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RESEARCH ARTICLE

Omicron wave during December 2022 – January 2023: access to pharmaceuticals and healthcare resources and impacts on health outcomes in Shenzhen, China

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ABSTRACT

Purpose: This study described pharmaceutical and medical resource accessibility of COVID-19 treatment in Shenzhen, China during the peak of COVID-19 infection from December 2022 to January 2023, and examined its influence on clinical outcomes.

Methods: We surveyed Shenzhen residents on COVID-19-related topics using electronic questionnaires. We conducted descriptive statistical analyses and multiple regressions including logistic and Tobit models to explore the impacts of resource constraints on patient outcomes. Resource utilisation and attempts to seek medical care were also described for severity-stratified subgroups.

Results: 76.8% of respondents reported experiencing COVID-19 symptoms between December 7, 2022 and January 29, 2023. Of those who attempted to purchase medication, 72.8% reported drug shortage. 49% of those seeking medical treatment experienced difficulties. Compared with those who did not experience drug shortages, those who did had an odds ratio of 1.959 (95% CI: 1.159 ~3.313) of presenting with moderate to severe symptoms. Compared with those without difficulties in seeking medical treatment, those who did had an average of 0.39 (95% CI: 0.110 ~0.670) more days absent from work.

Conclusion: Shenzhen residents with COVID-19 symptoms from December 2022 to January 2023 experienced a certain degree of pharmaceutical and medical resource constraints, which might have compromised their prognosis.

Abbreviations: CHCs: Community Health Care Centers; FDCS: Family doctor contract services

KEYWORDS COVID-19; medication; medical resource accessibility; omicron

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Introduction

The COVID-19 pandemic has exerted substantial public health, socio-economic, and humanistic burdens globally (Nicola et al., 2020). An overwhelming surge in COVID-19 infections was observed in China from December 2022 to January 2023, characterised by a swift escalation in the number of symptomatic patients since early December 2022, followed by a decline towards the end of the month (Chinese Center for Disease Control and Prevention, 2023).

During the COVID-19 pandemic, numerous countries grappled with the issue of healthcare resource availability (Pujolar et al., 2022; Ranney et al., 2020; WHO, 2021). A plethora of studies globally have posited that a lower level of healthcare resource availability could cause higher COVID-19 mortality rates (Bauer et al., 2020; Janke et al., 2021; Ji et al., 2020; Zampieri et al., 2020). In addition, a body of literature has unveiled the detrimental impacts of difficulties in accessing medical treatment during the COVID-19 pandemic on the prognosis of certain chronic non-communicable diseases (Maldonado et al., 2021; Rosengard et al., 2021; Sloan et al., 2021; Thaler et al., 2020). However, a paucity of empirical evidence persists regarding the accessibility of healthcare resources across different regions in China during the peak of COVID-19 infections from December 2022 to January 2023.

Given this evidentiary gap, it is important to shed light on the issues pertaining to healthcare resource availability in China during the COVID-19 pandemic. Such an investigation can help to identify any misallocation of medical resources when confronting infectious disease epidemics, thereby contributing to the evidence base of tackling future large-scale epidemics and avoid unnecessary mortality and morbidity. The city of Shenzhen, China has over 17 million residents and has established one of the most cutting-edge primary care systems in the country (National Health and Family Planning Commission of the People's Republic of China, 2017; Shenzhen Statistics Bureau, 2023; Wang et al., 2018). Specifically, the healthcare system of the city is spearheaded by Community Health Care Centers (CHCs) (Health Commission of Shenzhen Municipality, 2023). It is also a pioneering city in implementing family doctor contract services (FDCS) and integrated hospital-CHC systems (Li et al., 2020; Wang et al., 2018; Zheng et al., 2021).

By focusing on the experiences of Shenzhen residents, the evidence from the current study may help to understand the performance of a healthcare system with a strong primary network in responding to an unprecedented pressure caused by an infectious disease.

