



An online longitudinal study about search index reflexing public attention of vaccinate against COVID-19

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Background: The coronavirus disease of 2019 (COVID-19) has had catastrophic effects worldwide. Mounting efforts for vaccination against COVID-19 have achieved tremendous progress. Online searching is a voluntary behavior of people might reflect the public attention and awareness.. Screening and analyzing the details of vaccine related searches may help the government to grasp the trend of public opinion and provide a reference for vaccination strategies and future efforts to protect public health.

Methods: Three terms related to COVID-19 and COVID-19 vaccine as well as daily relative search volumes (RSV) were retrieved in the Baidu Index (BDI) from 1 January 2020 to 1 July 2021 in China. Besides the national total data, those of the individual provinces/cities/region of Beijing, Shanghai, Guangdong, Heilongjiang, Sichuan, and Tibet were also included. Vaccine-related policies were also gathered during this period. The vaccination rates within China were derived from the National Health Commission of the People's Republic of China, from 23 March 2021 to 1 July 2021. The searching index was calculated by the searching volume and curve graphs were used to demonstrate the variation and the related trend of the RSV and vaccination rates.

Results: A total of 548 days' BDI data were retrieved. The national and provincial curves of the BDI exhibited similar fluctuating upward trends, with 5 obvious rises, especially in COVID-19 vaccine searching volume. The vaccination number was correlated with the searching volume growth of COVID-19 vaccine and vaccine uptake ($r=0.382$, $P<0.001$; $r=0.256$, $P=0.010$). Relevant vaccination events corresponded to the variation searching trend and were attributed to or were influenced by the searching variation.

Conclusions: Public awareness about vaccination against COVID-19 was related to the implementation of vaccine policies. Positive vaccine-related policy and high public awareness about vaccination could play a vital role in maximizing the vaccination uptake. Advanced internet data grabbing could consolidate public information in an efficient and timely manner. These findings would support efforts to utilize the big data monitoring of the public opinion to forecast and guide the public health policies. Dynamic monitoring as well as prevention and timely adjustment under this supervision could be expected.

Keywords: Vaccine; coronavirus disease of 2019 (COVID-19); Baidu Index (BDI); public health

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Introduction

The coronavirus disease of 2019 (COVID-19), a highly contagious viral pneumonia, has caused catastrophic effects according to the World Health Organization (WHO) (1). Due to its rapid spread, at the time of writing this manuscript, the number of confirmed cases of COVID-19 has reached 205,338,159, including 4,333,094 deaths (2). Globally, to contain the pandemic, remarkable efforts incorporating technology from related domains have contributed to the sharp emergence and development of COVID-19 vaccines (3).

Previous studies have suggested that the reproductive number (R_0) of the COVID-19 virus was approximately 3, which means that one carrier can infect 3 healthy individuals (4,5). The newly emerged severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) variants have presented even further challenges to the global anti-epidemic efforts (6-8). Briefly, vaccination plays a crucial role in diminishing the route of transmission (9,10). Therefore, the willingness of the public to accept immunization has become a key feature of epidemic control.

The epidemic in China has been fully under control since 2020 (11) due to strong public health prevention measures, as well as vaccination. With the promotion of various media and government policies, the COVID-19 vaccination rate in China is impressive, but further efforts are still required. Current studies reported many factors that contributed to COVID-19 vaccine hesitancy, such as the concerns of effectiveness, safety and the vague side-effect about the existing vaccine (12-15). COVID-19 vaccine hesitancy presented to be a noteworthy public health issue.

A massive amount of traffic gives an internet search engine (SE) greater pertinence. Previous researches reported the searching behaviors of internet users reflect the popularity of issues, and has even been shown to be the “outpost” of events under certain circumstances (16). An SE could obtain more, comprehensive, and real-time public information in a short time. During the last year in China according to StatCounter (<https://statcounter.com/>), Baidu captured more than 70% of the market within China, making it the most popular SE (17). The predictive effect of SE has been verified by the most recently reported research (16,18-21). Thus, it is conceivable that the public opinion of vaccination could be monitored by such SEs.

