BMJ Open

Awareness of Influenza and Attitude Toward Influenza Vaccination Among Clinical and Non-clinical medical student:a cross-sectional study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055945
Article Type:	Original research
Date Submitted by the Author:	02-Aug-2021
Complete List of Authors:	Wang, Yunlong; Chongqing Medical University Zou, Fa; Chongqing Medical University Gan, Lin; Chongqing Medical University Luo, Qinwen; Chongqing Medical University Tang, Xiaojun; Chongqing Medical University
Keywords:	Epidemiology < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, IMMUNOLOGY

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Awareness of Influenza and Attitude Toward Influenza Vaccination Among Clinical and Non-clinical medical student：a cross-sectional study

Yunlong Wang[a,1] ,Fa Zou [a,1], Lin Gan[b], Qinwen Luo[b], Xiaojun Tang[b,*]

[a] School of basic medicine, Chongqing Medical University, Chongqing, China

[b] School of Public Health and Management, Chongqing Medical University, Chongqing, China

* Corresponding author: Xiaojun Tang, Email: tangxiaoj0726@qq.com

ABSTRACT

Objective This study aimed to understand the knowledge, attitudes, and practices (KAP) on influenza Vaccination between Clinical and Non-clinical medical students.

Methods A stratified cluster sampling method was used to survey the students of a medical school in Chongqing.

Results Clinical students had a higher rate of knowledge about influenza and influenza vaccine than non-clinical students (66.64%<58.03%), a lower rate of influenza vaccination than non-clinical students (5.17%<10.71%), and a similar rate of willingness to receive influenza vaccination (33.6%,33.7%). The results of the multifactorial analysis showed that for non-clinical students, medical students who knew about the vaccine (OR=2.23, 95% CI:1.28-3.98) and those who were actively informed about the vaccine were more likely to receive the influenza vaccine (OR=2.08, 95% CI:1.20-3.16); for clinical students, female medical students (OR=1.55, 95% CI:1.03-2.33) versus non-smoking medical students (OR=2.39, 95% CI:1.22-4.74) were more likely to get the influenza vaccine. Medical students with positive attitudes (OR=4.17, 95% CI:1.75-12.34) were more likely to get the influenza vaccine than medical students with negative attitudes toward the influenza vaccine.

Conclusion The influenza vaccination rate of clinical and non-clinical medical school students in Chongqing is low, and smoking and male clinical students are more reluctant to get a flu vaccine. A combination of old and new media should take different promotional measures for different groups in different professions.

Key words

Education,Flu,Immunization,Vaccine,Infection

Highlight

·Clinical students more willing to get flu vaccine than non-clinical students

· smoking and male clinical students more reluctant to get a flu vaccine

·Clinical students' reluctance to receive the new vaccine may be due to overwhelming concerns about the vaccine's safety

Strengths and limitations of this study

·This is the first representative study in Southwest China to assess the willingness of clinical and non-clinical students to receive influenza vaccine and the factors influencing influenza vaccination.

·Correctly develop statistical survey programs, design questionnaires, and minimize statistical survey bias

·the COVID-19 pandemic has spread enormous information about viruses in general, medical students would have had more opportunities to study infectious diseases than before.So our existing conclusions may have changed a little.

Background

Influenza (flu for short), a respiratory infection, is highly contagious and can easily cause epidemics in the population. According to the World Health Organization (WHO) data, the annual incidence of influenza is estimated at 5-10% of adults and

20-30% of children, causing 3-5 million severe cases and 250,000-500,000 deaths worldwide each year [1]. So influenza vaccination is the essential tool to prevent influenza infection and is a public health priority worldwide, with formal recommendations for vaccination of health care workers established in almost all countries [2-3]. Among them, China's Influenza Treatment Program (2020 version) clearly states that "annual influenza vaccination is the most effective means of influenza prevention, reducing the risk of influenza and serious complications in vaccinated individuals" [4-5].

As a place where students gather, the relatively crowded learning and living environment of schools are prone to influenza, and college students are highly mobile between campuses. Surveillance data from several provinces in recent years have shown that more than 90% of influenza occurring each year occurs on campus [5-6]. Medical students, however, are at higher risk of influenza illness than other college students due to the specificity of their discipline. They are the future medical workers and important disseminators of health knowledge, and there is an excellent need for vaccination [7]. They are likely to live and work with susceptible populations or provide health education to susceptible populations in the future. Therefore it is crucial to assess vaccination coverage, knowledge attitudes, and beliefs of this specific population. Medical students are the future workers of health, and their behavior will influence the health of their patients. At the same time, in most medical schools, the medical student population can be divided into clinical and non-clinical. Clinical medicine refers to majors that offer systematic clinical medicine course,

while non-clinical includes majors such as public health management, medical imaging, and pharmacy[6]. Both of them have different curricula design directions, resulting in differences in their knowledge of the influenza vaccine and a willingness to receive it.

Little has been reported on the current status of influenza vaccination in this group in China. From the few studies, it was found that the current vaccination rate of medical students in China is much lower than that of foreign countries. [7-10]. There are no studies comparing clinical and non-clinical students on their willingness to receive influenza vaccination and analysis of factors influencing vaccination. So this study was conducted to investigate the main factors influencing medical students' willingness to receive influenza vaccination by investigating the knowledge and beliefs about influenza vaccine among clinical and non-clinical medical students so as to provide a scientific basis for improving the influenza vaccination rate of medical students and strengthening influenza prevention and control.

MATERIAL AND METHODS

Study design and settings

From May 2019 to June 2019, according to the principle of stratified clus sampling, the second-level colleges under a medical school in Chongqing were divided into two strata of clinical and non-clinical categories(Clinical medicine is a specialty that will directly deal with diseases and patients and treat them directly in the future.

non-clinical medical includes medical imaging, pharmacy, public health management, preventive medicine), and one class each from the first to the fourth year of each categories was selected to conduct a survey on influenza and influenza vaccine knowledge, attitudes, and practices to vaccinate. According to previous studies, the influenza vaccination rate of medical students is 9.2%, therefore, using the sample size calculation formula $N=\pi_0 (1-\pi_0) \left(\frac{u\alpha + u\beta}{\delta}\right)2$ (π_0 =vaccination rate, two-sided test level $\alpha=0.05$, test efficacy $\beta=0.10$, the tolerance error $\delta=0.05$) we can obtain a sample size of n=351, taking into account factors such as refusal, 400 each in the clinical and non-clinical categories, The total number of participants was 800 medical students.

Questionnaire

The questionnaire was developed, and a pilot study was conducted on a sample of 30 participants. Feedback was used to modify the items, and the finalized instrument was administered electronically. Preventive measures advertised by the National Health Commission of the PRC on its official website were employed to assess the precautionary behavior. The survey consisted of two parts. The first part collected demographic information on the profession, gender, and ethnicity. The second part included knowledge about influenza and the influenza vaccine and attitude toward influenza vaccine—questionnaire with a Cronbach's alpha coefficient of over 0.7.

Ethical approval

This experiment only required the design of a questionnaire with cell phone data,

which met the ethical approval exemption requirements of the Ethics Committee of Chongqing Medical University, and therefore did not require ethics committee approval. Data collection procedures were in accordance with institutional and national ethical guidelines and followed the Declaration of Helsinki. Data anonymity and confidentiality were maintained, and written informed consent was obtained from the investigators for this experiment.

Survey

Influenza-related knowledge was scored 1 point for a correct answer and 0 points for a wrong answer, out of 23 points, and ≥14 points were judged as knowledge[9]. Influenza vaccine knowledge rate (%) = number of correct answers/total number of respondents × 100%. Regarding the attitude toward the influenza vaccine, a total of 45 points were assigned according to the attitude toward the influenza vaccine (5=very positive, 4=positive, 3=fair, 2=negative, 1=very negative), and ≥27 points were judged as positive toward influenza vaccine and vice versa. Influenza vaccination rate (%) = number of influenzas vaccinated/total number of surveyed × 100%. Influenza vaccination willingness rate (%) = number of people willing to receive influenza vaccination/total number of people surveyed × 100%.

Data analysis

Epidata 3.0 software was used for double data entry, and R 3.2.5 software was used for statistical analysis; the differences between means were tested by T-test. The

differences between rates were analyzed by chi-square test, and unconditional logistic stepwise regression analysis was used for influencing factors of influenza vaccination intention, and differences were considered statistically significant at $P<0.05$.

Patient and Public Involvement statement

Patients were not involved in the design or conduct of this study, and nor were members of the general public.

Results

Demographics

A total of 803 medical students were surveyed, of whom 294 (36.61%) were male, and 509 (63.39%) were female; 394 (49.06%) were urban residents, and 409 (50.04%) were rural residents; 720 (89.7%) were Han ethnic group, and 83(10.34%) were others ethnic group; in terms of Median Household Income, 208 (25.90%) were below 2000, 299 (37.24%) were 2001-4000, 152 (18.93) were 4001-6000, and 144 (17.93%) were above 6000; 503 (62.6%) people in clinical majors and 300 (37.4%) people in non-clinical majors; 12 (1.5%) people were suffering from chronic diseases and 791 (98.5%) people were not suffering from chronic diseases(Table 1.).

Table 1. Demographic characteristics of the study participants among clinical and non-clinical medical students in Chongqing, May to June 2019 (N=803)

Demographic information	Clinical medical	Non-clinical medical	Total	P
Sex				
Male	179	115	294	0.434
Female	324	185	509	
Account Location				
City	226	168	394	0.002
Rural	277	132	409	
Ethnicity				
Han	456	261	720	0.058
Others	44	39	83	
Median Household Income				
<¥2000	135	73	208	0.494
¥2001-4000	184	115	299	
¥4001-6000	100	52	152	
>¥6001	84	60	144	
Whether have a chronic disease				
Yes	4	8	12	0.034
No	499	292	791	
Whether have medical insurance				
Yes	483	278	761	0.039
No	20	22	42	

Knowledge

The knowledge rate of clinical medical students about influenza and influenza vaccines was 66.64%, while the non-clinical knowledge rate was 58.03%. The most significant number of students answered, "Can influenza be transmitted by droplets?" accounting for 97.8%, while the smallest number answered, "How long do droplets with influenza virus generally remain toxic in the air?", accounting for 15.2%. The awareness rate of clinical students was significantly higher than that of non-clinical students on the questions "Are influenza and the common cold the same disease?", "Is the flu only contagious after the onset of symptoms?" and "side effects of influenza vaccine (fever, pain, and swelling at the injection site)" ($p<0.05$)? On the contrary, the non-clinical students knew more about the questions "Should the flu vaccine be given within a specific period of time?" and "the priority group for influenza vaccination (medical personnel)" ($p<0.05$)(Table 2.).

Table 2. Awareness of influenza and influenza vaccine among medical students in Chongqing, May to June 2019 (N=803).

Knowledge	Awareness Rate (n/N*100%)			p
	Totality	Clinical medical	Non-clinical medical	
Can droplets transmit influenza?	97.8	98.4	96.7	0.11

Does wearing a regular mask prevent the spread of influenza?	87.0	86.5	88.0	0.54
Are influenza and the common cold the same disease?	90.3	92.2	87.0	0.02
Influenza incubation period	24.0	24.3	23.7	0.85
Can influenza be transmitted in close proximity?	65.4	63.8	68.0	0.23
Is the flu only contagious after the onset of symptoms?	87.9	90.0	84.3	0.02
Will you still get the flu after receiving the flu vaccine?	85.9	84.3	88.7	0.08
How long do droplets with influenza virus generally remain toxic in the air?	15.2	15.7	14.3	0.60
Are systemic flu vaccine side effects rare?	66.0	44.1	49.0	0.18
Should the flu vaccine be given within a specific period of time ?	59.5	56.2	65.0	0.01
Is the flu vaccine likely to contain many harmful chemical elements ?	54.7	55.1	54.0	0.77
Is naturally developed immunity through influenza better than influenza vaccination ?	46.5	45.9	47.3	0.70
Best dates for flu vaccination	51.3	51.1	51.7	0.88

How often should you get the flu vaccine?	37.0	36.2	38.3	0.54
Purpose of influenza vaccination	91.3	90.4	92.7	0.28
Influenza vaccine side effects:				
Fever	67.2	72.2	59.0	<0.01
Pain and swelling at the injection site	83.7	87.1	78.0	<0.01
Headaches	55.8	56.3	55.0	0.73
Influenza vaccination priority groups:				
People over 60 years old	71.9	73.6	69.0	0.16
Patients with chronic diseases and infirmity	87.8	88.3	87.0	0.59
Medical Staff	89.0	85.3	91.3	<0.01
Elementary school students and kindergarten children	88.9	90.3	86..7	0.12
Pregnant	44.8	45.3	44.0	0.71
Average value	——	66.64%	58.03%	——

Attitudes

More non-clinical students thought the flu vaccine was safe (67.0%>64.0%) and necessary (71.3%>64.4%), but clinical students were also more concerned about flu vaccine side effects (78.0%>69.0%); clinical students were less confident about the effectiveness of the flu vaccine (58.4%<66.0%)(Table 3.).

Table 3. Attitudes toward influenza vaccine among clinical and non-clinical medical students in Chongqing, May to June, 2019 (N=803).

Attitude	n		% (n/N*100%)	
	Clinical medical	Non-clinical medical	Clinical medical	Non-clinical medical
Do you think the flu vaccine is safe?				
Safe	322	201	64.0	67.0
Unsafe	181	99	36.0	33.0
Do you think flu vaccination is necessary?				
Necessary	324	214	64.4	71.3
Unnecessary	179	86	35.6	28.7
Your side effects of the flu vaccine:				
Worried	392	207	78.0	69.0
Not worried	111	63	22.0	31.0
How effective do you think the seasonal flu vaccine is:				
Effective	209	102	41.6	34.0
Invalid	294	198	58.4	66.0
I do not need a flu vaccination because I have never had the flu:				

Agree	365	223	72.6	74.3
Disagree	138	77	27.4	25.7
Influenza can still occur after receiving the flu vaccine:				
Agree	67	60	13.3	20.0
Disagree	436	240	86.7	80.0
Annual flu vaccination is important to me:				
Important	414	233	82.3	77.7
Unimportant	89	67	17.7	22.3
What do you think your chances are of getting the flu if you don't get the flu shot this year?				
Possible	439	259	87.3	86.3
Impossible	64	41	12.7	13.7

Practices

184 (22.9%) medical students actively learn about the vaccine, mainly through TV, newspapers, or media (48.6%); health-care professionals (37.2%); classmates, friends, relatives, or neighbors (11.5%). During the 2018-2019 influenza season, 54 medical students were vaccinated against influenza, with a vaccination rate of 6.72% (54/803), including 26 clinical students with a vaccination rate of 5.17% (26/503) and 28

non-clinical students with a vaccination rate of 10.71% (28/300). The main reasons for influenza vaccination of clinical and non-clinical medical students versus the main reasons for not receiving influenza vaccination are shown in Figure 1 and Figure 2

Fig. 1 Main reasons for influenza vaccination for Clinical and Non-clinical medical students in Chongqing

Fig. 2 The main reason why Chongqing Clinical and Non-clinical medical students are not vaccinated against influenza

Multifactor analysis

Univariate analysis of factors influencing Clinical and Non-clinical medical student's willingness to receive the vaccination The results of the univariate analysis showed that the knowledge about influenza and influenza vaccine, positive attitude towards influenza vaccine, and whether they would take the initiative to learn about influenza vaccine-related information might be factors influencing medical students to receive influenza vaccination ($p<0.05$)(Table 4.).

Table 4. Single-factor analysis of vaccination intention of medical students in Chongqing, May to June, 2019 (N=270).