Materials and methods

Study design and data sources

We conducted a retrospective cohort study to describe pharmaceutical and medical resource accessibility of COVID-19 treatment in Shenzhen, China during the peak of COVID-19 infection from December 2022 to January 2023, and examined their impacts on clinical outcomes. In addition, resource utilisation and attempts to seek medical care were described among subgroups by severity. Web-based questionnaires were delivered to collect information from Shenzhen residents about the occurrence of common COVID-19 symptoms, the use of medical treatment, the experience of medication purchasing, and other related information from December 7, 2022, to January 29, 2023. The questionnaires were delivered to the candidate pools of the popular Chinese online questionnaire platforms 'Wenjuanxing' ('WJX') and 'Tencent Survey'. Both platforms hosted general population registry from which sampling based on restrictions such as location and age could be deployed. The platforms sent out survey links to all candidate pool members who met the inclusion criteria. Participation was voluntary. After collecting responses up to the target quantity, the survey access was closed. As such, everyone in the candidate pool had an equal probability of participating. However, our sampling strategy should be considered convenience sampling to the extent that the candidate pool was readily available but not necessarily in a random way.

The two platforms can only use the registration information provided by members upon joining the candidate pools as the sampling criteria, which might not have accurately captured the actual circumstances when members filled out the questionnaires. Therefore, we collected basic demographic information in the survey again. After collecting a sufficient number of responses on both platforms, we further screened the samples based on the responses to the questionnaires. In summary, the inclusion criteria were: providing informed consent before completing the questionnaire and meeting the age requirement (participants from 'WJX' were 18–49 years old, and participants from 'Tencent Survey' were 50 years old or above). The exclusion criteria were: respondents aged less than 18; respondents whose IP addresses at the time of responding were not in Shenzhen (IP addresses reflected the geographical location of respondents); responses other than the first submission from respondents who answered multiple times (based on user identification number in the online questionnaire platform); responses with obvious contradictory answers, such as simultaneously selecting 'did not attempt to seek medical treatment' and 'attempted to go to the hospital for treatment' when answering questions about medical treatment. After inclusion and exclusion, we obtained 1193 valid responses (Figure 1).

