medical professional about COVID-19.

The results of the multivariate regression modeling, which examined the predictors of influenza vaccination uptake among respondents, are presented in Table 2. The variables that were significantly associated with a higher likelihood of influenza vaccination in the basic models (which included only socio-demographic variables) for both flu seasons were female gender, being divorced or widowed, having two or more household members, reporting a monthly income of CNY10000 or higher, and good self-rated health. Older respondents (36–45 and >45 years) and those employed in food or supermarkets, companies, and the unemployed were observed to have lower influenza vaccination uptake in the basic models across the two flu seasons. In addition, respondents who perceived that they had a high susceptibility to influenza (adjusted odds ratio (aOR): 1.68, 95% CI 1.28–2.21) and COVID-19 (aOR: 4.32, 95%CI: 3.08–6.04), and those who consulted a medical professional about COVID-19 (aOR: 5.41, 95%CI: 4.16–7.03), were also more likely to report uptake of influenza vaccination in the early 2020–2021 flu season.

Discussion

Our study examined influenza vaccination coverage during the 2019–2020 and early 2020–2021 flu seasons and the factors associated with its uptake among internal migrants in Shanghai, China. We found low influenza vaccination coverage in this migrant population, with 26.25% vaccinated in the 2019–2020 and 24.41% in the early 2020–2021 flu seasons. Respondents who were female, had more members in their household, and those with better self-rated health were more likely to receive a flu vaccination than their counterparts, irrespective of the influenza season (2019–2020 and early 2020–2021 seasons). Respondents who were divorced or widowed were more likely to receive a flu vaccination; this finding, in particular is inconsistent with previous research and warrants further investigation. Older respondents were observed to have lower flu vaccination uptake than their counterparts across both flu seasons. Perceiving a high susceptibility to influenza and COVID-19 and ever consulting a medical professional about COVID-19 were positively associated with influenza vaccination uptake among respondents in the early 2020–2021 flu season. This points to the need for targeted educational interventions for migrant workers emphasizing the risks of influenza infections and the importance of seasonal flu vaccination, especially during the ongoing pandemic.

Influenza vaccination rates among internal migrants in Shanghai during the 2019–2020 and early 2020–2021 flu seasons were similar but higher than in previous studies. A Chinese meta-analysis estimated an influenza vaccination coverage of around 10% among adults aged 18–59 during 2007 and 2015, excluding the estimate (>50%) during the 2009–2010 flu season, influenced by the 2009 influenza pandemic.[24] Another survey from China conducted in 2015 estimated that only one-fifth (N = 188, 18.16%) of young service industry workers (mainly aged 20 to 40 years old) in Guangzhou were vaccinated against influenza during the three years before the survey.[25] More in-depth research is needed to examine the reasons for the higher influenza vaccination uptake among migrant populations in Shanghai during the

Table 1. Respondent characteristics and flu vaccination status, n (%).