Variables	Number of people willing to be	Intention rate of vaccination	X^2	P

	vaccinated	(%)		
Sex				
Male	91	31.0	1.48	0.22
Female	179	35.2		
Account Location				
City	134	34.0	0.05	0.82
Rural	136	33.3		
Ethnicity				
Han	238	33.1	1.01	0.32
Others	32	38.6		
Median Household Income				
<¥2000	73	35.1		
¥2001-4000	102	34.1	1.41	0.70
¥4001-6000	45	29.6		
>¥6001	50	34.7		
Specialty				
Clinical medical	169	33.6	<0.01	0.98
Non-clinical medical	101	33.7		
Will you be proactive in learning about flu vaccine information:				
Yes	81	44.3	12.02	<0.01

No	189	30.5		
Whether or not you received a flu vaccination in the past year:				
Yes	22	40.7	1.31	0.25
No	248	33.1		
Whether suffering from chronic diseases:				
Yes	5	33.5	0.35	0.55
No	265	41.7		
Knowledge of influenza and influenza vaccine				
Know	198	37.1	8.82	<0.01
Unknown	72	26.7		
Attitude toward flu vaccine				
Positive	263	35.7	17.59	<0.01
Negative	7	10.4		

Multifactor analysis of factors influencing the willingness of Clinical and Non-clinical medical students to receive the vaccination A dichotomous uncategorical unconditional logistic stepwise regression analysis was performed with the five statistically significant factors in the univariate as independent variables and willingness to get influenza vaccination as dependent variables(0=unwilling,

1=willing). The results of the multifactorial analysis showed that for non-clinical students, medical students who were aware were more willing to receive the influenza vaccine than those who were not aware of influenza and influenza vaccine-related knowledge(OR=2.23, 95% CI:1.28-3.98); those who were actively informed about the vaccine were more willing to receive Influenza vaccine (OR=2.08, 95% CI:1.20-3.16). For clinical students, female medical students (OR=1.55, 95% CI:1.03-2.33) and non-smoking medical students (OR=2.39, 95% CI:1.22-4.74) were more likely to get the influenza vaccine. Medical students with positive attitudes were more likely to get the influenza vaccine compared to those with negative attitudes toward the influenza vaccine(OR=4.17, 95% CI:1.75-12.34). (Table 5 and Table 6)

Table 5. Multifactor analysis of vaccination intention of Non-clinical medical students in Chongqing, May to June 2019 (N=303)

Variables	Compare	β	P	OR	95% CI lower	95% CI upper
Awareness						
Know	Unknown	0.80	<0.01	2.23	1.28	3.98
Whether to proactively learn about flu vaccine information						

Yes	No	0.73	<0.01	2.08	1.20	3.61

Table 6. Multi-factor analysis of vaccination intention of Clinical medical students in Chongqing, May to June, 2019 (N=500)

Variables	Compare	β	P	OR	95% CI lower	95% CI upper
Sex						
Male	Female	0.44	<0.05	1.55	1.03	2.33
Smoking or not						
No	Yes	0.87	<0.05	2.39	1.22	4.74
Attitude						
Positive	Negative	1.43	<0.01	4.17	1.75	12.34

Discussion

This study shows that the influenza vaccination rate of medical students in this medical school was only 6.7% in the 2018-2019 influenza season, which is lower than the vaccination level of medical students in other cities in China such as Urumqi (in the year 2009, 2010 and 2011 were 4.1%, 9.2%, and 6.1%)[6], and much lower than

the vaccination level of medical students in developed countries such as Australia (36.3%)[11] and the United States (27.8%)[12]. This laterally reflects that the influenza vaccination level of medical students in Chongqing is low and needs to be further improved, and it is recommended that medical students are included in the priority recommended vaccination targets for influenza vaccination.

In terms of knowledge acquisition, the overall knowledge of influenza and influenza vaccine among students at the university was 66.4%, which indicates that more than 30% of the survey respondents did not know about influenza and influenza vaccine. Less than a quarter knew about the incubation period of influenza and the duration of influenza droplets in the air. Some studies have found that university education positively affects influenza knowledge[6], which means that students at the university do not pay much attention to influenza-related courses. The knowledge rate of clinical students was significantly higher than that of non-clinical students regarding the influenza disease itself, such as "Are influenza and the common cold the same disease?", "Is the flu only contagious after the onset of symptoms?" and side effects of influenza vaccine (fever, pain, and swelling at the injection site)? On the contrary, non-clinical students had a higher awareness of vaccination-related issues such as "Should the flu vaccine be given within a specific period of time?" and the priority groups for influenza vaccination (medical personnel). This is related to their education in degree programs, where clinical students learn more about the diagnosis and treatment of diseases, while non-clinical students focus more on the prevention and control of student diseases, which involves vaccination policies, vaccination

protocols, etc.

The primary reason for influenza vaccination among students of both majors was to "strengthen resistance and prevent influenza," which is consistent with other studies [13-15], suggesting that concern for one's own health is a driving factor for influenza vaccination in this group. The rate of influenza vaccination among non-clinical students (10.71%) was much higher than that of clinical students (5.17%), which was the opposite of what we had expected. According to the analysis of the obtained data, although clinical students considered it necessary to receive an influenza vaccine (82.3%), the depth of their own knowledge about influenza vaccine was greater than that of non-clinical students, which led to great distrust of the safety of influenza vaccine (78%>69%). It is recommended that health education on the safety of influenza vaccines should be strengthened for clinical students.

Among students who reported not receiving the influenza vaccine, there was little difference in the reasons for non-vaccination among clinical and non-clinical students, with a significant percentage of both students believing that vaccination was not necessary, suggesting that the influenza vaccine is not being taken seriously by this group. It is noteworthy that 46.54% of clinical majors and 46.54% of non-clinical majors have "never heard of influenza vaccine",which indicating that influenza vaccination education at the school is not in place. It is recommended that health education on influenza and influenza vaccination be strengthened, such as holding competitions on influenza and influenza vaccine knowledge and providing specific training on influenza vaccination in degree programs. Vaccine safety was the least

influential factor impeding vaccination, indicating solid expertise among study participants. The results of the current study suggest that providing information beyond expertise to study subjects could help improve vaccine coverage.

In this study, it was found that students with more knowledge about the influenza vaccine were more inclined to receive influenza vaccination, which is consistent with previous studies [16]. While the difference between clinical and non-clinical students regarding their willingness to receive influenza vaccination was not significant, according to the multifactorial analysis, it was found that non-clinical students who knew about influenza vaccine and those who actively learned about influenza vaccine-related to it were more willing to receive the vaccine. Thus, the main factor that influences non-clinical students to get vaccinated is the level of knowledge about the influenza vaccine, so we should increase the promotion of the influenza vaccine for non-clinical students. Among the clinical students, female and non-smoking students were more willing to receive the vaccine, so we should increase the promotion of the vaccine for male and smoking students.

The main way to learn about the flu vaccine is through TV, newspapers or the media. According to the report released by China Internet Network Information Center [16], cell phones have become the number one Internet terminal, and the usage rate of cell phones among college students is high. Some studies have shown that female students, natural life sciences and medicine, social sciences and management, and those with a monthly cell phone package costing $4 or more are highly dependent on cell phones[17-18]. Therefore, combining new media with old media can be more

effective in spreading health information about influenza and its vaccine.

Implications of the findings

Most of the current papers analyze and compare medical students as a group, but we refine the types of medical students: clinical medicine and non-clinical medicine. By comparing the analysis of the factors of willingness to vaccinate for influenza between the two groups, different promotional measures are taken for different groups of people in different specialties. This will provide a scientific basis for more effectively increasing the influenza vaccination rate among medical students and strengthening influenza prevention and control.

Limitations

However, this study has certain limitations; the data was collected using a self-reported questionnaire, which can be a potential cause of reporting bias. Moreover, since data is collected from medical students, so there is a possibility that they might answer the question positively on the basis of their medical knowledge as they already perceive what is expected from them. Another limitation is that data was collected online through social networking platforms. There is a possibility of bias as we may not be able to approach the students with an internet connectivity issue. Because our study was conducted at a medical school in Chongqing, it may limit the generalizability of the study, and we will subsequently expand the sample source in the hope of obtaining better results.

Since 2020, the COVID-19 pandemic has spread enormous information about viruses in general, and medical students, in particular, would have had more opportunities to study infectious diseases than before. Our study started before this time, so our existing conclusions may have changed, and we will conduct a new round of investigations as soon as possible to refine our experiments.

Conclusion

Excessive concerns about vaccine safety are a major barrier to influenza vaccination for clinical medical students, and a major barrier to influenza vaccination for non-clinical medical students is the low prevalence of knowledge about vaccine safety. Vaccine safety education should be provided to male and smoking clinical medical student populations and non-clinical medical student populations in a combination of old and new media.

Author Contributions

YLW and XJT drafted the manuscript. LG and QWL designed the Questionnaire ;YLW and FZ collected the data; YLW, LG, QWL and FZ participated in data analysis and data extraction. YLW and XJT finalized the manuscript. All authors read and approved the final manuscript.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Data sharing

No additional data available

References:

[1] World Health Organization(WHO). Vaccines against influenza WHO position pa per - November 2012. Wkly Epidemiol Rec. 2012, 87(47): 461-76.

[2] Hernandez-Garcia I, Aibar-Remon C. Measures to Improve Influenza Vaccination Coverage in Spanish Medical Students. Vaccines (Basel) 2020 2020-05-20;8(2).

[3] Grohskopf LA, Sokolow LZ, Broder KR, Walter EB, Fry AM, Jernigan DB. Prevention and Control of Seasonal Influenza with Vaccines: Recommendations of the Advisory Committee on Immunization Practices-United States, 2018-19 Influenza Season. MMWR. Recommendations and reports : Morbidity and mortality weekly report. Recommendations and reports 2018 2018-08-24;67(3).

[4] Guidelines for diagnosis and treatment of influenza (2020 version). Chin J Viral Dis; 2021-01-08:1-5.

[5] Technical guidelines for seasonal influenza vaccination in China,2020-2021.

Chin J Viral Dis; 2020-10-06;54(10):1035-59.

[6] Tuohetamu S, Pang M, Nuer X, Mahemuti, Mohemaiti P, Qin Y, et al. The knowledge, attitudes and practices on influenza among medical college students in Northwest China. Hum Vaccin Immunother 2017 2017-07-03;13(7):1688-92.

[7] G Gray, J Cooper. An evaluation of influenza vaccine uptake in UK medical students, Occupational Medicine, 2021-02-18;71:105-108

[8] Abalkhail MS, Alzahrany MS, Alghamdi KA, Alsoliman MA, Alzahrani MA, Almosned BS, et al. Uptake of influenza vaccination, awareness and its associated barriers among medical students of a University Hospital in Central Saudi Arabia. J Infect Public Health 2017 2017-09-01;10(5):644-8.

[9] Seale H, Wang Q, Yang P, Dwyer DE, Wang X, Zhang Y, MacIntyre CR. Influenza vaccination amongst hospital health care workers in Beijing. Occup Med (Lond). 2010-08;60(5):335-9

[10] Yue Ma . A comparative study on the knowledge, attitude and practice about seasonal influenza and seasonal influenza vaccine among healthcare workers in different level of medical institutions in Qingdao ; Qingdao University; 2017.

[11] Kelly D A , Macey D J , Mak D B . Annual influenza vaccination: Uptake, barriers, and enablers among student health care providers at the University of Notre Dame Australia, Fremantle[J]. 2014.

[12]Christopher JR, Kaitlin OB, Stephanie MB. Attitudes and barriers associated with seasonal influenza vaccination uptake among public health students; a cross-sectional

study. BioMed Central 2018 2018-12-01;18(1).

[13] Bednarczyk RA, Chu SL, Sickler H, Shaw J, Nadeau JA, McNutt LA. Low uptake of influenza vaccine among university students: evaluating predictors beyond cost and safety concerns. VACCINE 2015 2015-03-30;33(14):1659-63.

[14] Seale H, Leask J, MacIntyre CR. Attitudes amongst Australian hospital healthcare workers towards seasonal influenza and vaccination. Influenza Other Respir Viruses 2010;4(1):41–6.

[15] Gallone M S , Gallone M F , Cappelli M G , et al. Medical students' attitude toward influenza vaccination: Results of a survey in the University of Bari (Italy)[J]. Human Vaccines and Immunotherapeutics, 2017, 13(1):00-00.

[16]Feher A, Fekete M, Varga JT, Horvath I.Medical students' knowledge on vaccinology. Orv Hetil. 2019-07-01;160(30):1193-9.

[17]ZHOU Xiong-hui ,LI Qian-wei ,XIANG Ke,et al.Investigation and Countermeasure Analysis of Current Situation of College Students' Dependence on Mobile Phones in Xiangxi Area. Journal of Medical Information. 2021,34(09):137-140+148.

[18] Ding Nani Tu Xiaolian Shen Yijia.The relationship between medical university freshmen's social integration and mobile phone dependence:the mediation effect of self-esteem. China Higher Medical Education.2017(06):47-48.

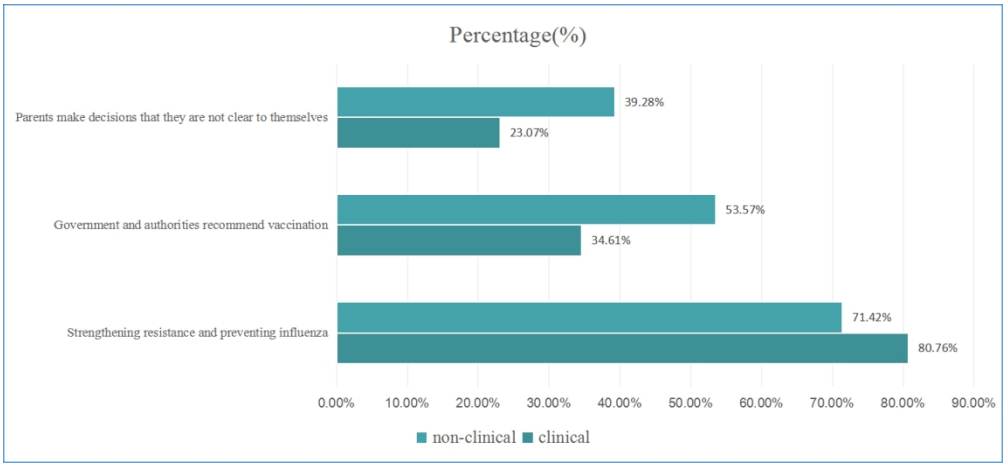


Fig. 1 Main reasons for influenza vaccination for Clinical and Non-clinical medical students in Chongqing

619x284mm (59 x 59 DPI)

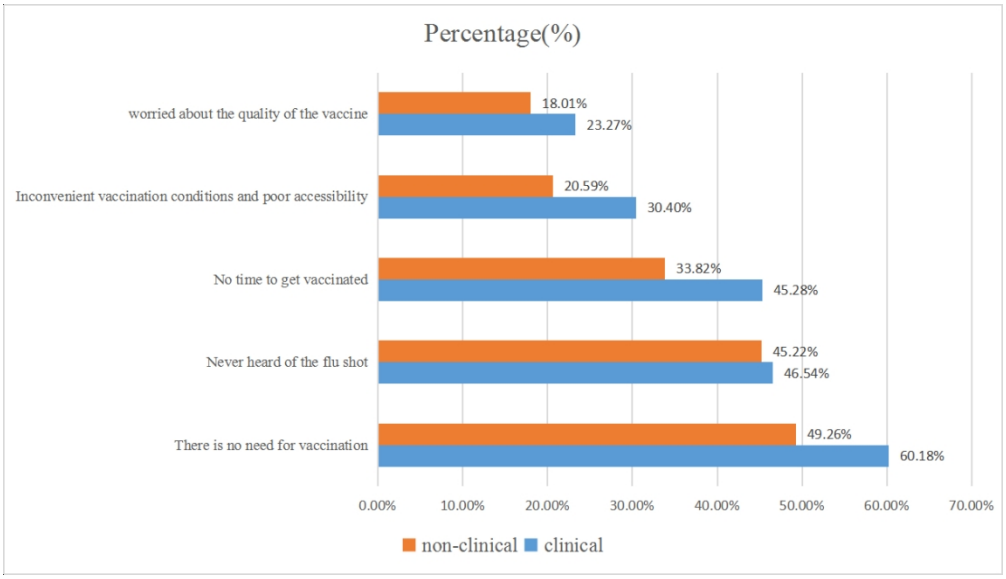


Fig. 2 The main reason why Chongqing Clinical and Non-clinical medical students are not vaccinated against influenza

538x306mm (59 x 59 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8-9
		(b) Give reasons for non-participation at each stage	8-9
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	8-17
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-17

		(*b*) Report category boundaries when continuous variables were categorized	8-17
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-17
Discussion			
Key results	18	Summarise key results with reference to study objectives	19-21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22-23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	23
Generalisability	21	Discuss the generalisability (external validity) of the study results	21-23
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Does COVID-19 have an effect on influenza vaccine knowledge,attitude and practice among medical students: a two-year Prospective cohort study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055945.R1
Article Type:	Original research
Date Submitted by the Author:	01-Mar-2022
Complete List of Authors:	Wang, Yunlong; Chongqing Medical University Wu, Guangjie; Chongqing Medical University, School of Public Health and Management Jiang, Yueming; Chongqing Medical University, Clinical 5+3 integration, the second clinical school Zou, Fa; Chongqing Medical University Gan, Lin; Chongqing Medical University Luo, Qinwen; Chongqing Medical University Tang, Xiaojun; Chongqing Medical University
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Public health
Keywords:	Epidemiology < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, IMMUNOLOGY, COVID-19

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Does COVID-19 have an effect on influenza vaccine knowledge,attitude and practice among medical students: a two-year Prospective cohort study

Yunlong Wang[a,#] ,Guangjie Wu[b#], Yueming Jiang[c], Fa Zou[a], Lin Gan[b], Qinwen Luo[b], Xiaojun Tang[b,*]

[a] School of basic medicine, Chongqing Medical University, Chongqing, China

[b] School of Public Health and Management, Chongqing Medical University, Chongqing, China

[C] Clinical 5+3 integration, the second clinical school, Chongqing medical university.

# These authors contributed equally to the work

* Corresponding author: Xiaojun Tang, Email: tangxiaoj0726@qq.com

ABSTRACT

Objective To explore the main factors affecting the knowledge ,attitude and practice about influenza and influenza vaccine and the intention to receive influenza vaccination among the same group of medical students before (2019) and after (2021) the COVID-19 outbreak.

Methods A prospective cohort study has been conducted among undergraduate medical students in Chongqing, which includes a survey of influenza and influenza vaccine knowledge, attitudes, practice, and vaccination intentions between September 2019 and October 2019.And a return visit to those who had previously received the questionnaire has been completed in November 2021.