Recently, infodemiology studies concentrated more on the correlations of online SE trends with COVID-19 incidence and confirmed cases (16,22-24). However, in

concern of the rapid-mutate viruses as well as the constant pandemic situation, it is necessary to explore the correlation between the online searching that reflected the public concern and the vaccination rates. Hence, the purpose of this paper was to use Baidu Index (BDI; <https://index.baidu.com/v2/index.html#/>) to explore the awareness about COVID-19 vaccination among the Chinese public, as well as to verify the role of internet SEs in monitoring public opinion during public health emergencies, and to assess the social impact of the related policies. We supposed that the findings from this study could help the government to grasp the trend of public opinion and provide a reference for policy making decisions.

Methods

BDI data collection

The algorithm of BDI is based on the search volume of the terms on the internet, further filtering and weighting the data to reflect the variation tendency of search scale for certain terms in Baidu during specific periods of time (25). In consideration of data collection from BDI and the searching behaviors of public, the final retrieval terms we selected were “Novel Coronavirus Pneumonia (xin xing guan Zhuang bing du fei yan, xin guang)”, “COVID-19 vaccine (xin guan yi miao)”, and “vaccine (yi miao)”. These daily relative search volumes (RSV) data were retrieved from BDI on 1 January 2020 to 1 July 2021. Besides the national total data, 6 representative provinces/cities/region were also included: Beijing, Shanghai, Guangdong, Heilongjiang, Sichuan, and Tibet. All the RSV data we calculated were absolute searching volumes.

Data sources

The number of vaccinations of China were derived from the National Health Commission of the People’s Republic of China (26). As the daily official report of COVID-19 vaccinations was instigated 23 March 2021, the data of daily vaccination numbers was gathered from 23 March 2021 to 1 July 2021. To ensure the reliability of policy information sources, we collected the official information and policies of vaccination from the National Health Commission of the People’s Republic of China (26), Chinese Center for Disease Control and Prevention (CDC) (27), Xinhua net (28), and People’s Daily (29). The related events were collected by chronological peak order. The data we collected were from

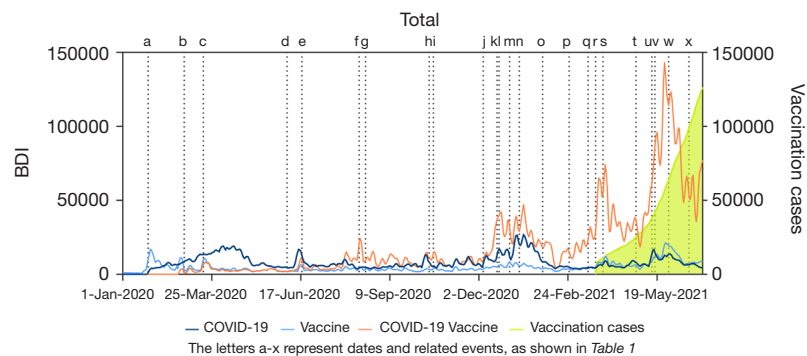


Figure 1 Total relative search volumes curves and vaccination cases. BDI, Baidu Index; COVID-19, coronavirus disease of 2019.

an open publicly accessible website. There was no funding for this study.

Statistical analysis

This is a correlation analysis. The first confirmed case of COVID-19 in China was reported in January 2020 and the epidemic trend has been controlled since 22 April 2020. In the view of reflecting clearer variation and illustrating a longer tendency, the analysis time was set from 1 January 2020 to 1 July 2021.

Based on the data of more than one year, statistical analysis was performed using the software SPSS 25.0 (IBM Corp., Armonk, NY, USA) and GraphPad Prism 9 (GraphPad Software Inc., San Diego, CA, USA). We applied 3-day smoothing in a curve graph to reduce the unnecessary variation. The RSV and the number of vaccinations were separately superimposed on the 2 period curves for better comparison. Pearson correlation testing was used for further analysis. Differences were considered significant at $P < 0.05$.