Characteristics	Total	Flu vaccination during the 2019–2020 flu season		Flu vaccination during the early 2020–2021 season	
		Yes	No	Yes	No
Total	2126	558 (26.25)	1568(73.75)	519(24.41)	1607(75.59)
Gender		p = .755		p = .671	
Male	1070(50.33)	284(26.54)	786(73.46)	257(24.02)	813(75.98)
Female	1056(49.67)	274(25.95)	782(74.05)	262(24.81)	794(75.19)
Age (years)		p < .001		p < .001	
≤25	491(23.1)	136(27.7)	355(72.3)	121(24.64)	370(75.36)
26–35	987(46.43)	316(32.02)	671(67.98)	288(29.18)	699(70.82)
36–45	375(17.64)	79(21.07)	296(78.93)	74(19.73)	301(80.27)
>45	273(12.84)	27(9.89)	246(90.11)	36(13.19)	237(86.81)
Marital status		p = .017		p = .005	
Single	620(29.16)	161(25.97)	459(74.03)	145(23.39)	475(76.61)
Married	1441(67.78)	370(25.68)	1071(74.32)	347(24.08)	1094(75.92)
Divorced or widow	65(3.06)	27(41.54)	38(58.46)	27(41.54)	38(58.46)
Number of household members		p < .001		p < .001	
1	292(13.73)	46(15.75)	246(84.25)	45(15.41)	247(84.59)
2	455(21.4)	103(22.64)	352(77.36)	98(21.54)	357(78.46)
≥3	1379(64.86)	409(29.66)	970(70.34)	376(27.27)	1003(72.73)
Education		p < .001		p < .001	
Primary school or below	94(4.42)	12(12.77)	82(87.23)	14(14.89)	80(85.11)
Middle school	458(21.54)	73(15.94)	385(84.06)	62(13.54)	396(86.46)
High school	584(27.47)	152(26.03)	432(73.97)	131(22.43)	453(77.57)
Bachelor degree or above	990(46.57)	321(32.42)	669(67.58)	312(31.52)	678(68.48)
Monthly personal income (Chinese Yuan)		p < .001		p < .001	
≤2500	204(9.6)	35(17.16)	169(82.84)	30(14.71)	174(85.29)
2501–5000	585(27.52)	106(18.12)	479(81.88)	98(16.75)	487(83.25)
5001–7500	726(34.15)	206(28.37)	520(71.63)	194(26.72)	532(73.28)
7501–10000	347(16.32)	108(31.12)	239(68.88)	98(28.24)	249(71.76)
>10000	264(12.42)	103(39.02)	161(60.98)	99(37.5)	165(62.5)
Workplace		p < .001		p < .001	
Manufacturing industry (such as factories)	266(12.51)	79(29.7)	187(70.3)	74(27.82)	192(72.18)
Food market or supermarket	334(15.71)	34(10.18)	300(89.82)	33(9.88)	301(90.12)
Small service industry (such as catering or express delivery)	514(24.18)	201(39.11)	313(60.89)	192(37.35)	322(62.65)
Company or government agency	768(36.12)	206(26.82)	562(73.18)	182(23.7)	586(76.3)
Unemployed	105(4.94)	12(11.43)	93(88.57)	17(16.19)	88(83.81)
Others	139(6.54)	26(18.71)	113(81.29)	21(15.11)	118(84.89)
Self-rated health status		p < .001		p < .001	
Fair or poor	421(19.80)	73(17.34)	348(82.66)	65(15.44)	356(84.56)
Good	1705(80.20)	485(28.45)	1220(71.55)	454(26.63)	1251(73.37)
Perceived susceptibility to flu				p < .001	
Low	1506(70.84)	/		252(16.73)	1254(83.27)
High	620(29.16)	/		267(43.06)	353(56.94)
Perceived susceptibility to COVID-19				p < .001	
Low	1810(85.14)	/		321(17.73)	1489(82.27)
High	316(14.86)	/		198(62.66)	118(37.34)
Medical consulting about COVID-19				p < .001	
Yes	968(45.53)	/		419(43.29)	549(56.71)
No	1158(54.47)	/		100(8.64)	1058(91.36)

p value from Chi-square test.

COVID-19 pandemic. It is vital to ensure high influenza vaccination coverage among vulnerable populations such as internal migrants to protect them from the risk of severe illness due to influenza and preserve their limited financial resources.

The current COVID-19 pandemic has caused more than 180 million infections and 4 million deaths by June 2021.[26] In addition, nearly 80 million children have been left partially or completely vulnerable to vaccine-preventable diseases due to disruptions in the routine immunization programs of at least 68 countries due to the publics' fear of utilizing healthcare services, lockdown policies, organizational or accessibility barriers, and service delivery issues.[11,27,28] In our study, influenza vaccination coverage among the surveyed internal migrants in Shanghai during the early 2020–2021 flu season (September to mid-November 2020) was similar to the 2019–2020 flu season. However, since the 2020–2021 flu season was still not complete at the time of the survey, it is expected that the overall vaccination rate for the 2020–2021 flu season could be higher than in the previous season (2019–2020). These findings possibly point to the uninterrupted delivery of influenza vaccination services in Shanghai during the COVID-19 pandemic. As the COVID-19 pandemic subsides in China,[29] it is likely that the circulation of SARS-CoV-2 viruses will peak annually during fall/winter, similar to the flu viruses. Therefore, it is important to ensure that the contingency measures, including temperature measurement, checkup of personal health QR code and personal travel QR code, which were introduced during the pandemic to sustain the delivery of influenza vaccines are evaluated, and the effective interventions continued to ensure high uptake of influenza and other vaccinations among vulnerable populations in China.

Table 2. Factors associated with flu vaccination.