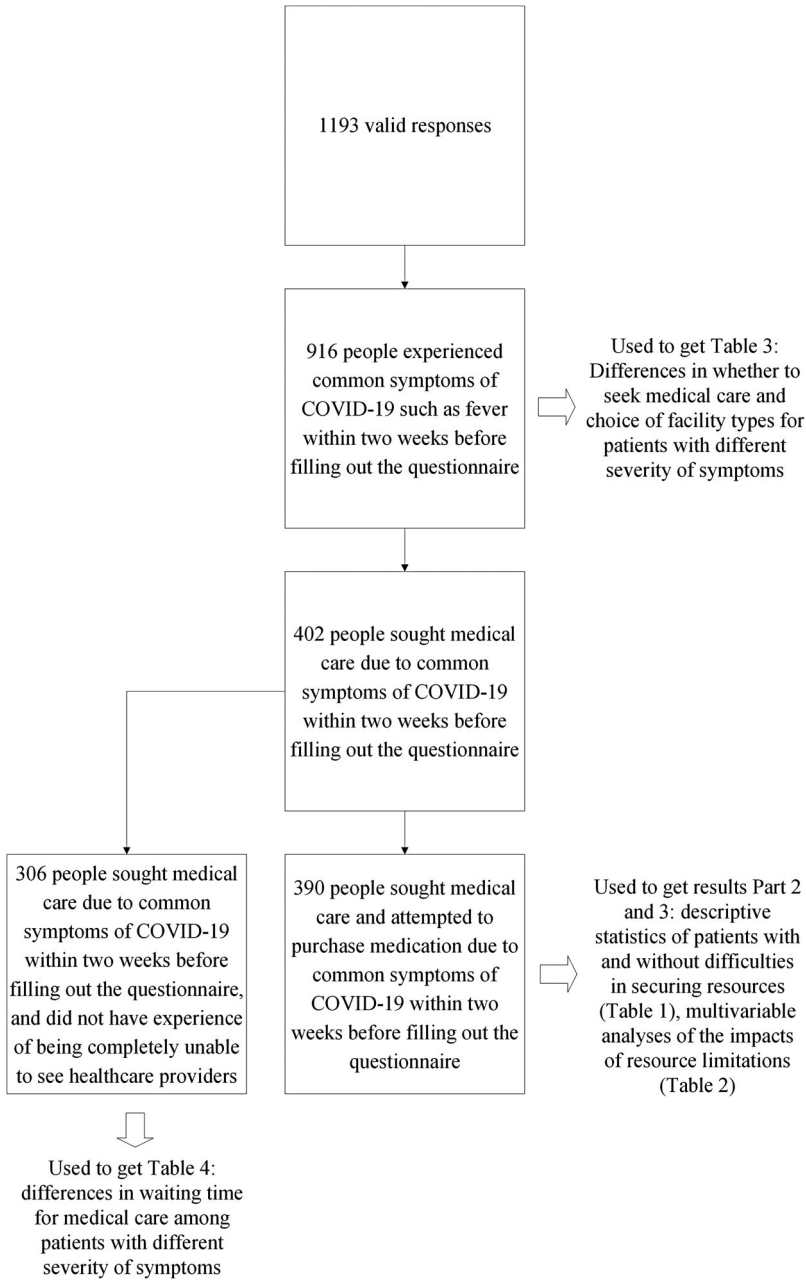

Figure 1. Sample selection flow chart.

Different subgroups were engaged for several non-primary analyses. When evaluating the impacts of experiencing resource inaccessibility on clinical outcomes, only those who were symptomatic and attempted to seek

medical attention were included in the analysis. Similarly, only those who were successfully attended by healthcare providers were included in the analysis of time spent in waiting rooms.

Questionnaire design

A structured questionnaire was used for the study. To determine the items in the survey relating to the common symptoms of COVID-19 and the types of COVID-19 vaccines, we referred to the literature and policy documents (Brandal et al., 2021; Chinese government website, 2021, 2022; Menni et al., 2022; National Health Commission of the People's Republic of China, 2022; Sha et al., 2023; Vihta et al., 2022).

Before the formal survey, we conducted a pilot study with 200 participants on December 26, 2022. To assess potential issues of the questionnaire and the delivery process, we evaluated the time spent on answering each of the question, the completion rate of the questions, and the questionnaire-return speed. After the pilot survey, we surmised that the questionnaires were effectively circulated and returned, with the target number of questionnaires returned within eight days. In addition, issues of the interpretability and relevance of the questionnaire items were not identified in the sense that the respondents provided responses to all questions.

The types of information collected include the occurrence and time of common COVID-19 symptom (fever, cough, sore throat, fatigue, eye pain, muscle pain, headache, loss of smell, loss of taste, nasal congestion, runny nose, and diarrhea) onsets within two weeks before answering the questionnaires, absence from work due to illness, medical treatment, medication purchasing, history of COVID-19 vaccination, history of underlying diseases, and demographic characteristics.

Outcomes and key explanatory variables

In the question about whether experienced difficulties in seeking medical treatment, this study grouped respondents that selected 'unable to see healthcare providers due to difficulties in making an appointment or registration' or 'did not receive timely medical attention due to difficulties in making an appointment or registration' as having experienced difficulties in seeking medical treatment. Similarly, in the question asking 'did you experience drug shortages when purchasing medication', samples that answered 'yes' were defined as having experienced difficulties in purchasing medication. The key explanatory variables were specified as indicators, with values of one indicating experiencing difficulties and shortages.

Participants having fever or other symptoms were also asked to rate their overall severity of symptoms as 'mild', 'moderate', or 'severe or critical'. Those

choosing the last two categories were considered non-mild patients in subsequent analyses. We also collected information on whether the respondents had any absence from work due to COVID-19 symptoms. The respondents with affirmative answers further filled in the number of days that they could not work. However, they only had to choose 'more than 7 days' if the duration of absence from work was longer than a week. Accordingly, the illness duration outcome variable was considered right-censored at seven days.

In addition, the variables of whether or not to seek medical care, the choice of medical institutions, and the waiting time for medical care were also included in the study to analyse differences between patients with different levels of symptom severity. There were three types of medical institutions. Namely, they were CHCs, hospitals, and online consultations.

Statistical analyses

Continuous variables and categorical variables were described using mean values (standard deviations, SD) and percentages, respectively. Chi-square tests were used to test differences in binary variables across vaccination status groups, whereas t-tests were conducted to test differences in continuous variables. In addition, Wilcoxon rank-sum tests were engaged to test differences in ordinal variables.