Results

BDI nationwide general trend

All the BDI data including searches conducted on personal computer (PC) and mobile were collected from 1 January 2020 to 1 July 2021, a total of 548 days.

As shown in *Figure 1*, the RSV curves of the COVID-19 and the vaccine exhibited some waves in specific periods, while the COVID-19 vaccine RSV curve exhibited an upward-fluctuating trend. Besides the initial growth in March 2020, the 4 obvious increases of the COVID-19 vaccine RSV curve appeared in August 2020, the end of

2020, March 2021, and May 2021, which related to the corresponding vaccine events. The peak value of each increase grew higher each time and reached 148,151 in the latest growth. For a better description, we selected the 5 periods with the most significant upward trend by taking the national BDI data as the reference standard. Peak I to V were set as 1 January 2020 to 25 February 2020, 4 June 2020 to 17 August 2020, 6 December 2020 to 31 January 2021, 25 February 2021 to 29 March 2021, and 29 April 2021 to 18 June 2021. In our following study, these growths were connected to the timing of vaccine policy. *Table 1* shows the related events about vaccination against COVID-19 and the relevant time points. A total of 30 events are presented in order.

As the COVID-19 RSV grew from zero, the vaccine RSV ranged with it. The dominant searching status of vaccine RSV was replaced in August 2020 by COVID-19 vaccine according to the curve graph. During this period however, the variation of vaccine and COVID-19 vaccine RSV was correlated with the COVID-19 RSV.

As shown in *Figure 1* and *Table 2*, the sharp increase of the vaccination number is correlated with the growth of COVID-19 vaccine RSV and vaccine RSV ($r = 0.382$, $P < 0.001$; $r = 0.256$, $P = 0.010$). Further, the COVID-19 vaccine RSV is correlated with the COVID-19 RSV and vaccine RSV ($r = 0.232$, $P < 0.001$; $r = 0.778$, $P < 0.001$).

BDI trend by provinces/cities/region

Among all the 6 selected provinces/cities/region, the form of RSV curves shared remarkable similarity to the national curves, especially that of the COVID-19 vaccine. Notably, Guangdong's closest RSV curves to the national make it stand out, with upward fluctuating trends (*Figure 2*). On

Table 1 Relevant vaccine policies and events

Peak	Note	Date	Events
I	a	2020-01-26	The Chinese Center for Disease Control and Prevention has begun developing the COVID-19 vaccine
	b	2020-02-25	The world's first mRNA drug development company has opened the safety clinical trial
	c	2020-03-17	Recombinant COVI-19 vaccine approved for clinical trials
II	d	2020-06-04	China's NHC Director Ma Xiaowei attended a video conference of the Global Vaccine Summit
	e	2020-06-18	Circular on the issuance of general biosafety requirements for vaccine production workshops
	f	2020-08-11	Russia has announced the registration of the world's first COVID-19 vaccine
	g	2020-08-17	China's first patent for COVID-19 vaccine was approved
	h	2020-10-16	Preliminary clinical trial results of a COVID-19 inactivated vaccine in China have been published in the <i>Lancet</i>
	i	2020-10-20	The coronavirus mutation had no substantial impact on vaccine development
III		2020-10-20	COVID-19 vaccine development schedule, priority population, and pricing
	j	2020-12-06	Five COVID-19 vaccines were tested in phase III clinical trials in China
	k	2020-12-19	Introduction of COVID-19 vaccination in key populations
		2020-12-19	Vaccination population, location, price, adverse reactions, expiration date, safety of the COVID-19 vaccine
	l	2020-12-21	The situation of epidemic prevention and control and vaccination of key groups in winter and spring were introduced
	m	2020-12-31	China's first COVID-19 vaccine has been conditionally released and free for all
	n	2021-01-09	The COVID-19 vaccine is free for all
IV		2021-01-31	The incidence of severe abnormal reactions reported with COVID-19 vaccines was not higher than with influenza vaccines
	p	2021-02-25	The State Food and Drug Administration approved the application for registration of recombinant COVID-19 vaccine (adenovirus type 5 vector) of Consino Biosciences with conditions
		2021-02-25	COVID-19 inactivated vaccine (Vero cell) from Sinopharm Wuhan Company was approved by The State Food and Drug Administration with conditions
	q	2021-03-15	How long will it take to get other vaccines after the COVID-19 vaccine
	r	2021-03-22	Mass vaccination of people over the age of 60 will be launched
	s	2021-03-29	Official technical guidelines for vaccination are issued after 100 million people have been vaccinated
		2021-03-29	The introduction of COVID-19 vaccination: it should be carried out as soon as possible, promoted step by step, prioritized, and safeguarded
V		2021-03-29	Technical Guidelines for COVID-19 Vaccination (first edition)
	t	2021-04-29	Cross-regional vaccination efforts
	u	2021-05-14	Interpretation of the COVID-19 Prevention and Control Plan (Version 8)
	v	2021-05-17	Deployment of COVID-19 prevention and control and COVID-19 vaccination
	w	2021-05-30	People's Daily online released a popular map of COVID-19 vaccination
	x	2021-06-18	The NHC has deployed COVID-19 prevention and control and COVID-19 vaccination efforts