Variables (reference)	Flu vaccination during 2019–2020 flu season (yes vs no)	Flu vaccination during the early 2020–2021 flu season (yes vs no)	
	Basic model	Basic model	Additional model
Female	1.31(1.05–1.63)*	1.41(1.13–1.77)**	1.47(1.14–1.90)**
Age (≤25, years)			
26–35	0.84(0.62–1.14)	0.83(0.61–1.13)	0.77(0.55–1.08)
36–45	0.54(0.37–0.80)**	0.59(0.39–0.89)*	0.70(0.44–1.09)
>45	0.34(0.20–0.58)**	0.59(0.36–0.98)*	0.99(0.58–1.70)
Marital status (single)			
Married	1.17(0.87–1.56)	1.2(0.89–1.61)	1.19(0.85–1.66)
Divorced or widow	3.06(1.66–5.62)**	3.16(1.72–5.79)**	2.04(1.02–4.10)*
Number of household members (1)			
2	1.94(1.28–2.95)**	1.78(1.17–2.71)**	1.33(0.84–2.11)
≥3	2.51(1.74–3.63)**	2.22(1.53–3.22)**	1.56(1.04–2.34)*
Education (primary school or below)			
Middle school	0.7(0.34–1.45)	0.56(0.28–1.13)	0.65(0.30–1.39)
High school	0.92(0.45–1.89)	0.8(0.40–1.58)	0.88(0.41–1.87)
Bachelor degree or above	1.02(0.49–2.12)	1.12(0.56–2.25)	1.13(0.53–2.44)
Monthly personal income (≤2500 Chinese Yuan)			
2501–5000	0.79(0.50–1.25)	0.96(0.60–1.55)	0.82(0.49–1.35)
5001–7500	1.22(0.77–1.92)	1.55(0.96–2.48)	1.16(0.70–1.94)
7501–10000	1.54(0.95–2.51)	1.8(1.08–3.00)*	1.08(0.62–1.88)
>10000	2.41(1.45–4.01)**	3.06(1.81–5.19)**	2.16(1.22–3.83)**
Workplace (Manufacturing industry)			
Food market or supermarket	0.28(0.17–0.45)**	0.27(0.17–0.44)**	0.37(0.21–0.63)**
Small service industry	1.25(0.89–1.76)	1.21(0.86–1.72)	0.99(0.66–1.47)
Company or government agency	0.54(0.38–0.76)**	0.46(0.32–0.65)**	0.68(0.46–1.02)
Unemployed	0.26(0.13–0.53)**	0.44(0.23–0.82)**	0.55(0.28–1.08)
Others	0.46(0.27–0.78)**	0.38(0.21–0.66)**	0.55(0.30–1.01)
Poor or fair self-rated health	0.56(0.42–0.75)**	0.52(0.38–0.70)**	0.52(0.38–0.73)**
Perceived high susceptibility to flu	/	/	1.68(1.28–2.21)**
Perceived high susceptibility to COVID-19	/	/	4.32(3.08–6.04)**
Consulted medical professional about COVID-19	/	/	5.41(4.16–7.03)**

Odds ratio and 95% confidence intervals were presented. Significance level: ** $p < .01$, * $p < .05$.

We found that respondents' perceived susceptibility to influenza was associated with reported influenza vaccination uptake in the early 2020–2021 flu season. This finding is consistent with previous studies from China.[30,31] More interestingly, we found that respondents' perceived susceptibility to COVID-19 and ever consulting a medical professional about COVID-19 were independent predictors of influenza vaccination uptake during the early 2020–2021 flu season. Two reasons may explain why these factors were associated with influenza vaccination behavior in the early 2020–2021 season. First, influenza and COVID-19 can present with similar symptoms,[32,33] and beyond that, share the same high-risk groups, proving detrimental to older persons and persons with chronic comorbidities.[34,35] According to the Baidu index, which is compiled using data from the most popular internet search engine (Baidu)in China,[36] searches for the influenza vaccine during the early 2020–2021 flu season (3238) were more frequent than during the 2019–2020 flu season (1159).[37] More frequent search queries possibly indicate a higher interest in or awareness about the influenza vaccine among the general population. Second, previous studies have shown that health professionals are the most trusted sources of vaccination information for patients.[38] Thus, some respondents may have received a recommendation for influenza vaccination during their consultations for COVID-19, which served as a cue to action. While we cannot verify this with our survey data, public health and other health professionals should reiterate the importance of influenza vaccination to eligible persons, especially during the influenza season.