Results The influenza vaccination rate of students at this medical school is 6.7% in 2019, compared with 25.8% in 2021.The awareness rate of medical students about influenza and influenza vaccine was 82.8% in 2019 and 86% in 2021, and there was no significant statistical difference between the two years(P=0.134>0.05); the number of medical students with supportive attitude towards influenza vaccine was 95.1% in 2019 and 97.1% in 2021, and there was no significant statistical difference between the two (P= 0.078>0.05); the number of people who actively learned about information related to influenza vaccine rose from 183 (22.8%) in 2019 to 195 (40.3%) in 2021.

Conclusion The COVID-19 outbreak prompted an increase in influenza vaccination rates among medical students in Chongqing, with essentially everyone (96.0%)

believing that the spread of COVID-19 promoted their knowledge of influenza and influenza vaccine, and the vast majority (74.8%) believing that the spread of COVID-19 promoted their willingness to receive influenza vaccine.

Key words Education,Flu,Immunization,Vaccine,Infection,COVID-19

Highlight

·The COVID-19 outbreak prompted an increase in influenza vaccination rates among medical students in Chongqing

·Students who are more knowledgeable about the influenza vaccine and are actively learning about respiratory viral infectious diseases during COVID-19 transmission are more likely to get the influenza vaccine.

Background

Influenza (influenza for short), a respiratory tract infectious disease, is extremely contagious.Influenza virus antigenicity is variable and spreads rapidly.This virus can cause seasonal epidemics each year.[1].Among them, China's Influenza Treatment Program (2020 version) clearly states that "annual influenza vaccination is the most effective means of influenza prevention, reducing the risk of influenza and serious complications in vaccinated individuals"[2].During the outbreak of pandemic Coronavirus disease 2019 (COVID-19), the Chinese Ministry of Health considers influenza vaccination for 2020-2021 to be particularly important[3]. Influenza

vaccination has become especially important as the severe global epidemic of COVID-19 will continue this year and there may be a superimposed epidemic of COVID-19 epidemic with influenza and other respiratory infectious diseases this winter and next spring.

At a place where students gather, the relatively crowded learning and living environment of schools are prone to influenza, and college students are highly mobile between campuses. Surveillance data from several provinces in recent years have shown that more than 90% of influenza each year occurs on campus [4]. Medical students, however, are at higher risk of influenza illness than other college students due to the specificity of their discipline. They are the future medical workers and important disseminators of health knowledge, and there is an excellent need for vaccination[5].

Little has been reported on the current status of influenza vaccination in this group in China. From the few studies, it was found that the current vaccination rate of medical students in China is much lower than that of foreign countries.Influenza vaccination rates for medical students were 17.1% in northwest China, 25.3% in Brazil, 20.7% in Saudi Arabia, 53.8% in Australia, 76% in the United Kingdom, and 43% in the United States[4,6-10]. To explore whether medical students' knowledge,attitude and practice about influenza and influenza vaccine have changed under the influence of today's COVID-19 epidemic, we compared the results of the survey on the knowledge and beliefs about influenza and influenza vaccine among the same group of medical students before the outbreak (2019) and after the outbreak (2021) to explore the main

factors affecting medical students' willingness to receive influenza vaccination, and to provide a scientific basis for improving influenza vaccination rates among medical students and strengthening influenza prevention and control efforts in the current context.

MATERIAL AND METHODS

Study design and settings

In this prospective cohort study, a survey on influenza and influenza vaccine awareness and willingness to vaccinate was conducted among freshman-year to senior-year medical students in a medical school in Chongqing from September 2019 to October 2019, and the questionnaire was named Q1.A new survey on influenza and influenza vaccine knowledge, attitude and practice to vaccinate was sent by email to volunteers who had previously received the questionnaire in November 2021, with some slight modifications due to the COVID-19 and the questionnaire was named Q2.The questionnaire data will be compiled and collected in January 2022.The final return rate of the questionnaire was only 60.27% due to graduation, email discontinuation, etc.All participants were randomly selected and volunteered to participate in this experiment and were not involved in the recruitment and conduct of the study.

Patient and public involvement

This research was done without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

Questionnaire

Both questionnaire (Q1 and Q2) was developed, and a pilot study was conducted on a sample of 30 participants. Feedback was used to modify the items, and the finalized instrument was administered electronically. Preventive measures advertised by the National Health Commission of the PRC on its official website were employed to assess the precautionary behavior. The survey consisted of two parts. The first part collected demographic information on profession and gender. The second part included knowledge about influenza and the influenza vaccine and attitude toward influenza vaccine—questionnaire with a Cronbach's alpha coefficient of over 0.7.

Ethical approval

Data collection procedures comply with institutional and national ethical guidelines and follow the Declaration of Helsinki. The anonymity and confidentiality of data is maintained. Written informed consent has been obtained from the investigators for this experiment.

Survey

We collated questions on influenza-related knowledge and influenza vaccine attitude from both Q1 and Q2 questionnaires and we analyzed them after excluding redundant and repetitive questions. Influenza-related knowledge was scored 1 point for a correct answer and 0 points for a wrong answer. The full score is 18 points and a score of ≥11 is judged as knowing. Influenza vaccine knowledge rate (%) = number of correct answers/total number of respondents × 100%. For influenza vaccine attitude, a score was assigned according to the attitude towards influenza vaccine (5=very positive, 4=positive, 3=fair, 2=negative, 1=very negative).And the full score is 25, and ⩾15 points are judged as positive treatment of influenza.Vaccine vaccination rate (%) = number of influenzas vaccinated/total number of surveyed × 100%. Influenza vaccination willingness rate (%) = number of people willing to receive influenza vaccination/total number of people surveyed × 100%.

Data analysis

Epidata 3.0 software was used for double data entry, and R 3.2.5 software was used for statistical analysis; the differences between means were tested by T-test. The differences between rates were analyzed by chi-square test, and unconditional logistic stepwise regression analysis was used for influencing factors of influenza vaccination intention, and differences were considered statistically significant at $P<0.05$.

Results

Demographics

A total of 803 medical students participated in this survey between September and October 2019. Only 484 medical students answered the questionnaire during the return visit in November 2021.We define freshmen, sophomores and juniors as lower division students， and Seniors and Fifth year students as senior group.In the comparison between 2021 and 2019, there are statistically significant differences in gross monthly income(GMI), age and grade level, and the specific information can be seen in Table 1.

Knowledge

The knowledge rate of medical students about influenza and influenza vaccine was 82.8% in 2019 and 86% in 2021, and there was no statistically significant difference between the two comparisons (P=0.134>0.05)."Wearing a mask can prevent the spread of the flu to some extent.","Incubation period of influenza","Influenza can be spread through close contact with patients", "Influenza vaccination for immunity is less costly and more cost-effective than developing immunity from influenza infection", "The best time to get a flu vaccination", "How often should you get a flu vaccination?".The above six questions are significantly more known and statistically significant in 2021 than in 2019, while the three questions: "Influenza patients can spread the infection before symptoms appear", "Influenza vaccination does not give you the flu although it carries live virus", and "What do you think the purpose of influenza vaccination is" are less known and statistically significant in 2021 than in

2019(Table 2.).

Attitudes

The percentage of medical students who were supportive of influenza vaccine in 2019 was 95.1% and 97.1% in 2021, with no statistically significant difference between the two comparisons (P=0.078>0.05).More medical students in 2021 than in 2019 believe the flu vaccine is safer (91.5% > 65.1%), that getting the flu vaccine is necessary (83.9% > 67.0%), that the seasonal flu vaccine is more effective in preventing seasonal flu (86.8% > 73.2%), and that getting the vaccine is more important (59.3% > 43.1%), but are also more concerned about side effects of the influenza vaccine (56.0% > 25.5%)(Table 3.).

Practices

The main source of influenza vaccine information in 2019 was television, newspapers, and the media (48.6%), while the main source in 2021 was health care professionals (35.6%)(Figure 1).

The number of people actively seeking information about influenza vaccine rose from 183 (22.8%) in 2019 to 195 (40.3%) in 2021. The number of people who received influenza vaccination in 2021 was much higher than in 2019 (25.8% > 6.7%), and the most significant increase in adverse reactions to vaccination was seen in the phenomenon of temporary mild pain, redness and swelling at the injection site (39.2% > 18.5%). Among the reasons for receiving influenza vaccination: "to strengthen

resistance and prevent influenza" (75.9%<88.8%) and "recommended by government and health authorities" (44.4%<72.0%), both of which are lower in 2019 than in 2021(Table 4.).

The three main reasons for not getting vaccinated in 2019 were "did not think it was necessary to get vaccinated" (53.8%), "did not know about the flu vaccine" (46.1%), and "did not have time " (41.1%). the three main reasons for not getting vaccinated in 2021 were: "didn't have time to get vaccinated" (43.5%), "didn't think it was necessary to get vaccinated" (43.2%), and "Didn't know about the flu vaccine" (35.9%)(Fig.2).

During the COVID-19 epidemic in 2021, most people believed that the epidemic promoted awareness of influenza and influenza vaccine (96%) and willingness to receive influenza vaccination (74.8%)(Table 5.).

Analysis of Single Factors Affecting Medical Students' Vaccination Intentions in 2021

The vaccination rate of medical students who actively learned about influenza vaccine was significantly higher than that of medical students who did not actively learn about it (47.2% > 11.4%), and the vaccination rate of medical students who actively learned and learned about respiratory viral infectious diseases during COVID-19 was also higher than that of medical students who did not actively learn about it (29.5% > 8.3%)(Table 6.).

Discussion

This study showed that the influenza vaccination rate of medical students in this medical school was only 6.7% in the 2019 influenza season, which is lower than the vaccination levels of medical students in other cities such as Urumqi, China (4.1%, 9.2%, and 6.1% in 2009, 2010, and 2011, respectively) [6]. However, in 2021 the vaccination rate of medical students against influenza rose to 25.8%, which is not as high as the vaccination level of medical students in developed countries such as the United States and the United Kingdom, but it is also a significant improvement compared with 2019. This finding indicates that the COVID-19 outbreak has significantly boosted the influenza vaccination rate of medical students. However, the level of influenza vaccination among medical students in Chongqing is still low and needs to be further improved, and it is recommended that medical students be included in the key recommended vaccination targets for influenza vaccination.

Looking at the demographic characteristics of the respondents, factors such as graduation and email abandonment resulted in a return rate of only 60.27%. the gross monthly income(GMI) in 2021 is higher than that in 2019, which we speculate may be due to inflation. Over time, the age and grade level in 2021 are higher than in 2019, which is also in line with the objective rule and our speculation.

In terms of knowledge, there was no significant difference between the comparison of 2021 and 2019 ($p=0.134>0.05$). However, on average, only a quarter of the population knew the incubation period time of influenza, and one study found that university education has a positive impact on influenza knowledge [11], based on this, indicating that students at this university do not pay much attention to

influenza-related courses.The percentages for "Wearing a mask can prevent the spread of influenza to some extent," "Influenza can be spread through close contact with patients," and "Compared to developing immunity from influenza infection, getting immunity from influenza vaccination is less cost and better cost-effectiveness", which are significantly more correct in 2021 than in 2019. This is because of the emergence of COVID-19, which is more widely known due to state and government campaigns and changes in daily lifestyle (e.g., the need to wear a mask when using public transportation).The question "side effects of influenza vaccination: fever, headache" was also better answered in 2021, probably due to the reactions that occurred during the vaccination with COVID-19 or the possible side effects that were told by doctors or teachers before the vaccination [12-13]. As for the question "chronically ill and frail people are the priority recommended population for influenza vaccination", the answer was reversely better in 2019 than in 2021 (87.8% > 82.6%), which we speculate may be due to the fact that at the time of vaccination during the COVID-19, it was considered that the resistance of these groups was weak and that the newly developed vaccine was not unsafe and did not recommend patients with chronic diseases and frail patients to receive the COVID-19 vaccine, thus leading to poorer answers to this question [14-16].

Regarding the comparison of attitudes towards influenza vaccine, although there was no significant difference between 2021 and 2019 ($p=0.078>0.05$), 2021 respondents were more likely to believe that influenza vaccine is safe and important, that vaccination against influenza is necessary, and that they are not concerned about

the side effects of influenza vaccine.There are good reasons to attribute this to the COVID-19 epidemic brought about by the Change.

The most important reason for influenza vaccination among medical students in both 2021 and 2019 was "to increase resistance and prevent influenza", which is consistent with other studies [17-19], indicating that concern for one's health is the driving factor for influenza vaccination in this group. The reason "recommended by the government and health authorities" increased from 44.4% in 2019 to 72% in 2021, due to the government's strong call for people to get COVID-19 vaccine in the past year, which led to the group's increased interest in influenza vaccination.

Among students who reported not receiving the influenza vaccine, the reasons for not receiving the vaccine in 2021 and 2019 are not very different, with a significant percentage of students not considering it necessary, suggesting that the influenza vaccine is not being taken seriously by this group. It is noteworthy that the number of students who have "never heard of influenza vaccine" reached 46.1% in 2019 and 35.9% in 2021. It is recommended that health education on influenza and influenza vaccine be strengthened, such as holding a competition on influenza and influenza vaccine knowledge and providing specific training on influenza vaccination in degree programs. Vaccine safety was the least influential factor impeding vaccination, indicating solid expertise among study participants. The results of the current study suggest that providing information beyond expertise to study subjects could help to improve vaccine coverage.

This study found that students with more knowledge about influenza vaccine were

more inclined to receive influenza vaccine, which is consistent with previous studies [20]. Students who took the initiative to learn about respiratory viral infectious diseases during COVID-19 transmission were also more likely to get the influenza vaccine, suggesting that the promotion and dissemination of knowledge about COVID-19 also helped people to understand more about influenza and influenza vaccine. This shows that in the current environment, we should attach knowledge about influenza to the promotion of COVID-19-related knowledge and prevention methods, so that people can receive COVID-19 vaccination and also pay attention to influenza vaccination, thereby increasing the influenza vaccination rate.

Limitations

However, this study has certain limitations.The data was collected via using a self-reported questionnaire, which can be a potential cause of reporting bias. Moreover, since data is collected from medical students, there is a possibility that they might answer the question positively on the basis of their medical knowledge as they have already percieved what is expected from them. Another limitation is that data was collected online through social networking platforms. There is a possibility of bias as we may not be able to approach the students with an internet connectivity issue. Because our study was conducted at a medical school in Chongqing, it may limit the generalizability of the study, and we will subsequently expand the sample source in hope of obtaining better results.

Conclusion

The COVID-19 outbreak prompted an increase in influenza vaccination rates among medical students in Chongqing (6.7% in 2019 to 25.8% in 2021), with essentially everyone (96.0%) believing that the spread of COVID-19 promoted their knowledge of influenza and influenza vaccine, and the vast majority (74.8%) believing that the spread of COVID-19 promoted their willingness to receive influenza vaccine. We should promote COVID-19 vaccine along with the dissemination of influenza vaccine-related knowledge to help increase influenza vaccination rates.

Author Contributions

YLW and XJT drafted the manuscript. GJW and QWL designed the Questionnaire ;YLW and FZ collected the data; GJW, LG, QWL， YMJ and FZ participated in data analysis and data extraction. YLW and XJT finalized the manuscript. All authors read and approved the final manuscript.

Acknowledgments

The authors thank all participants of this study for sharing their time and experiences.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Data availability statement

Data are available upon reasonable request

References:

[1].Chinese Center for Disease Control and Prevention.Technical guidelines for seasonal influenza vaccination in China (2020-2021)[J].Chin J Viral Dis,2020,10(06):403-416. DOI:10.16505/j.2095-0136.2020.0076.

[2].Guidelines for diagnosis and treatment of influenza (2020 version). Chin J Viral Dis; 2021-01-08:1-5.

[3].Krishnaratne S, Pfadenhauer LM, Coenen M, et al. Measures implemented in the school setting to contain the COVID-19 pandemic: a scoping review. Cochrane Database Syst Rev. 2020;12:CD013812. Published 2020 Dec 17. doi:10.1002/14651858.CD013812

[4].Tuohetamu S, Pang M, Nuer X, et al. The knowledge, attitudes and practices on influenza among medical college students in Northwest China. Hum Vaccin Immunother. 2017;13(7):1688-1692. doi:10.1080/21645515.2017.1293769

[5].G Gray, J Cooper. An evaluation of influenza vaccine uptake in UK medical students, Occupational Medicine, 2021-02-18;71:105-108

[6].Abalkhail MS, Alzahrany MS, Alghamdi KA, Alsoliman MA, Alzahrani MA, Almosned BS, et al. Uptake of influenza vaccination, awareness and its associated barriers among medical students of a University Hospital in Central Saudi Arabia. J Infect Public Health 2017 2017-09-01;10(5):644-8.