The letters a–x are similar in *Figures 1,2*. COVID-19, coronavirus disease of 2019; mRNA, messenger RNA; NHC, National Health Commission.

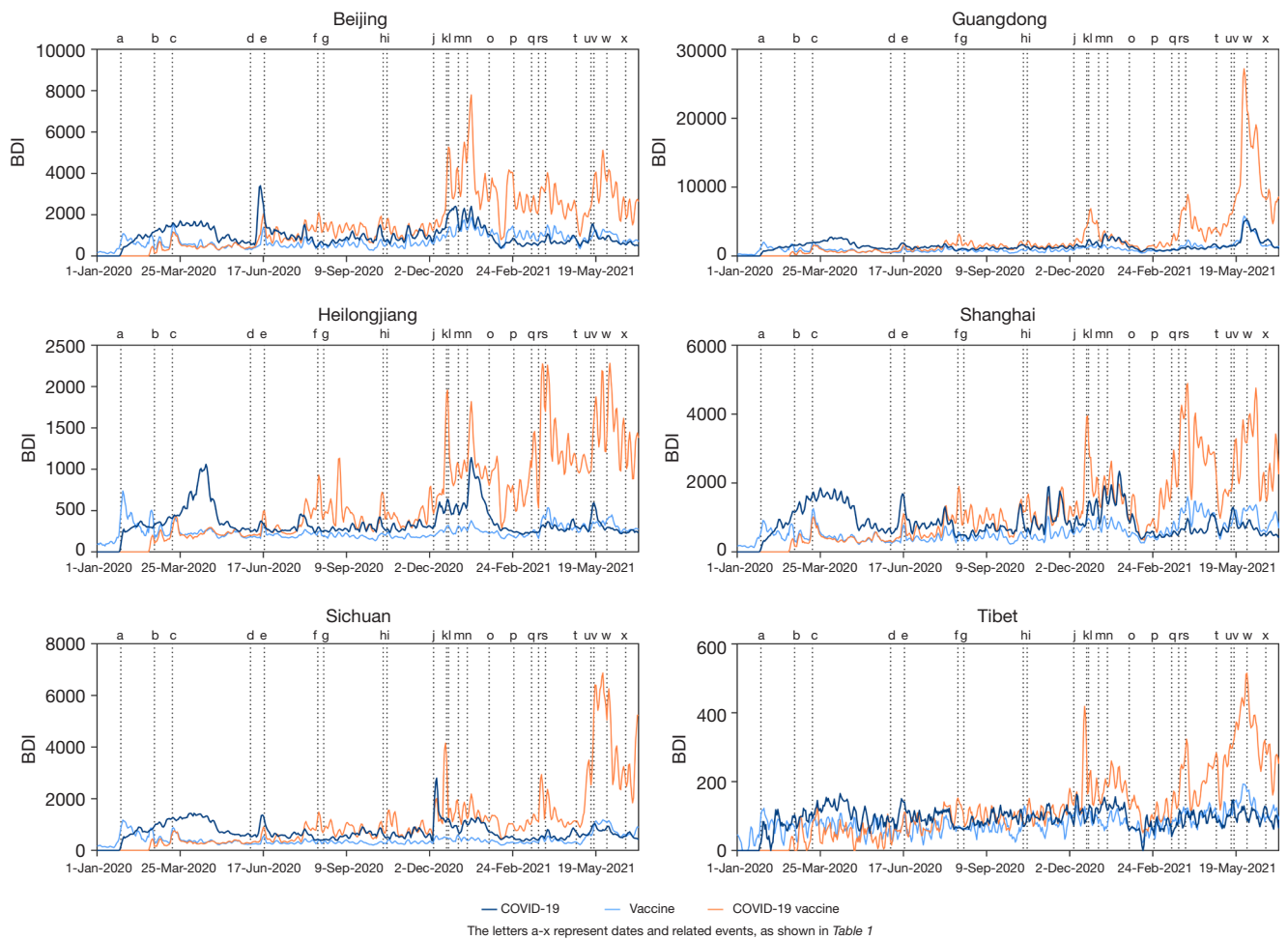


Figure 2 Relative search volumes curves in provinces/cities/region. BDI, Baidu Index; COVID-19, coronavirus disease of 2019.

Table 2 Results of Pearson correlation

Projects	COVID-19 vaccine RSV		COVID-19 RSV		Vaccine RSV	
	r	P value	r	P value	r	P value
Vaccinations	0.382	<0.001	0.081	0.422	0.256	0.010
COVID-19 vaccine RSV	–	–	0.232	<0.001	0.778	<0.001

COVID-19, coronavirus disease of 2019; RSV, relative search volume; r, Pearson correlation coefficient.

account of the particularity of the epidemic, the RSV of vaccine and COVID-19 vaccine after the episode of COVID-19 were usually associated with it.

The results of the mean and max daily RSV among the different provinces/cities/region are shown in *Table 3*. An obviously smaller volume occurred in Tibet, which ranked last on all 3 terms' RSV during the time of

analysis (COVID-19 RSV mean =92.08, COVID-19 vaccine RSV mean =121.45, vaccine RSV mean =78.26). When we focused on the searching of COVID-19 vaccine, all these provinces/cities/region exhibited remarkable increases in the last 3 peaks. Guangdong ranked first by absolute advantages on mean volume in every peak (peak I mean =23.93, peak II mean =1,252.51, peak IV mean =2,910.91,