We also found that respondents who were female, younger (≤25 years old), or considered themselves in good health were more likely to report an influenza vaccination in both flu seasons. The gender difference in influenza vaccination uptake may be attributed to women being more aware of health issues and general well-being.[39] The decline in reported vaccination uptake with increasing age in our study could be due to the relatively young age of the surveyed respondents [average age = 32 years SD = 10)]. The association between the respondents' self-rated health status and vaccination uptake is consistent with a previous study from China,[40] which found a lower flu vaccination uptake among adults with high-risk health conditions (7.2%) than those without (10.8%). These findings suggest that the drivers of influenza vaccination uptake in migrant populations are nuanced, and future investigations can consider using qualitative methods to understand better the factors underlying influenza vaccination acceptance during and outside pandemic settings.

In addition, we found the majority of respondents perceived low level of susceptibility (85.14%) of COVID-19. Previous studies have shown that respondent's awareness of and perceived susceptibility to COVID-19 were positively associated with the willingness to receive COVID-19 vaccination.[41–44] The respondents' perceived susceptibility to COVID-19 in our study is lower than that of the study in May 2020 in China,[45] which could be attributed to the successful prevention and control of the pandemic in China.[46] As China entered the low-risk period of the COVID-19 pandemic, the public's perception of infectious risk gradually decreased, which could

decrease the willingness of the COVID-19 vaccination. It is worth noting that COVID-19 vaccination is progressing rapidly in China. As of September 2021, the total number of people vaccinated has reached 1.1 billion, of which 1 billion have completed the full course of vaccination, accounting for 78% of the total population in China.[47] However, decreased protective efficacy in multiple types of vaccines and the circulating variants make booster vaccination necessary for recipients who have previously received "priming" vaccination.[48] The public's perceived low susceptibility to COVID-19 could pose a challenge to the achievement of booster vaccination. For better promoting vaccination, we should continually improve health education for COVID-19 susceptibility and the importance of vaccination, especially when the pandemic evolved into the low-risk period.

Our study assessed a wide range of factors putatively linked to influenza vaccination, which may help guide future public health efforts that aim to increase the uptake of influenza vaccines among internal migrants in Shanghai. However, our study has certain limitations to consider while drawing inferences from our findings. First, the cross-sectional study design limits causal inference on the various factors observed associated with respondent's influenza vaccination status. Second, the estimates of influenza vaccination coverage were based on self-reported information, which may be prone to recall bias, especially for the previous flu season (2019–2020). Third, the use of purposive sampling in our study may have led to a selection bias, as the sampling was not random. In addition, the generalizability of our study findings is further limited by our relatively small sample size compared with the nearly 9.78 million internal migrants in Shanghai. Thus, the findings of our survey may not represent actual influenza vaccination coverage or the factors associated with flu vaccination uptake among internal migrant populations in Shanghai or other large cities in China. Fourth, our survey also had a relatively low participation rate (56.4%), influenza vaccination uptake may differ between the survey respondents and non-respondents. We were unable to collect additional information to explore the differences in respondent characteristics based on their participation. Fifth, we did not investigate the impact of access to vaccination services on respondent's influenza vaccination behavior, including vaccine pricing and affordability issues, as the flu vaccination is not available free of charge in China.

Conclusions

Our study found suboptimal influenza vaccine coverage among internal migrants in Shanghai during the 2019–2020 and early 2020–2021 flu seasons. While it is expected that influenza vaccination coverage for the completed 2020–2021 flu season may be higher, contingency measures that may have been introduced during the COVID-19 pandemic to sustain the delivery of influenza and other vaccinations need to be evaluated and continued to ensure a high vaccination coverage among internal migrants in Shanghai. In addition, we found a range of factors associated with influenza vaccination uptake, which suggests the need for more nuanced and timely investigations to examine the underlying reasons driving vaccination uptake among vulnerable population subgroups in China. Improving influenza vaccination coverage among vulnerable populations like the internal migrants in Shanghai can protect them from severe illness due to influenza and reduce the burden on national healthcare resources during the COVID-19 pandemic and beyond.

Acknowledgments

We are thankful to Qian Wang, Simeng Hu, Yuting Xing, Shujie Zang, Zhiqiang Qu, and Longfei Feng from School of Public Health, Fudan University for their help with data collection.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

Zhiyuan Hou acknowledges financial support from the National Natural Science Foundation of China [No. 71874034], The National Key R&D Program of China [No. 2018YFC1312600 and 2018YFC1312604], and The National Institute for Health Research [EPIDZL9012] using UK aid from the UK Government to support global health research. The funders of the study had no role in study design, data collection, data analysis, data interpretation or writing of the report.