[6].Tuohetamu S, Pang M, Nuer X, et al. The knowledge, attitudes and practices on influenza among medical college students in Northwest China. Hum Vaccin Immunother. 2017;13(7):1688-1692. doi:10.1080/21645515.2017.1293769

[7].Deckers Leme M, Elias Gilio A. Health worker recommended vaccination rates among medical students in Brazil. Vaccine X. 2021;9:100118. Published 2021 Oct 19. doi:10.1016/j.jvacx.2021.100118

[8].Walker L, Newall A, Heywood AE. Knowledge, attitudes and practices of Australian medical students towards influenza vaccination. Vaccine. 2016;34(50):6193-6199. doi:10.1016/j.vaccine.2016.10.074

[9].Gray G, Cooper J. An evaluation of influenza vaccine uptake in UK medical students. Occup Med (Lond). 2021;71(2):105-108. doi:10.1093/occmed/kqab014

[10].Rogers CJ, Bahr KO, Benjamin SM. Attitudes and barriers associated with seasonal influenza vaccination uptake among public health students; a cross-sectional study. BMC Public Health. 2018;18(1):1131. Published 2018 Sep 20. doi:10.1186/s12889-018-6041-1

[11].Szilagyi PG, Schaffer S, Rand CM, et al. School-Located Influenza Vaccination: Do Vaccine Clinics at School Raise Vaccination Rates?. J Sch Health. 2019;89(12):1004-1012. doi:10.1111/josh.12840

[12].Leng A, Maitland E, Wang S, Nicholas S, Liu R, Wang J. Individual preferences for COVID-19 vaccination in China. Vaccine. 2021;39(2):247-254. doi:10.1016/j.vaccine.2020.12.009

[13].Zhang Y, Zeng G, Pan H, et al. Safety, tolerability, and immunogenicity of an inactivated SARS-CoV-2 vaccine in healthy adults aged 18-59 years: a randomised, double-blind, placebo-controlled, phase 1/2 clinical trial. Lancet Infect Dis. 2021;21(2):181-192. doi:10.1016/S1473-3099(20)30843-4

[14].Sharma A, Patnaik I, Kumar A, Gupta R. COVID-19 Vaccines in Patients With Chronic Liver Disease. J Clin Exp Hepatol. 2021;11(6):720-726. doi:10.1016/j.jceh.2021.06.013

[15].Morawska M. Reasons and consequences of COVID-19 vaccine failure in patients with chronic lymphocytic leukemia. Eur J Haematol. 2022;108(2):91-98. doi:10.1111/ejh.13722

[16].Alghamdi AA, Aldosari MS, Alsaeed RA. Acceptance and barriers of COVID-19 vaccination among people with chronic diseases in Saudi Arabia. J Infect Dev Ctries. 2021;15(11):1646-1652. Published 2021 Nov 30. doi:10.3855/jidc.15063

[17] Bednarczyk RA, Chu SL, Sickler H, Shaw J, Nadeau JA, McNutt LA. Low uptake of influenza vaccine among university students: evaluating predictors beyond cost and safety concerns. VACCINE 2015 2015-03-30;33(14):1659-63.

[18] Seale H, Leask J, MacIntyre CR. Attitudes amongst Australian hospital healthcare workers towards seasonal influenza and vaccination. Influenza Other Respir Viruses 2010;4(1):41–6.

[19] Gallone M S , Gallone M F , Cappelli M G , et al. Medical students' attitude toward influenza vaccination: Results of a survey in the University of Bari (Italy)[J]. Human Vaccines and Immunotherapeutics, 2017, 13(1):00-00.

[20] Feher A, Fekete M, Varga JT, Horvath I.Medical students' knowledge on vaccinology. Orv Hetil. 2019-07-01;160(30):1193-9.

Table 1. Demographic characteristics of the study participants in Chongqing

Demographic information	2019 n(%)	2021 n(%)	Total	P
Gender				

Male	294（36.6）	179（37.0）	473	0.894
Female	509（63.4）	305（63.0）	814	
GMI				
<¥4000	507（63.1）	275（56.8）	782	0.025
≥¥4000	296（36.9）	209（43.2）	505	
Age				
18-20 years old	350（43.6）	177（36.6）	527	0.013
21-23 years old	453（56.4）	307（63.4）	760	
Grade Level				
Lower Division	167（20.8）	39（8.1）	206	<0.001
Senior group	636（79.2）	445（91.9）	1081	

Table 2. Comparison of influenza vaccine knowledge in 2019 and 2021

Knowledge	Knowledge Awareness Level		
	2019	2021	
	Awareness rate n（n/N*100%）	Awareness rate n（n/N*100%）	P
Wearing a mask helps to prevent the spread of the flu	699（87.0）	472（97.5）	<0.001
Influenza is mainly spread	785（97.8）	475（98.1）	0.640

by respiratory (coughing, sneezing) droplets			
Incubation period of influenza	193（24.0）	156（32.2）	0.001
Influenza carriers (without symtoms) can spread the infection	706（87.9）	391（80.8）	0.001
Patients are contagious	525（65.4）	439（90.7）	<0.001
Influenza vaccination does not give you the flu despite carrying live virus	690（85.9）	272（56.2）	<0.001
Influenza vaccination for immunity is less costly and more cost-effective than developing immunity from influenza infection	373（46.5）	420（86.8）	<0.001
The best time to get vaccinated	412（51.3）	310（64.0）	<0.001
Frequency of vaccination	297（37.0）	213（44.0）	0.013
Perception of the aim of flu vaccination	733（91.3）	422（87.2）	0.020
Side effects of influenza			

vaccination			
Fever	540（67.2）	364（75.2）	0.002
Pain and swelling at the injection site	672（83.7）	419（86.6）	0.160
Headaches	448（55.8）	318（65.7）	<0.001
Influenza vaccination priority groups			
People over 60 years old	577（71.9）	351（72.5）	0.797
Patients with chronic illnesses and infirmity	705（87.8）	400（82.6）	0.011
Health facility staff, especially front-line staff	715（89.0）	415（85.7）	0.082
Pupils and kindergarten children	714（88.9）	420（86.8）	0.253
Pregnant women over the first trimester of pregnancy	360（44.8）	192 (39.7)	0.069

Table 3. Comparison of Influenza Vaccine Attitudes in 2019 vs. 2021

Attitude	2019	2021	P

	n	% (n/N)	n	% (n/N)	
Flu vaccine is safe					
Agree	523	65.1	443	91.5	<0.001
Disagree	280	34.9	41	8.5	
Flu vaccination is necessary					
Agree	538	67.0	406	83.9	<0.001
Disagree	265	33.0	78	16.1	
You are not worried about the side effects of the flu vaccine					
Agree	205	25.5	271	56.0	<0.001
Disagree	598	74.5	213	44.0	
The seasonal flu vaccine is more effective in preventing seasonal flu					
Agree	588	73.2	420	86.8	<0.001
Disagree	215	26.8	64	13.2	
Annual flu vaccination is important for you					
Agree	346	43.1	287	59.3	<0.001
Disagree	457	56.9	197	40.7	
You are planning to get a flu vaccination this autumn/winter					
Agree	268	33.4	187	38.6	0.056
Disagree	535	66.6	297	61.4	

Table 4. Comparison of influenza vaccination behaviour in 2019 vs.2021

Behaviour	2019		2021		P
	n	%(n/N)	n	%(n/N)	
Do you take the initiative to learn about the flu vaccine?					
Yes	183	22.8	195	40.3	<0.001
No	620	77.2	289	59.7	
Did you get a flu vaccination last year?					
Yes	54	6.7	125	25.8	<0.001
No	749	93.3	359	74.2	
Did you have any of the following adverse reactions in your last flu vaccination?					
Severe allergic reactions	7	13.0	23	18.4	0.362
Dizziness	9	16.7	26	20.8	0.483
Low fever	7	13.0	23	18.4	0.337
Transient mild pain, redness and swelling at the injection site	10	18.5	49	39.2	0.004
No adverse reactions	36	66.7	67	53.6	0.136
What are your reasons for getting the flu vaccine?					

Build up your resistance and prevent flu	41	75.9	111	88.8	0.033
Recommendation from government and health authorities	24	44.4	90	72.0	<0.001
Recommended by family and friends	17	31.5	58	46.4	0.061
Other	3	5.6	1	0.8	0.061
Have you had a flu-like illness within 1 year of vaccination?					
Yes	8	14.8	17	13.6	
No	25	46.3	96	76.8	<0.001
Don't remember	21	38.9	12	9.6	

Table 5. Analysis of COVID-19 related behaviors in 2021 (frequency statistics)

COVID-19 Related Acts	Number of people	Percentage (%)
The COVID-19 outbreak promotes your learning about respiratory infectious diseases		
Yes	400	82.6
No	84	17.4
The COVID-19 outbreak raised your awareness of flu and flu vaccine.		
Yes	384	96.0
No	16	4.0

The COVID-19 Outbreak boosts your intention to get flu vaccinated.		
Yes	362	74.8
No	122	25.2

Table 6. Analysis of factors influencing medical students' willingness to receive vaccinations in 2021.

Variables	Number of people vaccinated (percentage%)	Number of unvaccinated persons (%)	OR value (95% CI)	P
Gender				
Male	49(27.4)	130(72.6)	1.136(0.747-1.726)	0.551
Female	76(24.9)	229(75.1)	Ref	
Age				
18-20	48(27.1)	129(72.9)	1.111(.7300-1.692)	0.622
21-23	77(25.1)	230(74.9)	Ref	
Grade Level				
Lower School	14(35.9)	25(64.1)	1.685(0.846-3.355)	0.137
Upper School	111(24.9)	334(75.1)	Ref	

GMI				
<¥4000	65(23.6)	210(76.4)	0.769(0.511-1.157)	0.207
≥¥4000	60(28.7)	149(71.3)	Ref	
Attitudes towards the flu vaccine				
Negative	1(7.1)	13(92.9)	Ref	0.140
Active	124(26.4)	346(73.6)	4.659(0.603-35.984)	
Level of knowledge				
Understanding	13(19.1)	55(80.9)	Ref	0.443
Don't understand	112(26.9)	304(84.7)	1.559(0.820-2.962)	
proactive about information about flu vaccines				
Yes	92(47.2)	103(52.8)	6.929(4.380-10.963)	<0.001
No	33(11.4)	256(88.6)	Ref	
learning about respiratory infectious diseases during the COVID-19 outbreak				
Yes	118(29.5)	282(70.5)	4.603(2.062-10.275)	<0.001
No	7(8.3)	77(91.7)	Ref	

Fig.1 Sources of Influenza Vaccine Information for 2019 vs. 2021

Fig. 2 Main reasons for not getting an influenza vaccination in 2019 vs. 2021

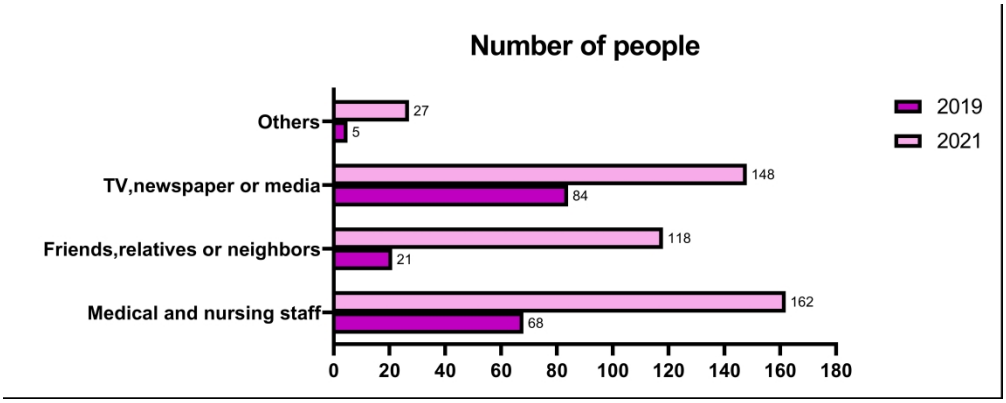
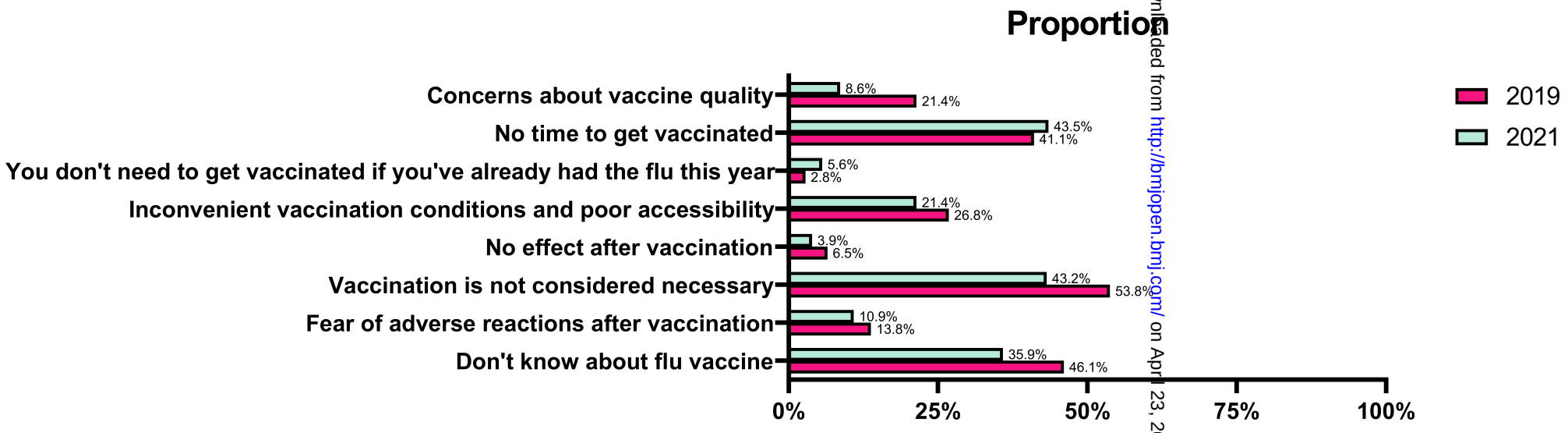


Fig. 1 Sources of Influenza Vaccine Information for 2019 vs. 2021

6284x2487mm (38 x 38 DPI)



STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8-9
		(b) Give reasons for non-participation at each stage	8-9
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	8-17
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-17

		(*b*) Report category boundaries when continuous variables were categorized	8-17
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-17
Discussion			
Key results	18	Summarise key results with reference to study objectives	19-21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22-23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	23
Generalisability	21	Discuss the generalisability (external validity) of the study results	21-23
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Does COVID-19 have an effect on influenza vaccine knowledge,attitude and practice among medical students: a two-year Prospective cohort study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055945.R2
Article Type:	Original research
Date Submitted by the Author:	06-Jun-2022
Complete List of Authors:	Wang, Yunlong; Chongqing Medical University Wu, Guangjie; Chongqing Medical University, School of Public Health and Management Jiang, Yueming; Chongqing Medical University, Clinical 5+3 integration, the second clinical school Zou, Fa; Chongqing Medical University Gan, Lin; Chongqing Medical University Luo, Qinwen; Chongqing Medical University Tang, Xiaojun; Chongqing Medical University Wu, Xiaorong; Chongqing Medical University
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Public health
Keywords:	Epidemiology < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, IMMUNOLOGY, COVID-19

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Does COVID-19 have an effect on influenza vaccine knowledge, attitude and practice among medical students: a two-year Prospective cohort study

Yunlong Wang[a,#], Guangjie Wu[b#], Yueming Jiang[c], Fa Zou[a], Lin Gan[b], Qinwen Luo[b], Xiaorong Wu[b,*], Xiaojun Tang [b,*]

[a] School of basic medicine, Chongqing Medical University, Chongqing, China

[b] School of Public Health and Management, Chongqing Medical University, Chongqing, China

[C] Clinical 5+3 integration, the second clinical school, Chongqing medical university.

# These authors contributed equally to the work

* Corresponding author: Xiaojun Tang, Email: tangxiaoj0726@qq.com, Xiaorong Wu, Email:101609@cqmu.edu.cn

ABSTRACT

Objectives To explore the main factors affecting the knowledge, attitude and practice about influenza and influenza vaccine as well as the intention to receive influenza vaccination among the same group of medical students before (2019) and after (2021) the COVID-19 outbreak.

Design A population-based prospective cohort study.

Setting A longitudinal cohort study of a selected medical school in Chongqing, China, which ran from 2019 to 2021.

Participants A total of 803 medical students participated in the study in 2019 and only 484 students responded in 2021. The response rate for our survey was only 60.27% due to graduation, emails being abandoned, etc.

Results The influenza vaccination rate of students at this medical school was 6.7% in 2019, compared with 25.8% in 2021.The awareness rate of medical students about influenza and influenza vaccine was 82.8% in 2019 and 86% in 2021, and there was no significantally statistical difference between the two years ($p = 0.134$); the number of medical students with supportive attitude towards influenza vaccine was 95.1% in 2019 and 97.1% in 2021, and there was no statistically significant difference between the two ($p = 0.078$); the number of students who actively learned about knowledge related to influenza vaccine rose from 183 (22.8%) in 2019 to 195 (40.3%) in 2021.

Conclusions The COVID-19 outbreak prompted an increase in influenza vaccination rates among medical students in Chongqing, with almost all students (96.0%) believing that the spread of COVID-19 promoted their knowledge in influenza and influenza

vaccine, and the vast majority (74.8%) believing that the spread of COVID-19 promoted their willingness to receive influenza vaccine.

Key words Education, Flu, Immunization, Vaccine, Infection, COVID-19

Strengths and limitations of this study

·Comparing knowledge attitude and practice toward influenza vaccine in the same group before and after the COVID-19 outbreak, and this condition cannot be replicated now.