In multivariable regressions, a Tobit model was used to explore the impacts of difficulties in seeking medical treatment and purchasing medication on days of absence, and logistic regressions were used to explore the impacts on symptom onsets and severity. The Tobit model can be used when a continuous dependent variable is censored (Davidson & MacKinnon, 2004; Wooldridge, 2010, 2015). In the current study, days of absence was right-censored at seven. The results from the Tobit model were denoted using marginal effects, which denoted the change in the magnitude of the dependent variables in response to a unit change of the explanatory variable holding other factors constant. In the logistic regression, the severity was defined as a dichotomous variable with zero indicating mild symptoms and one indicating non-mild symptoms. In both the Tobit model and the logistic regressions, the covariates used were sex, age (defined as a categorical variable with the groups of 18–34 years old, 35–49 years old, and 50 years old and above), COVID-19 vaccination status (with the categories of did not complete the primary series, completed the primary series, primary series + 1 booster shot, primary series + 2 booster shots, and unspecified/unknown), and the underlying disease status (lower respiratory disease, upper respiratory disease, hypertension, diabetes, cardio- and cerebrovascular diseases, malignant tumours, and other underlying conditions). All explanatory variables are listed in Table 2.

Finally, chi-squared tests were used to compare the differences in the respondents' attempts to seek medical attention and their choices of the types of medical facilities across different severity groups, whereas a Wilcoxon rank-sum test was used to compare the differences in waiting time for medical treatment among patients with different symptom severity. All analyses in this study were performed using Stata 17 software (StataCorp, College Park, Texas, the USA).

Results

Overall profile of respondents

Figure 1 delineates the process of sample selection. Out of the 1,193 respondents deemed valid, 730 (61.2%) reported the manifestation of fever within two weeks preceding the completion of the questionnaire. Furthermore, 916 (76.8%) respondents reported having any form of symptoms commonly associated with COVID-19. Within this group of 916 symptomatic respondents, 476 (52%) considered their symptoms as mild, 432 (47.2%) as moderate, and eight (0.9%) as severe or critical, with only two (0.22%) ever hospitalized. Moreover, 726 (79.3%) of these respondents called in sick or could not perform household work for at least one day due to their symptoms. Conversely, 190 (20.7%) respondents did not report difficulties in working or finishing household work due to illness.

Among the total valid respondents (1,193), 599 (50.2%) were unable to go to their jobs or to conduct daily household work for at least one day within the two weeks preceding the questionnaire completion due to caring for a sick family member with common COVID-19 symptoms. The remaining 594 (49.8%) did not report this issue.

Of the 916 symptomatic respondents, 402 (43.9%) sought medical attention, while the remaining 514 (56.1%) did not. Among those who sought medical attention, 197 (49%) encountered difficulties due to issues with appointment scheduling or registration, while 205 (51%) did not report such difficulties. Furthermore, among those who sought medical attention, 249 (61.9%) attempted to visit CHCs, 179 (44.5%) tried to go to hospitals, and 97 (24.1%) sought online consultations. The primary reasons for not seeking medical attention included: the belief that their symptoms were manageable and could be self-monitored or self-treated (N = 442, 86%), concerns about the inability to secure appointments or long waiting times (N = 47, 9.1%), fear of contracting COVID-19 during the treatment process (N = 19, 3.7%), and other reasons (N = 6, 1.2%).

Among the 916 symptomatic respondents, 816 (89.1%) attempted to purchase medication, while 100 (10.9%) did not. Among those who attempted to purchase medication, 594 (72.8%) experienced shortage of

supplies at any point during their illness courses, while 222 (27.2%) did not experience this situation. Among the 1,193 valid respondents, 164 (13.7%) stated that they should not stock up on medication in advance when they did not have symptoms, while the other 1,029 (86.3%) believed that they should stock up in advance. The primary reasons for thinking it is a good idea to stock up in advance were: fear of getting sick in the near future (N = 620, 60.3%), concern that it might be difficult to buy medication for a long period in the future (N = 359, 34.9%), wanting to purchase in advance and then share with others (N = 44, 4.3%), and other reasons (N = 6, 0.6%).

Additionally, among the 1,193 valid respondents, 153 (12.8%) reported that they had sought medical treatment for diseases other than common COVID-19 symptoms within two weeks prior to completing the questionnaire. Among these, 97 (63.4%) were unable to receive timely medical treatment due to overcrowding of patients in hospitals or difficulties in receiving care, while 56 (36.6%) did not experience this situation.