ORCID

Zhiyuan Hou http://orcid.org/0000-0003-3413-0076

Data availability statement

The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication. The data used to support the findings of this study are available from the corresponding author upon request.

Informed consent statement

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

Institutional review board statement

This study was approved by Ethics Committee at the Fudan University School of Public Health [IRB#2020-12-0861].

References

1. The World Health Organization (WHO). Global Influenza Strategy 2019-2030. https://www.who.int/influenza/global_influenza_strategy_2019_2030/en/.
2. Doornekamp L, van Leeuwen L, van Gorp E, Voeten H, Goeijenbier M. Determinants of vaccination uptake in risk populations: a comprehensive literature review. Vaccines (Basel). 2020;8:3.
3. Bernstein DI, Guptill J, Naficy A, Nachbagauer R, Berlanda-Scorza F, Feser J, Wilson PC, Solórzano A, Van der Wielen M, Walter EB, et al. Immunogenicity of chimeric haemagglutinin-based, universal influenza virus vaccine candidates: interim results of a randomised, placebo-controlled, phase 1 clinical trial. Lancet Infect Dis. 2020;20(1):80–91. doi:10.1016/S1473-3099(19)30393-7.
4. The U. S. Centers for Disease Control and Prevention (CDC). Flu vaccination coverage, United States, 2019–20 influenza season. https://www.cdc.gov/flu/fluvaxview/coverage-1920estimates.htm.