·Because our study was conducted at a medical school in Chongqing, it may limit the generalizability of the study.

Background

Influenza (or flu), a respiratory tract infectious disease, is extremely contagious. Influenza virus antigenicity is variable and spreads rapidly.This virus can cause seasonal epidemics each year.[1].Among them, China's Influenza Treatment Program (2020 version) clearly states that "annual influenza vaccination is the most effective means for influenza prevention, reducing the risk of influenza and serious complications in vaccinated individuals"[2].During the outbreak of pandemic Coronavirus disease 2019 (COVID-19), the Chinese Ministry of Health considers influenza vaccination for 2020-2021 to be particularly important[3]. Influenza vaccination has become especially important as the severe global epidemic of COVID-19 will continue this year and there may be a superimposed epidemic of COVID-19

epidemic with influenza and other respiratory infectious diseases this winter and next spring.

As a place where students frequently gather, the relatively crowded learning and living environment of schools makes it easy for students to catch the flu, and college students are highly mobile between campuses. Surveillance data from several provinces in recent years have shown that more than 90% of influenza each year occurs on campus.From 2004-2008, 90.48% of influenza outbreaks in Jiangsu Province occurred on campus.From 2006-2013, 97.26% of influenza outbreaks in Shanxi Province also occurred on campus[4-6]. Among all the students on campus, medical students are believed to possess a higher risk of influenza illness than other students due to the specificity of their discipline. They are the future medical workers and important disseminators of health knowledge, so there is a need for vaccination for them[7]. However, little has been reported regarding the current status of influenza vaccination in this group in China. From the few studies, it was found that the current vaccination rate of medical students in China was much lower than that of foreign countries. Influenza vaccination rates for medical students were 17.1% in northwest China, 25.3% in Brazil, 20.7% in Saudi Arabia, 53.8% in Australia, 76% in the United Kingdom, and 43% in the United States[4,8-13]. To explore whether medical students' knowledge,attitude and practice about influenza and influenza vaccine have changed under the influence of today's COVID-19 epidemic, we compared the results of a survey on their knowledge in and beliefs about influenza and influenza vaccine among the same group of medical students before the outbreak (2019) and after the outbreak (2021)

to 1) investigate the main factors affecting medical students' willingness to receive influenza vaccination; 2) provide a scientific basis for improving influenza vaccination rates among medical students and strengthening influenza prevention and control efforts in the current context.

MATERIAL AND METHODS

Study design and settings

In this prospective cohort study, a survey study focusing on influenza and influenza vaccine awareness and willingness to vaccinate was first conducted among freshman-year to senior-year medical students in a medical school in Chongqing, China from September 2019 to October 2019, and the questionnaire used was named Q1. A new survey on influenza and influenza vaccine knowledge, attitude and practice to vaccinate with some slight modifications due to the COVID-19 was sent by email to volunteers who had previously received the questionnaire (Q1) in November 2021, and the new questionnaire was named Q2. The questionnaire data will be compiled and collected in January 2022.The final return rate of the questionnaire was only 60.27% due to graduation, email discontinuation, etc. All participants in 2019 were randomly selected and volunteered to participate in this experiment and were not involved in the conduct of the study.

Patient and public involvement

This research was done without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

Questionnaire

Both questionnaires (Q1 and Q2) were pilot tested on a sample of 30 participants, and their feedback was used to further modify the items. The finalized instrument was administered electronically. The questionnaires used the precautionary measures promoted by the National Health Commission of the People's Republic of China on its official website as questions to determine the level of knowledge in influenza prevention. The survey consisted of two parts. The first part collected demographic information on profession and gender while the second part asked about respondents' knowledge in influenza and the influenza vaccine, as well as attitude towards influenza vaccine—a set of questions with a Cronbach's alpha coefficient greater than 0.7.

Ethical approval

Our data collection procedures complied with the institutional and national ethical guidelines and followed the Declaration of Helsinki. The anonymity and confidentiality of data was maintained. Written informed consent was obtained from the investigators for this experiment. This study was approved by the Ethics Committee of Chongqing Medical University

Survey

We collated questions on influenza-related knowledge and influenza vaccine attitude from both Q1 and Q2 and analyzed them after excluding redundant and repetitive questions. Influenza-related knowledge was scored 1 point for a correct answer and 0 points for a wrong answer. The full score was 18 points and a score ≥11 would be judged as knowing. Influenza vaccine knowledge rate (%) = number of correct answers/total number of respondents × 100%. For influenza vaccine attitude, a score was assigned according to the attitude towards influenza vaccine (5=very positive, 4=positive, 3=fair, 2=negative, 1=very negative). The full score was 25, any scores ≥15 would be considered as having a positive attitude towards influenza vaccine.Vaccine vaccination rate (%) = number of influenzas vaccinated/total number of surveyed × 100%. Influenza vaccination willingness rate (%) = number of people willing to receive influenza vaccination/total number of people surveyed × 100%.

Data analysis

Epidata 3.0 software was used for double data entry, and R 3.2.5 software was used for statistical analysis; the differences between means were tested by T-test. The differences between rates were analyzed by chi-squared test, and unconditional logistic stepwise regression analysis was used for influencing factors of influenza vaccination intention. The level of statistical significance was chosen to be 0.05 ($\alpha = 0.05$).

Results

Demographics

A total of 803 medical students participated in the study between September and October 2019. Only 484 medical students answered the questionnaire during the return visit in November 2021.We define freshmen, sophomores and juniors as lower division students,and Seniors and Fifth year students as the senior group. In the comparison between 2021 and 2019, there are statistically significant differences in gross monthly income(GMI), age and grade level, and the specific information can be seen in Table 1.

Knowledge

The knowledge rate of medical students about influenza and influenza vaccine was 82.8% in 2019 and 86% in 2021, and there was no statistically significant difference between the two comparisons (p=0.134). The following six questions 1) “Wearing a mask can prevent the spread of the flu to some extent”; 2) “Incubation period of influenza”; 3) “Influenza can be spread through close contact with patient”; 4) “Influenza vaccination for immunity is less costly and more cost-effective than developing immunity from influenza infection”; 5) “The best time to get a flu vaccination”; and 6) “How often should you get a flu vaccination?” are significantly more known to the students in 2021 than in 2019. Meanwhile, these three questions 1) “Influenza patients can spread the infection before symptoms appear”; 2) “Influenza vaccination does not give you the flu although it carries live virus”; and 3) “What do

you think the purpose of influenza vaccination is?" are less known to the students in 2021 than in 2019 (Table 2.).

Attitudes

The percentage of medical students who were supportive of influenza vaccine was 95.1% in 2019 and 97.1% in 2021, with no statistically significant difference between the two comparisons (p=0.078). As compared to the students' responses from 2019, a higher percentage of medical students in 2021 believe that the influenza vaccine is safe (91.5% > 65.1%); the influenza vaccination is necessary (83.9% > 67.0%); the seasonal influenza vaccine is effective in preventing seasonal influenza (86.8% > 73.2%); vaccination is important. However, we also observed a higher percentage of students in 2021 worried about the side effects of influenza vaccine relative to those in 2019 (56.0%>25.5%）(Table 3.).

Practices

The main source of influenza vaccine information in 2019 was television, newspapers, and the media (48.6%), while the main source in 2021 was health care professionals (35.6%) (Figure 1).

The number of people actively seeking information about influenza vaccine rose from 183 (22.8%) in 2019 to 195 (40.3%) in 2021. The number of people who received influenza vaccination in 2021 was much higher than in 2019 (25.8% > 6.7%), and the most significant increase in adverse reactions to vaccination was seen

in the phenomenon of temporary mild pain, redness and swelling at the injection site (39.2% > 18.5%). Among the reasons for receiving influenza vaccination, both “To enhance resistance and prevent influenza” (88.8%>75.9%) and “Recommended by government and health authorities” (72.0>44.4%) were selected by a higher percentage of students in 2021 relative to 2019. (Table 4.).

The three main reasons for not getting vaccinated in 2019 were "did not think it was necessary to get vaccinated" (53.8%), "did not know about the flu vaccine" (46.1%), and "did not have time " (41.1%). The three main reasons for not getting vaccinated in 2021 were: "didn't have time to get vaccinated" (43.5%), "didn't think it was necessary to get vaccinated" (43.2%), and "didn't know about the flu vaccine" (35.9%) (Fig.2).

During the COVID-19 epidemic in 2021, most students believed that the epidemic promoted awareness of influenza and influenza vaccine (96%) and willingness to receive influenza vaccination (74.8%) (Table 5.).

Analysis of Single Factors Affecting Medical Students' Vaccination Intentions in 2021

The vaccination rate of medical students who actively learned about influenza vaccine was significantly higher than that of medical students who did not actively learn about it (47.2% > 11.4%), and the vaccination rate of medical students who actively learned about respiratory viral infectious diseases during COVID-19 was also higher than that of medical students who did not actively learn about it (29.5% > 8.3%)(Table 6.).

Discussion

This study showed that the influenza vaccination rate of medical students in the studied medical school was only 6.7% in the 2019 influenza season, which is lower than the vaccination levels of medical students in other cities such as Urumqi, China (9.2% in 2010) [9]. However, in 2021 the vaccination rate of medical students against influenza rose to 25.8%, which is not as high as the vaccination level of medical students in developed countries such as the United States and the United Kingdom, but it is also a significant improvement as compared to 2019. This finding indicates that the COVID-19 outbreak has significantly boosted the influenza vaccination rate of the medical students that we studied. Similar results were obtained in a teaching and research hospital in Milan, during the COVID-19 pandemic,flu vaccination rates for physicians and administrative staff rise significantly[14].This may be due to the fact that there are numerous studies showing a significant reduction in the possibility of contracting COVID-19 after receiving the flu vaccine, and therefore the willingness to receive the flu vaccine has increased[15-16]

However, the level of influenza vaccination among medical students in Chongqing is still low and needs to be further improved, and it is recommended that medical students be included in the key recommended vaccination targets for influenza vaccination.

Looking at the demographic characteristics of the students, the gross monthly income(GMI) in 2021 is higher than that in 2019, which we speculate may be due to inflation. Over time, the age and grade level in 2021 are higher than in 2019, which is

also in line with the objective rule and our speculation.

In terms of knowledge, there was no significant difference between the comparison of 2021 and 2019 (p=0.134). However, on average, only a quarter of the students knew the incubation period time of influenza, and one similar study found that university education has a positive impact on influenza knowledge [17], indicating that students at this university do not pay much attention to influenza-related courses.The questions "Wearing a mask can prevent the spread of influenza to some extent," "Influenza can be spread through close contact with patients," and "Compared to developing immunity from influenza infection, getting immunity from influenza vaccination has better cost-effectiveness" are answered significantly more correctly in 2021 than in 2019. This is because of the emergence of COVID-19, which is more widely known due to state and government campaigns and changes in daily lifestyle (e.g., the need to wear a mask when using public transportation).The question "side effects of influenza vaccination: fever, headache" was also better answered in 2021, probably due to the reactions that occurred during the vaccination with COVID-19 or the possible side effects told by doctors or teachers before the vaccination [18-19]. As for the question "chronically ill and frail people are the priority recommended population for influenza vaccination", the answer was reversely better in 2019 than in 2021 (87.8% > 82.6%), which we speculate that this may be due to the fact that the COVID-19 vaccine is prohibited for patients with acute exacerbations of chronic disease or severe uncontrolled chronic disease in the Chinese New Crown Vaccination Technical Guidelines (Version 1), so some participants misunderstood that influenza vaccine is also contraindicated for

patients with chronic disease, thus leading to a poor response to this question[20-23].

Regarding the comparison of attitudes towards influenza vaccine, although there was no significant difference between 2021 and 2019 (p=0.078), Students in 2021 were more likely to believe that influenza vaccine is safe and important, that vaccination against influenza is necessary, and that they are not concerned about the side effects of influenza vaccine.There are good reasons to attribute this to the COVID-19 epidemic

The most important reason for influenza vaccination among medical students in both 2021 and 2019 was "to increase resistance and prevent influenza", which is consistent with other studies [24-26], indicating that concerns for one's health are the driving factor for influenza vaccination in this group. The reason "recommended by the government and health authorities" increased from 44.4% in 2019 to 72% in 2021, this is likely because of the government's strong call for people to get COVID-19 vaccine in the past year, which led to the group's increased interest in influenza vaccination.

Among students who reported not receiving the influenza vaccine, the reasons for not receiving the vaccine in 2021 and 2019 are not very different, with a significant percentage of students not considering it necessary, suggesting that the influenza vaccine is not being taken seriously by this group. Among those who have not received the flu vaccine, the percentage of students who have "never heard of the flu vaccine" reached 46.1% in 2019 and 35.9% in 2021. It is recommended that health education on influenza and influenza vaccine be strengthened, such as holding a competition on influenza and influenza vaccine knowledge and providing specific training on influenza vaccination in degree programs. Vaccine safety was the least influential factor

impeding vaccination, indicating solid expertise among study participants.The results of the present study suggest that providing more information increasing influenza vaccine awareness and basic knowledge of influenza vaccines among study participants may help improve vaccine coverage

This study found that students with more knowledge in influenza vaccine were more inclined to receive influenza vaccine, which is consistent with previous studies [27]. Students who took the initiative to learn about respiratory viral infectious diseases during COVID-19 transmission were also more likely to get the influenza vaccine, suggesting that the promotion and dissemination of knowledge about COVID-19 also helped people to understand more about influenza and influenza vaccine. This shows that in the current environment, we should attach knowledge about influenza to the promotion of COVID-19-related knowledge and prevention methods, so that people can receive COVID-19 vaccination and also pay attention to influenza vaccination, thereby increasing the influenza vaccination rate.

Limitations

This study has certain limitations. First, the data were collected via self-reported questionnaires, which can be a potential cause of reporting bias. Second, since our data were collected from medical students only, there is a possibility that they might have answered the questions positively on the basis of their medical knowledge as they had already percieved what would be expected from them. Third, the data were collected online through social networking platforms. Thus, we might have failed to approach

the students who were not able to access internet, resulting in a sampling bias. Last, because our study was conducted at a medical school in Chongqing, China, it may limit the generalizability of the findings from this study. We will subsequently expand the sample source in hope of obtaining better results.

Conclusion

The COVID-19 outbreak prompted an increase in influenza vaccination rates among medical students in Chongqing (6.7% in 2019 to 25.8% in 2021), with almost all students (96.0%) believing that the spread of COVID-19 promoted their knowledge of influenza and influenza vaccine, and the vast majority (74.8%) believing that the spread of COVID-19 promoted their willingness to receive influenza vaccine. We could disseminate information about influenza vaccine along with information about covid-19 vaccine to help increase influenza vaccination rates.

Author Contributions

YLW and XJT drafted the manuscript. GJW and XJT designed the Questionnaire ;YLW and FZ collected the data; GJW, LG, QWL， YMJ and FZ participated in data analysis and data extraction. YLW and XRW finalized the manuscript. All authors read and approved the final manuscript.

Acknowledgments

The authors thank all participants of this study for sharing their time and experiences.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Data availability statement

Data are available upon reasonable request

References:

[1].Chinese Center for Disease Control and Prevention.Technical guidelines for seasonal influenza vaccination in China (2020-2021)[J].Chin J Viral Dis,2020,10(06):403-416. DOI:10.16505/j.2095-0136.2020.0076.

[2].Guidelines for diagnosis and treatment of influenza (2020 version). Chin J Viral Dis; 2021-01-08:1-5.