Descriptive statistics of patients with and without difficulties in securing resources

Table 1 describes the disparities in symptom severity, days of absenteeism, and baseline characteristics across those who encountered difficulties in seeking medical treatment and those who did not, as well as those who experienced challenges in procuring medication and those who did not. Although the median number of absenteeism days was three days for both those who experienced difficulty accessing medical care and those who did not, the Wilcoxon rank-sum test found a significant difference ($p < 0.001$) in the distribution of absenteeism days between the two groups.

Furthermore, the proportion of patients with underlying conditions such as lower respiratory tract diseases (18.0% vs. 4.6%, $p < 0.001$), upper respiratory tract diseases (30.9% vs. 14.3%, $p < 0.001$), and cardiovascular diseases (13.9% vs. 5.1%, $p < 0.01$) was notably higher among those who experienced difficulties in seeking medical treatment. Conversely, the proportion of patients without any underlying conditions was lower in the group that experienced difficulties (53.1% vs. 70.9%, $p < 0.001$). Other characteristics were not significantly different across the two groups.

When compared to patients who did not face shortages of medication supplies, those who did had a higher proportion of self-reporting non-mild symptoms (59.7% vs. 43.1%, $p < 0.01$). Additionally, the group that experienced shortages of medication supplies had higher proportions of individuals with lower respiratory tract diseases (14.2% vs. 2.9%, $p < 0.01$) and upper respiratory tract diseases (28.5% vs. 5.9%, $p < 0.001$), but had a lower proportion of patients without any underlying conditions (56.6% vs. 77.5%, $p < 0.001$).

Table 1. The difference in symptom severity, days of absenteeism, and baseline characteristics across those who encountered difficulties in seeking medical treatment and those who did not, as well as those who experienced challenges in procuring medication and those who did not.

	Encountered difficulties in seeking medical treatment[a] (*N* = 390)			Experienced challenges in procuring medication[b] (*N* = 390)		
Explanatory variables	Yes (N = 194)	No (N = 196)	*P* value	Yes (N = 288)	No (N = 102)	*P* value
Moderate, severe or critical symptoms	117(60.3)	99(50.5)	0.052	172(59.7)	44(43.1)	0.004
Days of absenteeism [median (IQR)]	3(3)	3(3)	<0.001***	3(3)	3(3)	0.063
Age (years) [mean (SD)]	33.9(11.7)	36.0(15.1)	0.129	34.8(13.5)	35.2(13.9)	0.784
Male	86(44.3)	83(42.3)	0.693	128(44.4)	41(40.2)	0.457
COVID-19 vaccination status						
Unvaccinated	14(7.2)	10(5.1)	0.385	15(5.2)	9(8.8)	0.192
Did not complete the primary series	5(2.6)	5(2.6)	0.987	8(2.8)	2(2.0)	0.654
Completed the primary series	45(23.2)	55(28.1)	0.271	78(27.1)	22(21.6)	0.273
Primary series + 1 booster shot	82(42.3)	91(46.4)	0.408	124(43.1)	49(48.0)	0.384
Primary series + 2 booster shots	47(24.2)	33(16.8)	0.071	60(20.8)	20(19.6)	0.792
Unspecified/ unknown	1(0.5)	2(1.0)	0.568	3(1.0)	0(0.0)	0.301
Underlying disease status						
No underlying diseases	103(53.1)	139(70.9)	<0.001***	163(56.6)	79(77.5)	<0.001
Lower respiratory disease	35(18.0)	9(4.6)	<0.001***	41(14.2)	3(2.9)	0.002
Upper respiratory disease	60(30.9)	28(14.3)	<0.001***	82(28.5)	6(5.9)	<0.001
Hypertension	24(12.4)	23(11.7)	0.847	36(12.5)	11(10.8)	0.647
Diabetes	15(7.7)	8(4.1)	0.126	19(6.6)	4(3.9)	0.324
Cardio- and cerebrovascular diseases	27(13.9)	10(5.1)	0.003**	32(11.1)	5(4.9)	0.066
Malignant tumours	4(2.1)	3(1.5)	0.693	7(2.4)	0(0)	0.112
Other underlying conditions	4(2.1)	2(1.0)	0.403	4(1.4)	2(2.0)	0.687

Notes: Values are presented as N (%) unless specified otherwise;
N number, IQR interquartile range, SD standard deviation.

The respondents did not exhibit any statistical differences in other characteristics.