5. Yang J, Atkins KE, Feng L, Pang M, Zheng Y, Liu X, Cowling BJ, Yu H. Seasonal influenza vaccination in China: landscape of diverse regional reimbursement policy, and budget impact analysis. Vaccine. 2016;34(47):5724–35. doi:10.1016/j.vaccine.2016.10.013.
6. Yan S, Wang Y, Zhu W, Zhang L, Gu H, Liu D, Zhu A, Xu H, Hao L, Ye C . Barriers to influenza vaccination among different populations in Shanghai. Hum Vaccin Immunother. 2021;17(5):1403-1411. doi:10.1080/21645515.2020.1826250.
7. Billon-Denis E, Tournier JN. COVID-19 and vaccination: a global disruption. Med Sci: M/S. 2020;36(11):1034–37. doi:10.1051/medsci/2020203.
8. Lassi ZS, Naseem R, Salam RA, Siddiqui F, Das JK. The impact of the COVID-19 pandemic on immunization campaigns and programs: a systematic review. Int J Environ Res Public Health. 2021;18(3):988. doi:10.3390/ijerph18030988.
9. Chen S, Yang J, Yang W, Wang C, Bärnighausen T. COVID-19 control in China during mass population movements at New Year. Lancet. 2020;395(10226):764–66. doi:10.1016/S0140-6736(20)30421-9.
10. Saxena S, Skirrow H, Bedford H. Routine vaccination during covid-19 pandemic response. Bmj. 2020;369:m2392. doi:10.1136/bmj.m2392.
11. Dinleyici EC, Borrow R, Safadi MAP, van Damme P, Munoz FM. Vaccines and routine immunization strategies during the COVID-19 pandemic. Hum Vaccin Immunother. 2020:1–8. doi:10.1080/21645515.2020.1704580.
12. Bramer CA, Kimmins LM, Swanson R, Kuo J, Vranesich P, Jacques-Carroll LA, Shen AK. Decline in child vaccination coverage during the COVID-19 pandemic - Michigan Care Improvement Registry, May 2016-May 2020. Am J Transplant. 2020;20(7):1930–31. doi:10.1111/ajt.16112.
13. Din M, Ali H, Khan M, Waris A, Ullah S, Kashif M, Rahman S, Ali M. Impact of COVID-19 on polio vaccination in Pakistan: a concise overview. Rev Med Virol. 2020;31. doi:10.1002/rmv.2190.
14. McDonald HI, Tessier E, White JM, Woodruff M, Knowles C, Bates C, Parry J, Walker JL, Scott JA, Smeeth L, et al. Early impact of the coronavirus disease (COVID-19) pandemic and physical distancing measures on routine childhood vaccinations in England, January to April 2020. Euro Surveill. 2020;25(19). doi:10.2807/1560-7917.ES.2020.25.19.2000848.
15. Joob B, Wiwanitkit V. COVID-19 and migrant workers: lack of data and need for specific management. Public Health. 2020;183:64. doi:10.1016/j.puhe.2020.05.008.
16. Yang M, Dijst M, Helbich M. Mental health among migrants in Shenzhen, China: does it matter whether the migrant population is identified by hukou or birthplace? Int J Environ Res Public Health. 2018;15(12):2671. doi:10.3390/ijerph15122671.
17. Yu C, Lou C, Cheng Y, Cui Y, Lian Q, Wang Z, Gao E, Wang L. Young internal migrants' major health issues and health seeking barriers in Shanghai, China: a qualitative study. BMC Public Health. 2019;19(1):336. doi:10.1186/s12889-019-6661-0.
18. Wang B, Li X, Stanton B, Fang X. The influence of social stigma and discriminatory experience on psychological distress and quality of life among rural-to-urban migrants in China. Soc Sci Med (1982). 2010;71(1):84–92. doi:10.1016/j.socscimed.2010.03.021.
19. Wen M, Zheng Z, Niu J. Psychological distress of rural-to-urban migrants in two Chinese cities: Shenzhen and Shanghai. Asian Popul Stud. 2017;13(1):5–24. doi:10.1080/17441730.2016.1233655.
20. Glaeser EL, Gorback C, Redding SJ . JUE insight: how much does COVID-19 increase with mobility? Evidence from New York and four other U.S. cities. J Urban Econ. 2020:103292 doi:10.1016/j.jue.2020.103292.
21. Shanghai statistical bulletin on national economic and social development. 2019. http://tjj.sh.gov.cn/tjgb/20200329/05f0f4abb2d448a69e4517f6a6448819.html.
22. Questionaire Star. www.wjx.cn.
23. Wechat(Tencent's messaging service app). https://baike.baidu.com/item/%E5%BE%AE%E4%BF%A1/3905974?fr=aladdin.
24. Wang Q, Yue N, Zheng M, Wang D, Duan C, Yu X, Zhang X, Bao C, Jin H. Influenza vaccination coverage of population and the factors influencing influenza vaccination in mainland China: a meta-analysis. Vaccine. 2018;36(48):7262–69. doi:10.1016/j.vaccine.2018.10.045.
25. Ma Y, Li T, Chen W, Chen J, Li M, Yang Z. Knowledge, attitudes and practices (KAP) toward seasonal influenza vaccine among young workers in South China. Hum Vaccin Immunother. 2018;14(5):1283–93. doi:10.1080/21645515.2017.1423157.
26. Coronavirus disease (COVID-19) pandemic: World Health Organization. 2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019.
27. Nelson R. COVID-19 disrupts vaccine delivery. Lancet Infect Dis. 2020;20(5):546. doi:10.1016/S1473-3099(20)30304-2.
28. Roberts L. Global polio eradication falters in the final stretch. Science. 2020;367(6473):14–15. doi:10.1126/science.367.6473.14.
29. Rocklov J, Sjodin H, Wilder-Smith A. COVID-19 outbreak on the diamond princess cruise ship: estimating the epidemic potential and effectiveness of public health countermeasures. J Travel Med. 2020;27(3). doi:10.1093/jtm/taaa030.
30. Wu AMS, Lau JTF, Ma YL, Cheng KM, Lau MMC. A longitudinal study using parental cognitions based on the theory of planned behavior to predict childhood influenza vaccination. J Infect Public Health. 2020;13(7):970–79. doi:10.1016/j.jiph.2020.04.009.
31. Yang L, Cowling BJ, Liao Q. Intention to receive influenza vaccination prior to the summer influenza season in adults of Hong Kong, 2015. Vaccine. 2015;33(48):6525–28. doi:10.1016/j.vaccine.2015.10.012.
32. Ma S, Lai X, Chen Z, Tu S, Qin K. Clinical characteristics of critically ill patients co-infected with SARS-CoV-2 and the influenza virus in Wuhan, China. Int J Infect Dis: IJID. 2020;96:683–87. doi:10.1016/j.ijid.2020.05.068.
33. Hashemi SA, Safamanesh S, Ghafouri M, Taghavi MR, Mohajer Zadeh Heydari MS, Namdar Ahmadabad H, Ghasemzadeh-Moghaddam H, Azimian A. Co-infection with COVID-19 and influenza A virus in two died patients with acute respiratory syndrome, Bojnurd, Iran. J Med Virol. 2020;92(11):2319–21. doi:10.1002/jmv.26014.
34. Danis K, Fonteneau L, Georges S, Daniau C, Bernard-Stoecklin S, Domegan L, O'Donnell J, Hauge SH, Dequeker S, Vandael E. High impact of COVID-19 in long-term care facilities, suggestion for monitoring in the EU/EEA, May 2020. Euro Surveill. 2020;25:22.
35. Petrilli CM, Jones SA, Yang J, Rajagopalan H, O'Donnell L, Chernyak Y, Tobin KA, Cerfolio RJ, Francois F, Horwitz LI, et al. Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. Bmj. 2020;369:m1966. doi:10.1136/bmj.m1966.
36. Baidu. https://baike.baidu.com/item/%E7%99%BE%E5%BA%A6/6699?fr=aladdin.
37. Baidu index-influenza vaccine. https://index.baidu.com/v2/main/index.html#/trend/%E6%B5%81%E6%84%9F%E7%96%AB%E8%8B%97?words=%E6%B5%81%E6%84%9F%E7%96%AB%E8%8B%97.
38. Leung KC, Mui C, Chiu WY, Ng YY, Chen MHY, Ho PH, Kwok CP, Lam SSM, Wong CY, Wong KY, et al. Impact of patient education on influenza vaccine uptake among community-dwelling elderly: a randomized controlled trial. Health Educ Res. 2017;32(5):455–64. doi:10.1093/her/cyx053.
39. Lazarus JV, Ratzan SC, Palayew A, Gostin LO, Larson HJ, Rabin K, Kimball S, El-Mohandes A. A global survey of potential acceptance of a COVID-19 vaccine. Nat Med. 2021;27(2):225–28. doi:10.1038/s41591-020-1124-9.
40. Wagner AL, Montgomery JP, Xu W, Boulton ML. Influenza vaccination of adults with and without high-risk health conditions in China. J Public Health (Oxford, England). 2017;39(2):358–65. doi:10.1093/pubmed/fdw041.
41. Coe AB, Elliott MH, Gatewood SBS, Goode JR, Moczygemba LR. Perceptions and predictors of intention to receive the COVID-19 vaccine. Res Soc Adm Pharm: RSAP. 2021. doi:10.1016/j.sapharm.2021.04.023.
42. Tao L, Wang R, Han N, Liu J, Yuan C, Deng L, Han C, Sun F, Liu M, Liu J, et al. Acceptance of a COVID-19 vaccine and associated factors among pregnant women in China: a multi-center cross-sectional study based on health belief model. Hum Vaccin Immunother. 2021;17(8):2378–88. doi:10.1080/21645515.2021.1892432.