[3].Krishnaratne S, Pfadenhauer LM, Coenen M, et al. Measures implemented in the school setting to contain the COVID-19 pandemic: a scoping review. Cochrane Database Syst Rev. 2020;12:CD013812. Published 2020 Dec 17. doi:10.1002/14651858.CD013812

[4].Tuohetamu S, Pang M, Nuer X, et al. The knowledge, attitudes and practices on influenza among medical college students in Northwest China. Hum Vaccin Immunother. 2017;13(7):1688-1692. doi:10.1080/21645515.2017.1293769

[5].Li L, Pan H, Bao CJ, et al. Epidemic features and influencing factors of recent influenza outbreaks in jiangsu province. Modern Preventive Med 2009; 36(17):3221-4

[6].Ma P, Wang JJ, Zhang Y,et al. Epidemiological characteristics and influence factors of influenza outbreak in Shaanxi province, 2006 - 2013. Chinese J Public Health 2015; 31(1):17-21

[7].G Gray, J Cooper. An evaluation of influenza vaccine uptake in UK medical students, Occupational Medicine, 2021-02-18;71:105-108

[8].Abalkhail MS, Alzahrany MS, Alghamdi KA, Alsoliman MA, Alzahrani MA, Almosned BS, et al. Uptake of influenza vaccination, awareness and its associated barriers among medical students of a University Hospital in Central Saudi Arabia. J Infect Public Health 2017 2017-09-01;10(5):644-

8.
[9].Tuohetamu S, Pang M, Nuer X, et al. The knowledge, attitudes and practices on influenza among medical college students in Northwest China. Hum Vaccin Immunother. 2017;13(7):1688-1692. doi:10.1080/21645515.2017.1293769
[10].Deckers Leme M, Elias Gilio A. Health worker recommended vaccination rates among medical students in Brazil. Vaccine X. 2021;9:100118. Published 2021 Oct 19. doi:10.1016/j.jvacx.2021.100118
[11].Walker L, Newall A, Heywood AE. Knowledge, attitudes and practices of Australian medical students towards influenza vaccination. Vaccine. 2016;34(50):6193-6199. doi:10.1016/j.vaccine.2016.10.074
[12].Gray G, Cooper J. An evaluation of influenza vaccine uptake in UK medical students. Occup Med (Lond). 2021;71(2):105-108. doi:10.1093/occmed/kqab014
[13].Rogers CJ, Bahr KO, Benjamin SM. Attitudes and barriers associated with seasonal influenza vaccination uptake among public health students; a cross-sectional study. BMC Public Health. 2018;18(1):1131. Published 2018 Sep 20. doi:10.1186/s12889-018-6041-1
[14].Perrone PM, Biganzoli G, Lecce M,et al. Influenza Vaccination Campaign during the COVID-19 Pandemic: The Experience of a Research and Teaching Hospital in Milan. Int J Environ Res Public Health. 2021 May 30;18(11):5874. doi: 10.3390/ijerph18115874.
[15].Jabr Alwazzeh M, Mohammed Telmesani L, Saud AlEnazi A, et al. Seasonal influenza vaccination coverage and its association with COVID-19 in Saudi Arabia. Inform Med Unlocked. 2021;27:100809. doi: 10.1016/j.imu.2021.100809.
[16].Yang MJ, Rooks BJ, Le TT, et al. Influenza Vaccination and Hospitalizations Among COVID-19 Infected Adults. J Am Board Fam Med. 2021 Feb;34(Suppl):S179-S182. doi: 10.3122/jabfm.2021.S1.200528.
[17].Szilagyi PG, Schaffer S, Rand CM, et al. School-Located Influenza Vaccination: Do Vaccine Clinics at School Raise Vaccination Rates?. J Sch Health. 2019;89(12):1004-1012. doi:10.1111/josh.12840
[18].Leng A, Maitland E, Wang S, Nicholas S, Liu R, Wang J. Individual preferences for COVID-19 vaccination in China. Vaccine. 2021;39(2):247-254. doi:10.1016/j.vaccine.2020.12.009
[19].Zhang Y, Zeng G, Pan H, et al. Safety, tolerability, and immunogenicity of an inactivated SARS-CoV-2 vaccine in healthy adults aged 18-59 years: a randomised, double-blind, placebo-controlled, phase 1/2 clinical trial. Lancet Infect Dis. 2021;21(2):181-192. doi:10.1016/S1473-3099(20)30843-4
[20].Sharma A, Patnaik I, Kumar A, Gupta R. COVID-19 Vaccines in Patients With Chronic Liver Disease. J Clin Exp Hepatol. 2021;11(6):720-726. doi:10.1016/j.jceh.2021.06.013
[21].Morawska M. Reasons and consequences of COVID-19 vaccine failure in patients with chronic lymphocytic leukemia. Eur J Haematol. 2022;108(2):91-98. doi:10.1111/ejh.13722
[22].Alghamdi AA, Aldosari MS, Alsaeed RA. Acceptance and barriers of COVID-19 vaccination among people with chronic diseases in Saudi Arabia. J Infect Dev Ctries. 2021;15(11):1646-1652. Published 2021 Nov 30. doi:10.3855/jidc.15063
[23].Bureau of Disease Control Prevention,National Health Commission of the People′s Republic of China(Version 1).Technical guidelines for novel coronavirus vaccination(First Edition)[J].Chinese Journal of Viral Diseases,2021,11(03):161-162. DOI:10.16505/j.2095-0136.2021.0018.

[24] Bednarczyk RA, Chu SL, Sickler H, Shaw J, Nadeau JA, McNutt LA. Low uptake of influenza vaccine among university students: evaluating predictors beyond cost and safety concerns. VACCINE 2015 2015-03-30;33(14):1659-63.
[25] Seale H, Leask J, MacIntyre CR. Attitudes amongst Australian hospital healthcare workers towards seasonal influenza and vaccination. Influenza Other Respir Viruses 2010;4(1):41–6.
[26] Gallone M S , Gallone M F , Cappelli M G , et al. Medical students' attitude toward influenza vaccination: Results of a survey in the University of Bari (Italy)[J]. Human Vaccines and Immunotherapeutics, 2017, 13(1):00-00.
[27] Feher A, Fekete M, Varga JT, Horvath I.Medical students' knowledge on vaccinology. Orv Hetil. 2019-07-01;160(30):1193-9.

Table 1. Demographic characteristics of the study participants in Chongqing

Demographic information	2019 n(%)	2021 n(%)	Total	P
Gender				
Male	294（36.6）	179（37.0）	473	0.894
Female	509（63.4）	305（63.0）	814	
GMI				
<¥4000	507（63.1）	275（56.8）	782	0.025
≥¥4000	296（36.9）	209（43.2）	505	
Age				
18-20 years old	350（43.6）	177（36.6）	527	0.013
21-23 years old	453（56.4）	307（63.4）	760	
Grade Level				
Lower Division	167（20.8）	39（8.1）	206	<0.001
Senior group	636（79.2）	445（91.9）	1081	

Table 2. Comparison of influenza vaccine knowledge in 2019 and 2021

Knowledge	Knowledge Awareness Level		
	2019	2021	
	Awareness rate	Awareness rate	
	n	n	P
	（n/N*100%）	（n/N*100%）	
Wearing a mask helps to prevent the spread of the flu	699（87.0）	472（97.5）	<0.001
Influenza is mainly spread by respiratory (coughing, sneezing) droplets	785（97.8）	475（98.1）	0.640
Incubation period of influenza	193（24.0）	156（32.2）	0.001
Influenza carriers (without symtoms) can spread the infection	706（87.9）	391（80.8）	0.001
Patients are contagious	525（65.4）	439（90.7）	<0.00

			1
The influenza shot contains live viruses cannot cause people to get influenza.	690（85.9）	272（56.2）	<0.001
Influenza vaccination for immunity is less costly and more cost-effective than developing immunity from influenza infection	373（46.5）	420（86.8）	<0.001
The best time to get vaccinated	412（51.3）	310（64.0）	<0.001
Frequency of vaccination	297（37.0）	213（44.0）	0.013
Perception of the aim of flu vaccination	733（91.3）	422（87.2）	0.020
Side effects of influenza vaccination			
Fever	540（67.2）	364（75.2）	0.002
Pain and swelling at the injection site	672（83.7）	419（86.6）	0.160
Headaches	448（55.8）	318（65.7）	<0.001

Influenza vaccination priority groups			
People over 60 years old	577（71.9）	351（72.5）	0.797
Patients with chronic illnesses and infirmity	705（87.8）	400（82.6）	0.011
Health facility staff, especially front-line staff	715（89.0）	415（85.7）	0.082
Pupils and kindergarten children	714（88.9）	420（86.8）	0.253
Pregnant women over the first trimester of pregnancy	360（44.8）	192 (39.7)	0.069

Table 3. Comparison of Influenza Vaccine Attitudes in 2019 vs. 2021

Attitude	2019		2021		P
	n	% (n/N)	n	% (n/N)	
Flu vaccine is safe					
Agree	523	65.1	443	91.5	<0.001
Disagree	280	34.9	41	8.5	
Flu vaccination is necessary					

Agree	538	67.0	406	83.9	<0.001
Disagree	265	33.0	78	16.1	
You are not worried about the side effects of the flu vaccine					
Agree	205	25.5	271	56.0	<0.001
Disagree	598	74.5	213	44.0	
The seasonal flu vaccine is more effective in preventing seasonal flu					
Agree	588	73.2	420	86.8	<0.001
Disagree	215	26.8	64	13.2	
Annual flu vaccination is important for you					
Agree	346	43.1	287	59.3	<0.001
Disagree	457	56.9	197	40.7	
You are planning to get a flu vaccination this autumn/winter					
Agree	268	33.4	187	38.6	0.056
Disagree	535	66.6	297	61.4	

Table 4. Comparison of influenza vaccination behaviour in 2019 vs.2021

Behaviour	2019		2021		P
	n	%(n/N)	n	%(n/N)	

Do you take the initiative to learn about the flu vaccine?					
Yes	183	22.8	195	40.3	<0.001
No	620	77.2	289	59.7	
Did you get a flu vaccination last year?					
Yes	54	6.7	125	25.8	<0.001
No	749	93.3	359	74.2	
Did you have any of the following adverse reactions in your last flu vaccination?					
Severe allergic reactions	7	13.0	23	18.4	0.362
Dizziness	9	16.7	26	20.8	0.483
Low fever	7	13.0	23	18.4	0.337
Transient mild pain, redness and swelling at the injection site	10	18.5	49	39.2	0.004
No adverse reactions	36	66.7	67	53.6	0.136
What are your reasons for getting the flu vaccine?					
Build up your resistance and prevent flu	41	75.9	111	88.8	0.033
Recommendation from government	24	44.4	90	72.0	<0.001

and health authorities					
Recommended by family and friends	17	31.5	58	46.4	0.061
Other	3	5.6	1	0.8	0.061
Have you had a flu-like illness within 1 year of vaccination?					
Yes	8	14.8	17	13.6	
No	25	46.3	96	76.8	<0.001
Don't remember	21	38.9	12	9.6	

436

437 Table 5. Analysis of COVID-19 related behaviors in 2021 (frequency statistics)

COVID-19 Related Acts	Number of people	Percentage (%)
The COVID-19 outbreak promotes your learning about respiratory infectious diseases		
Yes	400	82.6
No	84	17.4
The COVID-19 outbreak raised your awareness of flu and flu vaccine.		
Yes	384	96.0
No	16	4.0
The COVID-19 Outbreak boosts your intention to get flu		

vaccinated.

Yes	362	74.8
No	122	25.2

Table 6. Analysis of factors influencing medical students' willingness to receive vaccinations in 2021.

Variables	Number of people vaccinated (percentage%)	Number of unvaccinated persons (%)	OR value (95% CI)	P
Gender				
Male	49(27.4)	130(72.6)	1.136(0.747-1.726)	0.551
Female	76(24.9)	229(75.1)	Ref	
Age				
18-20	48(27.1)	129(72.9)	1.111(.7300-1.692)	0.622
21-23	77(25.1)	230(74.9)	Ref	
Grade Level				
Lower School	14(35.9)	25(64.1)	1.685(0.846-3.355)	0.137
Upper School	111(24.9)	334(75.1)	Ref	
GMI				

<¥4000	65(23.6)	210(76.4)	0.769(0.511-1.157)	0.207
≥¥4000	60(28.7)	149(71.3)	Ref	
Attitudes towards the flu vaccine				
Negative	1(7.1)	13(92.9)	Ref	0.140
Active	124(26.4)	346(73.6)	4.659(0.603-35.984)	
Level of knowledge				
Understanding	13(19.1)	55(80.9)	Ref	0.443
Don't understand	112(26.9)	304(84.7)	1.559(0.820-2.962)	
proactive about information about flu vaccines				
Yes	92(47.2)	103(52.8)	6.929(4.380-10.963)	<0.001
No	33(11.4)	256(88.6)	Ref	
learning about respiratory infectious diseases during the COVID-19 outbreak				
Yes	118(29.5)	282(70.5)	4.603(2.062-10.275)	<0.001
No	7(8.3)	77(91.7)	Ref	

Fig.1 Sources of Influenza Vaccine Information for 2019 vs. 2021

445 Fig. 2 Main reasons for not getting an influenza vaccination in 2019 vs. 2021

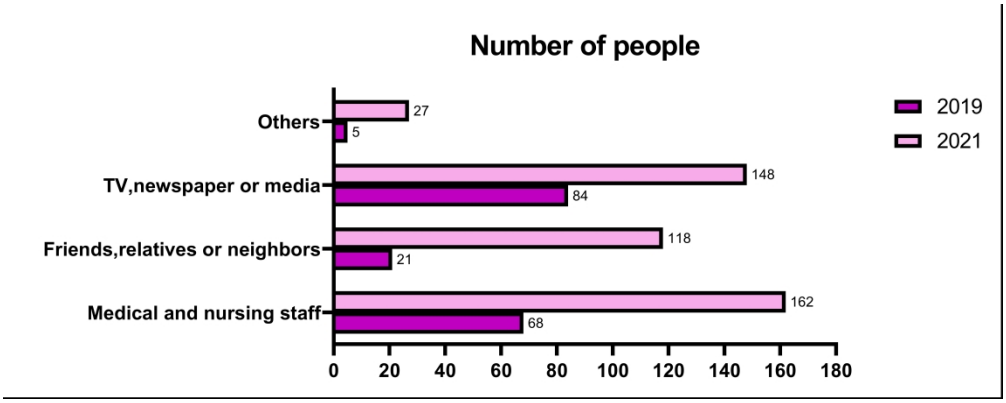
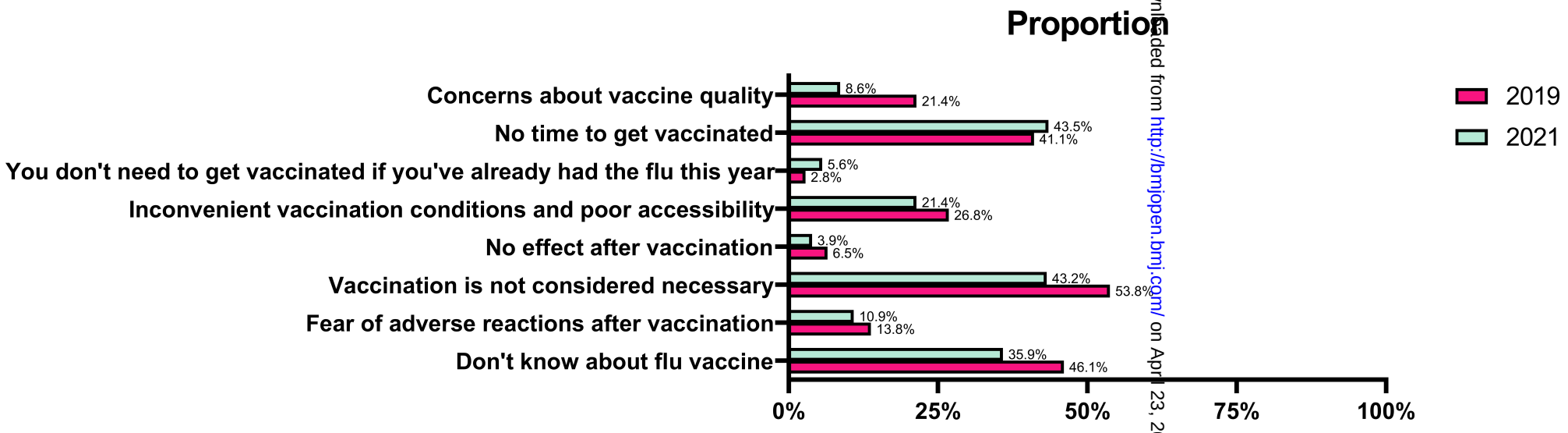


Fig. 1 Sources of Influenza Vaccine Information for 2019 vs. 2021

6284x2487mm (38 x 38 DPI)



STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8-9
		(b) Give reasons for non-participation at each stage	8-9
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	8-17
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-17

		(*b*) Report category boundaries when continuous variables were categorized	8-17
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-17
Discussion			
Key results	18	Summarise key results with reference to study objectives	19-21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22-23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	23
Generalisability	21	Discuss the generalisability (external validity) of the study results	21-23
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Does COVID-19 have an impact on influenza vaccine knowledge, attitude and practice among medical students: a two-year Prospective cohort study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-055945.R3
Article Type:	Original research
Date Submitted by the Author:	04-Jul-2022
Complete List of Authors:	Wang, Yunlong; Chongqing Medical University Wu, Guangjie; Chongqing Medical University, School of Public Health and Management Jiang, Yueming; Chongqing Medical University, Clinical 5+3 integration, the second clinical school Zou, Fa; Chongqing Medical University Gan, Lin; Chongqing Medical University Luo, Qinwen; Chongqing Medical University Tang, Xiaojun; Chongqing Medical University Wu, Xiaorong; Chongqing Medical University
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Public health
Keywords:	Epidemiology < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, IMMUNOLOGY, COVID-19

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Does COVID-19 have an impact on influenza vaccine knowledge, attitude and practice among medical students: a two-year Prospective cohort study

Yunlong Wang[a,#], Guangjie Wu[b#], Yueming Jiang[c], Fa Zou[a], Lin Gan[b], Qinwen Luo[b], Xiaorong Wu[b,*], Xiaojun Tang [b,*]

[a] School of basic medicine, Chongqing Medical University, Chongqing, China

[b] School of Public Health and Management, Chongqing Medical University, Chongqing, China

[C] Clinical 5+3 integration, the second clinical school, Chongqing medical university.

# These authors contributed equally to the work

* Corresponding author: Xiaojun Tang, Email: tangxiaoj0726@qq.com, Xiaorong Wu, Email:101609@cqmu.edu.cn

ABSTRACT

Objectives To explore the main factors affecting the knowledge, attitude and practice about influenza and influenza vaccine as well as the intention to receive influenza vaccination among the same group of medical students before (2019) and after (2021) the COVID-19 outbreak.

Design A population-based prospective cohort study.

Setting A longitudinal cohort study of a selected medical school in Chongqing, China, which ran from 2019 to 2021.