Table 3 Results of the mean and max daily RSV among provinces/cities/region

Provinces/ cities/region	Groups	Daily BDI			Peak I			Peak II			Peak III			Peak IV			Peak V		
		Mean	Max	Days	Mean	Max	Days	Mean	Max	Days	Mean	Max	Days	Mean	Max	Days	Mean	Max	Days
Beijing	COVID-19	965.77	3,682	548	429.12	1,277	56	1,131.49	3,682	75	1,648.35	2,615	57	616.82	1,008	33	822.00	1,674	51
	COVID-19 vaccine	1,596.73	7,912		17.23	965		1,062.80	2,615		3,509.04	7,912		2,663.91	3,707		2,817.78	5,134	
Guangdong	Vaccine	736.01	2,063		508.45	1,763		578.09	1,897		1,195.67	2,063		998.52	1,351		906.78	1,322	
	COVID-19	1,444.86	6,089		604.25	1,601		1,280.43	1,910		1,982.54	3,423		913.91	1,315		2,500.29	6,089	
Heilongjiang	COVID-19 vaccine	2,628.72	31,162		23.93	1,340		1,252.51	4,093		3,069.33	7,668		2,910.91	8,805		11,300.88	31,162	
	Vaccine	1,078.28	6,375		862.70	3,076		787.64	1,805		1,204.26	2,053		982.73	2,036		2,494.63	6,375	
Shanghai	COVID-19	349.55	1,129		165.89	412		293.92	553		621.88	1,129		248.73	363		316.94	638	
	COVID-19 vaccine	614.30	2,847		6.95	389		350.92	1,113		1,029.56	2,654		1,044.36	2,847		1,415.57	2,611	
Sichuan	Vaccine	245.51	1,001		281.11	1,001		209.04	470		268.21	412		243.88	482		320.86	489	
	COVID-19	851.77	2,744		366.30	1,208		818.89	1,729		1,322.04	2,744		524.70	767		736.41	1,416	
Tibet	COVID-19	1,185.51	5,052		12.59	705		693.23	2,275		1,821.00	4,932		2,140.70	4,976		2,538.98	5,052	