43. Abu-Farha R, Mukattash T, Itani R, Karout S, Khojah HMJ, Abed Al-Mahmood A, Alzoubi KH. Willingness of Middle Eastern public to receive COVID-19 vaccines. Saudi Pharm J: SPJ. 2021;29(7):734–39. doi:10.1016/j.jsps.2021.05.005.
44. Jaspal R, Breakwell GM . Social support, perceived risk and the likelihood of COVID-19 testing and vaccination: cross-sectional data from the United Kingdom. Current Psychol (New Brunswick, NJ). 2021:1–13 doi:10.1007/s12144-021-01681-z.
45. Lin Y, Hu Z, Zhao Q, Alias H, Danaee M, Wong LP. Understanding COVID-19 vaccine demand and hesitancy: a nationwide online survey in China. PLoS Negl Trop Dis. 2020;14(12):e0008961. doi:10.1371/journal.pntd.0008961.
46. Wang J, Lu X, Lai X, Lyu Y, Zhang H, Fenghuang Y, Jing R, Li L, Yu W, Fang H. The changing acceptance of COVID-19 vaccination in different epidemic phases in China: a longitudinal study. Vaccines (Basel). 2021;9:3.
47. The number of novel coronavirus vaccine coverage in China has reached 1.1 billion. http://www.gov.cn/xinwen/2021-09/19/content_5638418.htm.
48. Ai J, Zhang H, Zhang Q, Lin K, Fu Z, Song J, Zhao Y, Fan M, Wang H, Qiu C. Recombinant protein subunit vaccine booster following two-dose inactivated vaccines dramatically enhanced anti-RBD responses and neutralizing titers against SARS-CoV-2 and variants of concern. Cell Res. 2021:1–4. doi:10.1038/s41422-020-00447-9.