Participants A total of 803 medical students participated in the study in 2019 and only 484 students responded in 2021. The response rate for our survey was only 60.27% due to graduation, emails being abandoned, etc.

Results The influenza vaccination rate of students at this medical school was 6.7% in 2019, compared with 25.8% in 2021.The awareness rate of medical students about influenza and influenza vaccine was 82.8% in 2019 and 86% in 2021, and there was no significantly statistical difference between the two years ($p = 0.134$); the number of medical students with supportive attitude towards influenza vaccine was 95.1% in 2019 and 97.1% in 2021, and there was no statistically significant difference between the two years ($p = 0.078$); the number of students who actively learned about knowledge related to influenza vaccine rose from 183 (22.8%) in 2019 to 195 (40.3%) in 2021.

Conclusions The COVID-19 outbreak prompted an increase in influenza vaccination rates among medical students in Chongqing, with almost all students (96.0%) believing

that the spread of COVID-19 promoted their knowledge in influenza and influenza vaccine, and the vast majority (74.8%) believing that the spread of COVID-19 promoted their willingness to receive influenza vaccine.

Key words Education, Flu, Immunization, Vaccine, Infection, COVID-19

Strengths and limitations of this study

·Comparing knowledge attitude and practice toward influenza vaccine in the same group before and after the COVID-19 outbreak, and this condition cannot be replicated now.

·This study will contribute to the promotion of influenza vaccination in the medical student population.

·The data were collected online through social networking platforms. Thus, we might have failed to approach the students who were not able to access internet, resulting in a sampling bias.

·Because our study was conducted at a medical school in Chongqing, it may limit the generalizability of the study.

Background

Influenza (or flu), a respiratory tract infectious disease, is extremely contagious. Influenza virus antigenicity is variable and spreads rapidly.This virus can cause seasonal epidemics each year.[1]. China's Influenza Treatment Program (2020 version) clearly states that "annual influenza vaccination is the most effective means for

influenza prevention, reducing the risk of influenza and serious complications in vaccinated individuals"[2].During the outbreak of pandemic Coronavirus disease 2019 (COVID-19), the Chinese Ministry of Health considers influenza vaccination for 2020-2021 to be particularly important[3]. Influenza vaccination has become especially important as the severe global epidemic of COVID-19 will continue this year and there may be a superimposed epidemic of COVID-19 along with influenza and other respiratory infectious diseases this winter and next spring.

As a place where students frequently gather, the relatively crowded learning and living environment of schools makes it easy for students to catch the flu, and college students are highly mobile between campuses. Surveillance data from several provinces in recent years has shown that more than 90% of influenza each year occurs on campus.From 2004-2008, 90.48% of influenza outbreaks in Jiangsu Province occurred on campus.From 2006-2013, 97.26% of influenza outbreaks in Shanxi Province also occurred on campus[4-6]. Among all the students on campus, medical students are believed to possess a higher risk of influenza illness than other students due to the specificity of their discipline. They are the future medical workers and important disseminators of health knowledge, so there is a need for vaccination for them[7].

However, few has been reported regarding the current status of influenza vaccination in this group in China. From the few studies, it was found that the current vaccination rate of medical students in China was much lower than that of foreign countries. Influenza vaccination rates for medical students were 17.1% in northwest China, 25.3% in Brazil, 20.7% in Saudi Arabia, 53.8% in Australia, 76% in the United Kingdom, and

43% in the United States[4,8-13]. To explore whether medical students' knowledge,attitude and practice about influenza and influenza vaccine have changed under the influence of today's COVID-19 epidemic, we compared the results of a survey on their knowledge and attitude about influenza and influenza vaccine among the same group of medical students before the outbreak (2019) and after the outbreak (2021) to 1) investigate the main factors affecting medical students' willingness to receive influenza vaccination; 2) provide a scientific basis for improving influenza vaccination rates among medical students and strengthening influenza prevention and control efforts in the current context.

MATERIAL AND METHODS

Study design and settings

In this prospective cohort study, a survey study focusing on influenza and influenza vaccine awareness and willingness to vaccinate was first conducted among freshman-year to senior-year medical students in a medical school in Chongqing, China from September 2019 to October 2019, and the questionnaire applied was named Q1. A new survey on influenza and influenza vaccine knowledge, attitude and practice to vaccinate with some slight modifications due to the COVID-19 was sent by email to volunteers who had previously received the questionnaire (Q1) in November 2021, and the new questionnaire was named Q2. The questionnaire data was compiled and collected in January 2022.The final return rate of the questionnaire was only 60.27% due to

graduation, email discontinuation, etc. All participants in 2019 were randomly selected and volunteered to participate in this experiment and were not involved in the conduct of the study.

Patient and public involvement

This research was done without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

Questionnaire

Both questionnaires (Q1 and Q2) were pilot tested on a sample of 30 participants, and their feedback was used to further modify the items. The finalized instrument was administered electronically. The questionnaires used the precautionary measures promoted by the National Health Commission of the People's Republic of China on its official website as questions to determine the level of knowledge in influenza prevention. The survey consisted of two parts. The first part collected demographic information on profession and gender while the second part asked about respondents' knowledge in influenza and the influenza vaccine, as well as attitude towards influenza vaccine—a set of questions with a Cronbach's alpha coefficient greater than 0.7.

Ethical approval

Our data collection procedures complied with the institutional and national ethical guidelines and followed the Declaration of Helsinki. The anonymity and confidentiality of data was maintained. Written informed consent was obtained from the investigators for this experiment. This study was approved by the Ethics Committee of Chongqing Medical University

Survey

We collated questions on influenza-related knowledge and influenza vaccine attitude from both Q1 and Q2 and analyzed them after excluding redundant and repetitive questions. Influenza-related knowledge was scored 1 point for a correct answer and 0 point for a wrong answer. The full score was 18 points and a score ≥11 would be judged as knowing. Influenza vaccine knowledge rate (%) = number of correct answers/total number of respondents × 100%. For influenza vaccine attitude, a score was assigned according to the attitude towards influenza vaccine (5=very positive, 4=positive, 3=fair, 2=negative, 1=very negative). The full score was 25, any scores ≥15 would be considered as having a positive attitude towards influenza vaccine.Vaccine vaccination rate (%) = number of influenzas vaccinated/total number of surveyed × 100%. Influenza vaccination willingness rate (%) = number of people willing to receive influenza vaccination/total number of people surveyed × 100%.

Data analysis

Epidata 3.0 software was used for double data entry, and spss24.0 software was used

for statistical analysis. The differences between rates were analyzed by chi-squared test, and unconditional logistic stepwise regression analysis was used for influencing factors of influenza vaccination intention. The level of statistical significance was chosen to be 0.05 ($\alpha = 0.05$).

Results

Demographics

A total of 803 medical students participated in the study between September and October 2019. Only 484 medical students answered the questionnaire during the return visit in November 2021.We define freshmen, sophomores and juniors as lower division students,and Seniors and Fifth year students as the senior group. In the comparison between 2021 and 2019, there are statistically significant differences in gross monthly income(GMI), age and grade level, and the specific information can be seen in Table 1.

Knowledge

The knowledge rate of medical students about influenza and influenza vaccine was 82.8% in 2019 and 86% in 2021, and there was no statistically significant difference between the two comparisons (p=0.134). The following six questions 1) “Wearing a mask can prevent the spread of the flu to some extent”; 2) “Incubation period of influenza”; 3) “Influenza can be spread through close contact with patient”; 4) “Influenza vaccination for immunity is less costly and more cost-effective than

developing immunity from influenza infection"; 5) "The best time to get a flu vaccination"; and 6) "How often should you get a flu vaccination?" are significantly more known to the students in 2021 than in 2019. Meanwhile, these three questions 1) "Influenza patients can spread the infection before symptoms appear"; 2) "Influenza vaccination does not give you the flu although it carries live virus"; and 3) "What do you think the purpose of influenza vaccination is?" are less known to the students in 2021 than in 2019 (Table 2.).

Attitudes

The percentage of medical students who were supportive of influenza vaccine was 95.1% in 2019 and 97.1% in 2021, with no statistically significant difference between the two comparisons (p=0.078). As compared to the students' responses from 2019, a higher percentage of medical students in 2021 believe that the influenza vaccine is safe (91.5% > 65.1%); the influenza vaccination is necessary (83.9% > 67.0%); the seasonal influenza vaccine is effective in preventing seasonal influenza (86.8% > 73.2%); vaccination is important. However, we also observed a higher percentage of students in 2021 worried about the side impacts of influenza vaccine relative to those in 2019 (56.0%>25.5%）(Table 3.).

Practices

The main source of influenza vaccine information in 2019 was television, newspapers, and the media (48.6%), while the main source in 2021 was health care

professionals (35.6%) (Figure 1).

The number of people actively seeking information about influenza vaccine rose from 183 (22.8%) in 2019 to 195 (40.3%) in 2021. The number of people who received influenza vaccination in 2021 was much higher than in 2019 (25.8% > 6.7%), and the most significant increase in adverse reactions to vaccination was seen in the phenomenon of temporary mild pain, redness and swelling at the injection site (39.2% > 18.5%). Among the reasons for receiving influenza vaccination, both “To enhance resistance and prevent influenza” (88.8%>75.9%) and “Recommended by government and health authorities” (72.0>44.4%) were selected by a higher percentage of students in 2021 relative to 2019. (Table 4.).

The three main reasons for not getting vaccinated in 2019 were "did not think it was necessary to get vaccinated" (53.8%), "did not know about the flu vaccine" (46.1%), and "did not have time " (41.1%). The three main reasons for not getting vaccinated in 2021 were: "didn't have time to get vaccinated" (43.5%), "didn't think it was necessary to get vaccinated" (43.2%), and "didn't know about the flu vaccine" (35.9%) (Fig.2).

During the COVID-19 epidemic in 2021, most students believed that the epidemic promoted awareness of influenza and influenza vaccine (96%) and willingness to receive influenza vaccination (74.8%) (Table 5.).

Analysis of Single Factors Affecting Medical Students' Vaccination Intentions in 2021

The vaccination rate of medical students who actively learned about influenza vaccine

was significantly higher than that of medical students who did not actively learn about it (47.2% > 11.4%), and the vaccination rate of medical students who actively learned about respiratory viral infectious diseases during COVID-19 was also higher than that of medical students who did not actively learn about it (29.5% > 8.3%)(Table 6.).

Discussion

This study showed that the influenza vaccination rate of medical students in the studied medical school was only 6.7% in the 2019 influenza season, which is lower than the vaccination levels of medical students in other cities such as Urumqi, China (9.2% in 2010) [9]. In 2021 the vaccination rate of medical students against influenza rose to 25.8%, which was not as high as the vaccination level of medical students in developed countries such as the United States and the United Kingdom, but it is also a significant improvement as compared to 2019. This finding indicates that the COVID-19 outbreak has significantly boosted the influenza vaccination rate of the medical students that we studied. Similar results were obtained in a teaching and research hospital in Milan, during the COVID-19 pandemic, and flu vaccination rates for physicians and administrative staff rise significantly[14].This may be due to the fact that there are numerous studies showing a significant reduction in the possibility of contracting COVID-19 after receiving the flu vaccine, therefore, the willingness to receive the flu vaccine has increased[15-16]

However, the level of influenza vaccination among medical students in Chongqing is still low and needs to be further improved, and it is recommended that medical

students be included in the key recommended vaccination targets for influenza vaccination.

Looking at the demographic characteristics of the students, the gross monthly income(GMI) in 2021 is higher than that in 2019, which our speculation may be due to inflation. Over time, the age and grade level in 2021 are higher than in 2019, which is also in line with the objective rule and our speculation.

In terms of knowledge, there was no significant difference between the comparison of 2021 and 2019 (p=0.134). However, on average, only a quarter of the students knew the incubation period time of influenza, and one similar study found that university education has a positive impact on influenza knowledge [17], indicating that students at this university do not pay much attention to influenza-related courses.The questions "Wearing a mask can prevent the spread of influenza to some extent," "Influenza can be spread through close contact with patients," and "Compared to developing immunity from influenza infection, getting immunity from influenza vaccination has better cost-effectiveness" are answered significantly more correctly in 2021 than in 2019. This is because of the emergence of COVID-19, which is more widely known due to state and government campaigns and changes in daily lifestyle (e.g., the need to wear a mask when using public transportation).The question "side impacts of influenza vaccination: fever, headache" was also better answered in 2021, probably due to the reactions that occurred during the vaccination with COVID-19 or the possible side impacts told by doctors or teachers before the vaccination [18-19]. As for the question "chronically ill and frail people are the priority recommended population for influenza vaccination",

the answer was reversely better in 2019 than in 2021 (87.8% > 82.6%), which we speculate that this may be due to the fact that the COVID-19 vaccine is prohibited for patients with acute exacerbations of chronic disease or severe uncontrolled chronic disease in the Chinese New Crown Vaccination Technical Guidelines (Version 1), so some participants misunderstood that influenza vaccine is also contraindicated for patients with chronic disease, thus leading to a poor response to this question[20-23].

Regarding the comparison of attitudes towards influenza vaccine, although there was no significant difference between 2021 and 2019 (p=0.078), Students in 2021 were more likely to believe that influenza vaccine is safe and important, that vaccination against influenza is necessary, and that they are not concerned about the side impacts of influenza vaccine.There are good reasons to attribute this to the COVID-19 epidemic

The most important reason for influenza vaccination among medical students in both 2021 and 2019 was "to increase resistance and prevent influenza", which is consistent with other studies [24-26], indicating that concerns for one's health are the driving factor for influenza vaccination in this group. The reason "recommended by the government and health authorities" increased from 44.4% in 2019 to 72% in 2021, this is likely because of the government's strong call for people to get COVID-19 vaccine in the past year, which led to the group's increased interest in influenza vaccination.

Among students who reported not receiving the influenza vaccine, the reasons for not receiving the vaccine in 2021 and 2019 are not very different, with a significant percentage of students not considering it necessary, suggesting that the influenza vaccine is not being taken seriously by this group. Among those who have not received

the flu vaccine, the percentage of students who have "never heard of the flu vaccine" reached 46.1% in 2019 and 35.9% in 2021. It is recommended that health education on influenza and influenza vaccine should be strengthened, such as holding a competition on influenza and influenza vaccine knowledge and providing specific training on influenza vaccination in degree programs. Vaccine safety was the least influential factor impeding vaccination, indicating solid expertise among study participants.The results of the present study suggest that providing more information increasing influenza vaccine awareness and basic knowledge of influenza vaccines among study participants may help improve vaccine coverage

This study found that students with more knowledge in influenza vaccine were more inclined to receive influenza vaccine, which is consistent with previous studies [27]. Students who took the initiative to learn about respiratory viral infectious diseases during COVID-19 transmission were also more likely to get the influenza vaccine, suggesting that the promotion and dissemination of knowledge about COVID-19 also helped people to understand more about influenza and influenza vaccine. This shows that in the current environment, we should attach knowledge about influenza to the promotion of COVID-19-related knowledge and prevention methods, so that people can receive COVID-19 vaccination and also pay attention to influenza vaccination, thereby increasing the influenza vaccination rate.

Limitations

This study has certain limitations. First, the data were collected via self-reported

questionnaires, which can be a potential cause of reporting bias. Second, since our data were collected from medical students only, there is a possibility that they might have answered the questions positively on the basis of their medical knowledge as they had already perceived what would be expected from them. Third, the data were collected online through social networking platforms. Thus, we might have failed to approach the students who were not able to access internet, resulting in a sampling bias. Last, because our study was conducted at a medical school in Chongqing, China, it may limit the generalizability of the findings from this study. We will subsequently expand the sample source in hope of obtaining better results.

Conclusion

The COVID-19 outbreak prompted an increase in influenza vaccination rates among medical students in Chongqing (6.7% in 2019 to 25.8% in 2021), with almost all students (96.0%) believing that the spread of COVID-19 promoted their knowledge of influenza and influenza vaccine, and the vast majority (74.8%) believing that the spread of COVID-19 promoted their willingness to receive influenza vaccine. We could disseminate information about influenza vaccine along with information about covid-19 vaccine to help increase influenza vaccination rates.

Author Contributions

YLW and XJT drafted the manuscript. GJW and XJT designed the Questionnaire ;YLW and FZ collected the data; GJW, LG, QWL， YMJ and FZ

participated in data analysis and data extraction. YLW and XRW finalized the manuscript. All authors read and approved the final manuscript.

Acknowledgments

The authors thank all participants of this study for sharing their time and experiences.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Data availability statement

Data are available upon reasonable request

Ethics approval and consent to participate

This two-year prospective cohort study was approved by the Ethics Committee of Chongqing Medical University. Participation in this study was voluntary, and informed consent was gained. Our data collection procedures complied with the institutional and national ethical guidelines and followed the Declaration of Helsinki. The anonymity and confidentiality of data was maintained. Written informed consent was obtained from the investigators for this experiment.

References:

[1].Chinese Center for Disease Control and Prevention.Technical guidelines for seasonal influenza vaccination in China (2020-2021)[J].Chin J Viral Dis,2020,10(06):403-416. DOI:10.16505/j.2095-0136.2020.0076.

[2]. Guidelines for diagnosis and treatment of influenza (2020 version). Chin J Viral Dis; 2021-01-08:1-5.