	COVID-19 vaccine	586.76	1,613		433.77	1,452		416.73	1,197		742.33	1,418		708.85	1,533		919.92	1,461	
Total	COVID-19	716.45	3,906		381.82	1,091		640.53	1,422		1,160.56	3,906		448.33	620		704.37	1,151	
	COVID-19 vaccine	1,089.63	7,582		16.95	949		578.68	1,783		1,604.98	7,582		1,258.09	4,525		3,732.90	7,524	
Total	Vaccine	412.52	1,505		516.70	1,505		317.53	766		438.72	894		340.64	712		743.45	1,228	
	COVID-19	92.08	169		37.79	128		96.52	152		117.51	169		75.73	133		100.86	146	
Total	COVID-19 vaccine	121.45	624		1.30	73		83.31	172		192.11	624		143.82	330		325.41	534	
	Vaccine	78.26	222		55.46	146		62.67	130		93.63	160		82.85	143		125.10	222	
Total	COVID-19	8,110.95	28,637		3,193.04	10,003		6,841.96	17,784		15,723.00	28,637		4,657.55	7,149		9,574.04	17,172	
	COVID-19 vaccine	18,856.89	148,151		153.07	8,572		6,721.31	32,781		27,367.26	44,689		27,960.48	77,112		74,642.49	148,151	
Vaccine		4,868.81	24,439		5,223.70	24,439		3,150.84	10,590		5,523.18	12,681		4,617.70	9,718		11,043.55	22,231	

RSV, relative search volume; BDI, Baidu Index; COVID-19, coronavirus disease of 2019.

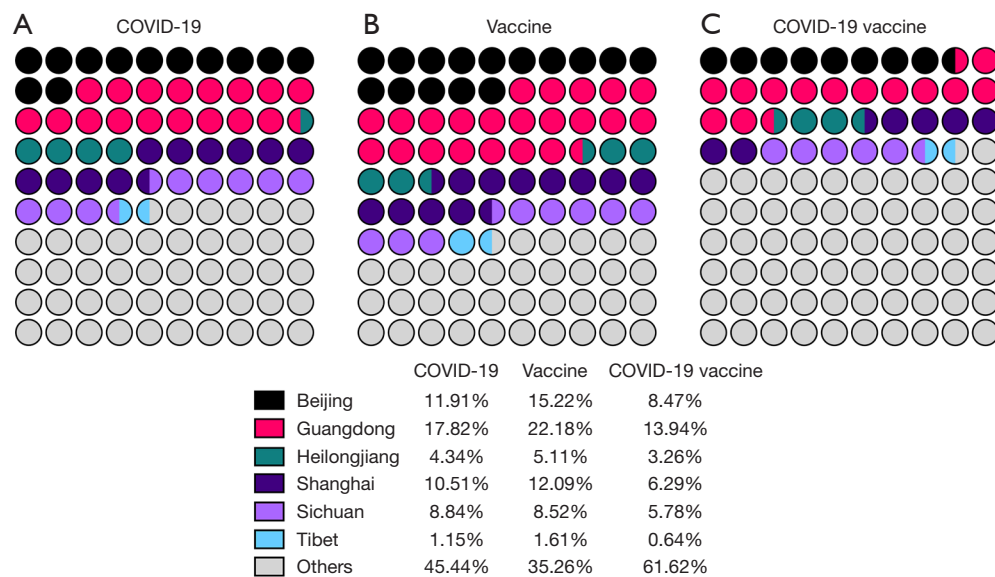


Figure 3 Daily average BDI contribution of provinces/cities/region in total. The contribution of daily average BDI of (A) “COVID-19”, (B) “vaccine”, and (C) “COVID-19 vaccine” in different provinces/cities/region. COVID-19, coronavirus disease of 2019; BDI, Baidu Index.

peak V mean =11,300.88) except peak III, for which Beijing hit the highest (peak III mean =3,509.04).