[3]. Krishnaratne S, Pfadenhauer LM, Coenen M, et al. Measures implemented in the school setting to contain the COVID-19 pandemic: a scoping review. Cochrane Database Syst Rev. 2020;12:CD013812. Published 2020 Dec 17. doi:10.1002/14651858.CD013812

[4]. Tuohetamu S, Pang M, Nuer X, et al. The knowledge, attitudes and practices on influenza among medical college students in Northwest China. Hum Vaccin Immunother. 2017;13(7):1688-1692. doi:10.1080/21645515.2017.1293769

[5]. Li L, Pan H, Bao CJ, et al. Epidemic features and influencing factors of recent influenza outbreaks in jiangsu province. Modern Preventive Med 2009; 36(17):3221-4

[6]. Ma P, Wang JJ, Zhang Y,et al. Epidemiological characteristics and influence factors of influenza outbreak in Shaanxi province, 2006 - 2013. Chinese J Public Health 2015; 31(1):17-21

[7].G Gray, J Cooper. An evaluation of influenza vaccine uptake in UK medical students, Occupational Medicine, 2021-02-18;71:105-108

[8].Abalkhail MS, Alzahrany MS, Alghamdi KA, Alsoliman MA, Alzahrani MA, Almosned BS, et al. Uptake of influenza vaccination, awareness and its associated barriers among medical students of a University Hospital in Central Saudi Arabia. J Infect Public Health 2017 2017-09-01;10(5):644-8.

[9].Tuohetamu S, Pang M, Nuer X, et al. The knowledge, attitudes and practices on influenza among medical college students in Northwest China. Hum Vaccin Immunother. 2017;13(7):1688-1692. doi:10.1080/21645515.2017.1293769

[10].Deckers Leme M, Elias Gilio A. Health worker recommended vaccination rates among medical students in Brazil. Vaccine X. 2021;9:100118. Published 2021 Oct 19. doi:10.1016/j.jvacx.2021.100118

[11].Walker L, Newall A, Heywood AE. Knowledge, attitudes and practices of Australian medical students towards influenza vaccination. Vaccine. 2016;34(50):6193-6199. doi:10.1016/j.vaccine.2016.10.074

[12].Gray G, Cooper J. An evaluation of influenza vaccine uptake in UK medical students. Occup Med (Lond). 2021;71(2):105-108. doi:10.1093/occmed/kqab014

[13].Rogers CJ, Bahr KO, Benjamin SM. Attitudes and barriers associated with seasonal influenza vaccination uptake among public health students; a cross-sectional study. BMC Public Health. 2018;18(1):1131. Published 2018 Sep 20. doi:10.1186/s12889-018-6041-1

[14].Perrone PM, Biganzoli G, Lecce M,et al. Influenza Vaccination Campaign during the COVID-19 Pandemic: The Experience of a Research and Teaching Hospital in Milan. Int J Environ Res Public Health. 2021 May 30;18(11):5874. doi: 10.3390/ijerph18115874.

[15].Jabr Alwazzeh M, Mohammed Telmesani L, Saud AlEnazi A, et al. Seasonal influenza vaccination coverage and its association with COVID-19 in Saudi Arabia. Inform Med Unlocked.

2021;27:100809. doi: 10.1016/j.imu.2021.100809.
[16].Yang MJ, Rooks BJ, Le TT, et al. Influenza Vaccination and Hospitalizations Among COVID-19 Infected Adults. J Am Board Fam Med. 2021 Feb;34(Suppl):S179-S182. doi: 10.3122/jabfm.2021.S1.200528.
[17].Szilagyi PG, Schaffer S, Rand CM, et al. School-Located Influenza Vaccination: Do Vaccine Clinics at School Raise Vaccination Rates?. J Sch Health. 2019;89(12):1004-1012. doi:10.1111/josh.12840
[18].Leng A, Maitland E, Wang S, Nicholas S, Liu R, Wang J. Individual preferences for COVID-19 vaccination in China. Vaccine. 2021;39(2):247-254. doi:10.1016/j.vaccine.2020.12.009
[19].Zhang Y, Zeng G, Pan H, et al. Safety, tolerability, and immunogenicity of an inactivated SARS-CoV-2 vaccine in healthy adults aged 18-59 years: a randomised, double-blind, placebo-controlled, phase 1/2 clinical trial. Lancet Infect Dis. 2021;21(2):181-192. doi:10.1016/S1473-3099(20)30843-4
[20].Sharma A, Patnaik I, Kumar A, Gupta R. COVID-19 Vaccines in Patients With Chronic Liver Disease. J Clin Exp Hepatol. 2021;11(6):720-726. doi:10.1016/j.jceh.2021.06.013
[21].Morawska M. Reasons and consequences of COVID-19 vaccine failure in patients with chronic lymphocytic leukemia. Eur J Haematol. 2022;108(2):91-98. doi:10.1111/ejh.13722
[22].Alghamdi AA, Aldosari MS, Alsaeed RA. Acceptance and barriers of COVID-19 vaccination among people with chronic diseases in Saudi Arabia. J Infect Dev Ctries. 2021;15(11):1646-1652. Published 2021 Nov 30. doi:10.3855/jidc.15063
[23].Bureau of Disease Control Prevention,National Health Commission of the People′s Republic of China(Version 1).Technical guidelines for novel coronavirus vaccination(First Edition)[J].Chinese Journal of Viral Diseases,2021,11(03):161-162. DOI:10.16505/j.2095-0136.2021.0018.
[24] Bednarczyk RA, Chu SL, Sickler H, Shaw J, Nadeau JA, McNutt LA. Low uptake of influenza vaccine among university students: evaluating predictors beyond cost and safety concerns. VACCINE 2015 2015-03-30;33(14):1659-63.
[25] Seale H, Leask J, MacIntyre CR. Attitudes amongst Australian hospital healthcare workers towards seasonal influenza and vaccination. Influenza Other Respir Viruses 2010;4(1):41–6.
[26] Gallone M S , Gallone M F , Cappelli M G , et al. Medical students' attitude toward influenza vaccination: Results of a survey in the University of Bari (Italy)[J]. Human Vaccines and Immunotherapeutics, 2017, 13(1):00-00.
[27] Feher A, Fekete M, Varga JT, Horvath I.Medical students' knowledge on vaccinology. Orv Hetil. 2019-07-01;160(30):1193-9.

Table 1. Demographic characteristics of the study participants in Chongqing

Demographic information	2019 n(%)	2021 n(%)	Total	P

Gender				
Male	294（36.6）	179（37.0）	473	0.894
Female	509（63.4）	305（63.0）	814	
GMI				
<¥4000	507（63.1）	275（56.8）	782	0.025
≥¥4000	296（36.9）	209（43.2）	505	
Age				
18-20 years old	350（43.6）	177（36.6）	527	0.013
21-23 years old	453（56.4）	307（63.4）	760	
Grade Level				
Lower Division	167（20.8）	39（8.1）	206	<0.001
Senior group	636（79.2）	445（91.9）	1081	

Table 2. Comparison of influenza vaccine knowledge in 2019 and 2021

Knowledge	Knowledge Awareness Level		
	2019	2021	
	Awareness rate	Awareness rate	P
	n	n	
	（n/N*100%）	（n/N*100%）	
Wearing a mask helps to	699（87.0）	472（97.5）	<0.001

prevent the spread of the flu			
Influenza is mainly spread by respiratory (coughing, sneezing) droplets	785（97.8）	475（98.1）	0.640
Incubation period of influenza	193（24.0）	156（32.2）	0.001
Influenza carriers (without symtoms) can spread the infection	706（87.9）	391（80.8）	0.001
Patients are contagious	525（65.4）	439（90.7）	<0.001
The influenza shot contains live viruses	690（85.9）	272（56.2）	<0.001
cannot cause people to get influenza.			
Influenza vaccination for immunity is less costly and more cost-effective	373（46.5）	420（86.8）	<0.001
than developing immunity from influenza infection			

The best time to get vaccinated	412（51.3）	310（64.0）	<0.001
Frequency of vaccination	297（37.0）	213（44.0）	0.013
Perception of the aim of flu vaccination	733（91.3）	422（87.2）	0.020
Side effects of influenza vaccination			
Fever	540（67.2）	364（75.2）	0.002
Pain and swelling at the injection site	672（83.7）	419（86.6）	0.160
Headaches	448（55.8）	318（65.7）	<0.001
Influenza vaccination priority groups			
People over 60 years old	577（71.9）	351（72.5）	0.797
Patients with chronic illnesses and infirmity	705（87.8）	400（82.6）	0.011
Health facility staff, especially front-line staff	715（89.0）	415（85.7）	0.082
Pupils and kindergarten children	714（88.9）	420（86.8）	0.253
Pregnant women over the	360（44.8）	192 (39.7)	0.069

first trimester of pregnancy					

Table 3. Comparison of Influenza Vaccine Attitudes in 2019 vs. 2021

Attitude	2019		2021		P
	n	% (n/N)	n	% (n/N)	
Flu vaccine is safe					
Agree	523	65.1	443	91.5	<0.001
Disagree	280	34.9	41	8.5	
Flu vaccination is necessary					
Agree	538	67.0	406	83.9	<0.001
Disagree	265	33.0	78	16.1	
You are not worried about the side effects of the flu vaccine					
Agree	205	25.5	271	56.0	<0.001
Disagree	598	74.5	213	44.0	
The seasonal flu vaccine is more effective in preventing seasonal flu					
Agree	588	73.2	420	86.8	<0.001

Disagree	215	26.8	64	13.2	
Annual flu vaccination is important for you					
Agree	346	43.1	287	59.3	<0.001
Disagree	457	56.9	197	40.7	
You are planning to get a flu vaccination this autumn/winter					
Agree	268	33.4	187	38.6	0.056
Disagree	535	66.6	297	61.4	

Table 4. Comparison of influenza vaccination behaviour in 2019 vs.2021

Behaviour	2019		2021		P
	n	%(n/N)	n	%(n/N)	
Do you take the initiative to learn about the flu vaccine?					
Yes	183	22.8	195	40.3	<0.001
No	620	77.2	289	59.7	
Did you get a flu vaccination last year?					
Yes	54	6.7	125	25.8	<0.001
No	749	93.3	359	74.2	
Did you have any of the following					

adverse reactions in your last flu vaccination?					
Severe allergic reactions	7	13.0	23	18.4	0.362
Dizziness	9	16.7	26	20.8	0.483
Low fever	7	13.0	23	18.4	0.337
Transient mild pain, redness and swelling at the injection site	10	18.5	49	39.2	0.004
No adverse reactions	36	66.7	67	53.6	0.136
What are your reasons for getting the flu vaccine?					
Build up your resistance and prevent flu	41	75.9	111	88.8	0.033
Recommendation from government and health authorities	24	44.4	90	72.0	<0.001
Recommended by family and friends	17	31.5	58	46.4	0.061
Other	3	5.6	1	0.8	0.061
Have you had a flu-like illness within 1 year of vaccination?					
Yes	8	14.8	17	13.6	
No	25	46.3	96	76.8	<0.001
Don't remember	21	38.9	12	9.6	

Table 5. Analysis of COVID-19 related behaviors in 2021 (frequency statistics)

COVID-19 Related Acts	Number of people	Percentage (%)
The COVID-19 outbreak promotes your learning about respiratory infectious diseases		
Yes	400	82.6
No	84	17.4
The COVID-19 outbreak raised your awareness of flu and flu vaccine.		
Yes	384	96.0
No	16	4.0
The COVID-19 Outbreak boosts your intention to get flu vaccinated.		
Yes	362	74.8
No	122	25.2

Table 6. Analysis of factors influencing medical students' willingness to receive vaccinations in 2021.

Variables	Number of people vaccinated (percentage%)	Number of unvaccinated persons (%)	OR value (95% CI)	P
Gender				
Male	49(27.4)	130(72.6)	1.136(0.747-1.726)	0.551
Female	76(24.9)	229(75.1)	Ref	
Age				
18-20	48(27.1)	129(72.9)	1.111(.7300-1.692)	0.622
21-23	77(25.1)	230(74.9)	Ref	
Grade Level				
Lower School	14(35.9)	25(64.1)	1.685(0.846-3.355)	0.137
Upper School	111(24.9)	334(75.1)	Ref	
GMI				
<¥4000	65(23.6)	210(76.4)	0.769(0.511-1.157)	0.207
≥¥4000	60(28.7)	149(71.3)	Ref	
Attitudes towards the flu vaccine				
Negative	1(7.1)	13(92.9)	Ref	0.140
Active	124(26.4)	346(73.6)	4.659(0.603-35.984)	

Level of knowledge				
Understanding	112(26.9)	304(84.7)	1.559(0.820-2.962)	0.443
Don't understand	13(19.1)	55(80.9)	Ref	
proactive about information about flu vaccines				
Yes	92(47.2)	103(52.8)	6.929(4.380-10.963)	<0.001
No	33(11.4)	256(88.6)	Ref	
learning about respiratory infectious diseases during the COVID-19 outbreak				
Yes	118(29.5)	282(70.5)	4.603(2.062-10.275)	<0.001
No	7(8.3)	77(91.7)	Ref	

Fig.1 Sources of Influenza Vaccine Information for 2019 vs. 2021

Fig. 2 Main reasons for not getting an influenza vaccination in 2019 vs. 2021

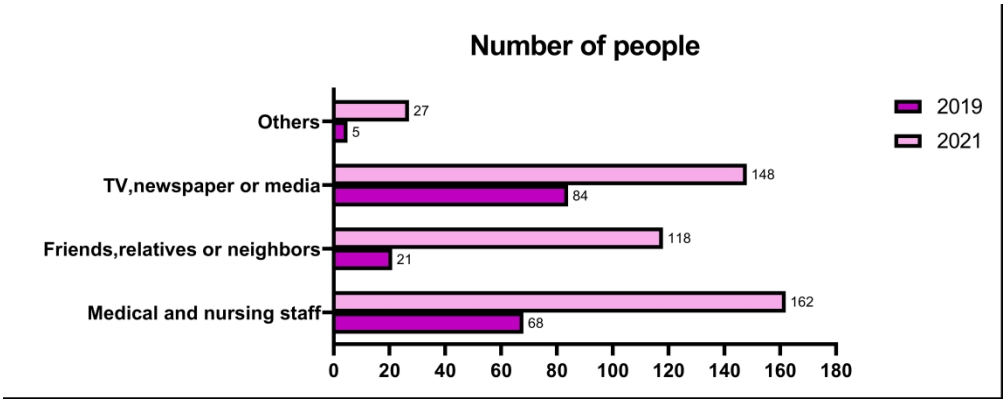
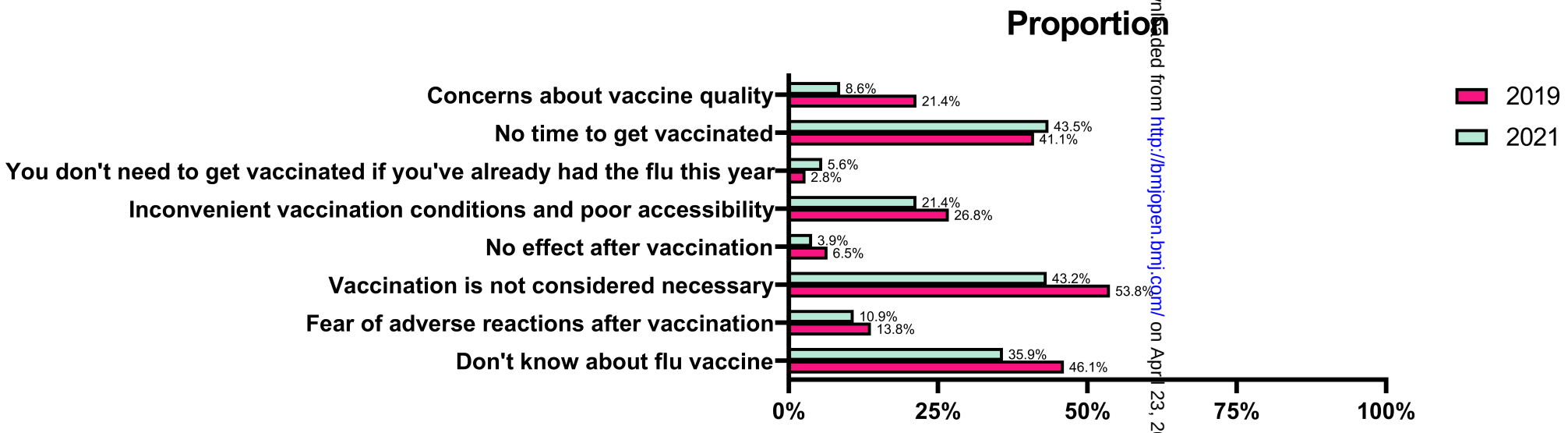


Fig. 1 Sources of Influenza Vaccine Information for 2019 vs. 2021

6284x2487mm (38 x 38 DPI)



STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8-9
		(b) Give reasons for non-participation at each stage	8-9
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	8-17
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-17

		(*b*) Report category boundaries when continuous variables were categorized	8-17
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-17
Discussion			
Key results	18	Summarise key results with reference to study objectives	19-21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22-23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	23
Generalisability	21	Discuss the generalisability (external validity) of the study results	21-23
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.