Provincial daily average BDI contribution

Figure 3, in which the contribution of daily average BDI in different provinces/cities/region during the 548 days is represented, illustrates a prominent discrepancy. The percentage of Guangdong RSV was the maximum within the selected 6 provinces/cities/region among 3 terms, and that of Tibet was the lowest. In addition, as shown in Figure 3A, these 6 provinces/cities/region accounted for more than half the searching of COVID-19 in China during this period (54.56%). The parallels appeared in vaccine, with even less proportion of other provinces/cities/region (35.26%) (Figure 3B). Key differences in the distribution of COVID-19 vaccine daily average BDI among provinces/cities/region are displayed in Figure 3C. Compared to the other 2 RSV proportions, the selected provinces/cities/region here comprise less of the total volume (38.38%), leading to a more balanced national searching situation.

Discussion

The present study investigated the vaccine searching volume in BDI during the COVID-19 outbreak. The data were collected from 1 January 2020 to 1 July 2021. We

found that the results revealed the public concern about COVID-19 vaccine and the tendency, which was influenced by the epidemic and related vaccine policy, provided a reference to optimize the allocation of prevention supplies resources and adjust the order of the epidemic prevention and control.

As we all know, vaccination decisions are determined by an interaction within individual social factors, historical and cultural factors, policy and regulations, and so on (30,31). The coverage of COVID-19 vaccination in China reflects a positive tendency of vaccination decisions. Considering the particularity of the epidemic period, COVID-19 vaccine information has almost solely come from internet. Social media had been thought of as the main resource of such medical information when there was a lack of research data (5,32,33). However, before we express an individual opinion on social media, we usually search the terms of interest online to fortify our knowledge. As an outpost of searching trend (16), BDI embodies the vaccine needs after the epidemic outbreak in time. The successive rising trend of 5 peaks reveals the public increasing attention about COVID-19 vaccine. There are several reasons that may explain the trend. Firstly, concerns about the repeated outbreaks of COVID-19 and the virus variation may add to the volume of searching. For another, vaccine approval policy by government would be another motivator. In addition, the sufficient production and the effectiveness

of the COVID-19 vaccine, which has been supported by research, will prolong the relevance of the issue.

In details we noticed, the first peak, in which vaccine RSV held the line with COVID-19 vaccine RSV, is correlated with the issue that the COVID-19 epidemic had been declared and the concern about and full recognition of the SARS-CoV-2 virus had commenced, thanks to the vigorous promotion by mainstream media. The obvious growth in June and August 2020 matched the period during which the epidemic was basically under control. During this time, countries around the world were boosting their efforts towards COVID-19 vaccine development because the epidemic was spreading around the world causing damage and loss. Russia announced the registration of the world's first COVID-19 vaccine on 11 August 2020, which might have triggered an increase in COVID-19 vaccine searching. During this period, the search words "volunteer", "Russian vaccine" appeared most frequently.

With the successive development of 5 COVID-19 vaccines in China, the third peak arose in December 2020 to January 2021. When the Chinese CDC announced that China's first COVID-19 vaccine had been conditionally released and would be free for all, the public interest for COVID-19 vaccines ran high. Consequently, the contraindication, side-effects, and other vaccine-associated issues hit the concerns of public. In addition, people paid more attention to the reserve of the COVID-19 vaccine considering its great demand within a short time. Still, some people questioned the vaccination necessity, which has been reported in previous studies (34,35). The higher searching peak in February 2021 to March 2021 reflects the new wave of vaccination that China's inoculation exceeded 100 million during this time. This would have been contributed to by the strong policies pursued by the local government to ensure that all people who should be vaccinated are vaccinated. Several COVID-19 vaccines came into service within this period. Side-effects, expiration dates, as well as contraindications comprised the searching volume. Pregnancy was also included in the list of concerning words, which could be attributed to the worry about the side-effects of the COVID-19 vaccine for the pre-pregnant couples (36,37). Simultaneously, the vaccination number has been published since 23 March 2021 and updated daily, revealing the vast increase of the vaccination coverage.

The last but the highest peak emerged in the latest time, showing the huge searching volume about the vaccination to prevent COVID-19. The stronger and wider support-vaccination policy inspired the public willingness to receive

the COVID-19 vaccine. As a consequence, people had more desire to obtain more vaccine-related information before and after vaccination. In addition to the already present vaccine-related attributes, with several marketed vaccines to prevent COVID-19 in China, the options of the type and the difference among varies vaccines also attracted public interest.

With regard to the local data of vaccine RSV, the variation tendency was basically the same compared to the total. Additionally, *Figure 3* reveals a large proportion of vaccine RSV for Beijing, Shanghai, and Guangdong, and the western and northern cities account for less visually. This geographic distribution difference might be attributed to the economic development level as well as the population distribution and quality, on account that education plays a vital role in willingness to vaccinate (35,38-41). Gross domestic product (GDP) in Guangdong ranks first in China and has considerable floating population. These factors might contribute to its large searching volume. In addition, the epidemic situation and sporadic imported cases could be other drivers effecting the interest in vaccination. Comprehensively collected data of all regions might make the comparative research more powerful, and not surprisingly, could provide a reference for the implementation of local government policies.

According to CDC public data, more than 1.2 billion doses of COVID-19 vaccine had been administrated in China up to 1 July 2021, indicating a great achievement in COVID-19 epidemic prevention in China. The BDI data also reflects the vaccine hesitancy trend and public response to vaccine-related policies. People who concentrated more on the news of the COVID-19 vaccine might have a better understanding of it, and this in turn would make them more willing to receive the vaccine (31,42). Thereby, the more sufficient vaccine-related information is, the more motivated people become to receive the vaccine (43). The publicity and education about the implementation of COVID-19 vaccination among people, especially the elderly, may affect their willingness and reluctance to receive the vaccine.

At present, most of the previous studies on the willingness to vaccinate against COVID-19 have been online surveys, and have been conducted by students, medical staff, and on the global scale (44-47). The survey scope and sampling offset are greatly affected by human factors. In addition, most of them have been cross-sectional studies, which may not adequately reflect real-time changes and may not be easily used as a relevant decision-making reference. Besides, it is difficult to cover all aspects due

to the lack of macro and micro considerations on factors influencing vaccination intention. However, information collection based on the SE in this paper can largely avoid the problem of information limitations and ensure the authenticity, reliability, and timeliness of information sources.

This study has several limitations. First of all, the data only collected from Baidu Index but not included other SE such as Google, Bing. Second, BDI has been accused for its lagged effect. For instance, person could not get vaccination immediately after searching online. Further exploration might take this into consideration. What's more, due to the privacy protection, we lack the data about the age and occupation information, which might restrict the profound correlation analysis.

Including specific values and general tendency, this study collected data from the online SE, showing the strong capacities for gathering and consolidating data. The public concerns about vaccination against COVID-19 could predict and indicate the implementation of vaccine policies, and policies also effect the vaccine concerns. In addition to vaccination, we need to innovate new preventative approaches to this pandemic. Gathering the efforts globally from the general public, management, bio-medical domain, informatics, scientific domain, and policy makers will help to create a strong, cooperative shield against the COVID-19. We hope these findings may serve as a guidepost for further advancement of this epidemic battle. By advanced big data analysis, rapid adjustment and detailed solutions are expected in future challenges.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://atm.amegroups.com/article/view/10.21037/atm-22-3064/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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