Multivariable analyses of the impacts of resource limitations

Table 2 presents the regression results from the Tobit model for the analysis of the duration of absenteeism and the Logit regression for the severity of symptoms. According to the results of the Tobit model, encountering difficulties in seeking medical treatment significantly increased the duration of absenteeism due to illness by 0.39 days (95% CI: 0.110 ~ 0.670) while experiencing difficulties in procuring medication insignificantly increased the duration of absenteeism by 0.067 (95% CI: −0.254 ~ 0.388). In addition, the odds ratio (OR) of having non-mild symptoms associated with experiencing

Table 2. The regression results from the Tobit model for the analysis of the duration of absenteeism and the logit regression for the severity of symptoms.

	Duration of absenteeism		Severity of symptoms	
Explanatory variables	Effect on duration (day)	95%CI	OR	95%CI
Experienced difficulties in seeking medical treatment	0.384**	0.104 ~0.664	1.216	0.765 ~1.933
Experienced difficulties in purchasing medication	0.084	−0.236 ~0.405	1.979*	1.171 ~3.345
Male	−0.114	−0.369 ~0.141	1.033	0.677 ~1.575
Age				
35–49 years old	0.256	−0.105 ~0.617	0.923	0.510 ~1.670
50 years old and above	−0.012	−0.415 ~0.391	0.718	0.369 ~1.397
COVID-19 vaccination status				
Did not complete the primary series	0.025	−0.926 ~0.975	0.787	0.162 ~3.827
Completed the primary series	−0.041	−0.617 ~0.536	0.534	0.202 ~1.414
Primary series + 1 booster shot	0.190	−0.376 ~0.756	0.846	0.324 ~2.208
Primary series + 2 booster shots	0.249	−0.344 ~0.843	0.589	0.216 ~1.604
Unspecified/unknown	−0.701	−2.260 ~0.857	0.255	0.019 ~3.416
Underlying disease status				
Lower respiratory disease	−0.297	−0.725 ~0.130	0.615	0.303 ~1.250
Upper respiratory disease	0.249	−0.078 ~0.577	1.008	0.585 ~1.736
Hypertension	0.082	−0.379 ~0.542	1.610	0.738 ~3.512
Diabetes	0.065	−0.531 ~0.660	1.484	0.539 ~4.083
Cardio- and cerebrovascular diseases	0.110	−0.382 ~0.602	0.851	0.378 ~1.914
Malignant tumours	1.041*	0.039 ~2.043	1.255	0.250 ~6.303
Other underlying conditions	0.233	−0.796 ~1.263	1.688	0.283 ~10.062

Notes**:** 18–34 years old, unvaccinated, and no underlying diseases were used as the reference groups; OR odds ratio;
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

difficulties in seeking medical treatment was 1.223 (95% CI: 0.769 ~ 1.943), whereas the corresponding OR associated with experiencing difficulties in procuring medication was 1.959 (95% CI: 1.159 ~ 3.313).

Whether to seek medical care, choices of facility types and waiting time

Table 3 shows the differences in whether to seek medical care and the choice of medical institutions among 916 patients with any form of common COVID-19 symptoms. The proportion of patients with mild symptoms who did not attempt to seek medical care (61.1%) was significantly higher ($p = 0.001$) than that of patients with non-mild symptoms (50.7%). Also, the percentages of both patients who attempted to go to hospitals (14.3% vs. 25.2%, $p < 0.001$) and those who sought online consultation (8.4% vs. 13.0%, $p < 0.001$) were significantly lower among the patients with self-reported mild symptoms than the corresponding percentages of patients with self-reported non-mild symptoms. Table 4 describes the differences in waiting time for

Table 3. The percentages of mild and non-mild patients choosing different types of care.

	Mild symptoms ($N = 476$)	Moderate, severe or critical symptoms ($N = 440$)	P value
Did not to seek medical care	291(61.1)	223(50.7)	0.001
Attempted to go to CHCs	117(24.6)	132(30.0)	0.065
Attempted to go to hospitals	68(14.3)	111(25.2)	<0.001
Attempted online consultation	40(8.4)	57(13.0)	0.025

Notes: Values are presented as N (%).

Table 4. The differences in waiting time for medical care among patients with different severity of symptoms.

	Mild symptoms (N = 142)	Moderate, severe or critical symptoms ($N = 164$)
Did not wait	11(7.7)	13(7.9)
0∼15 min	44(31.0)	21(12.8)
15∼30 min	31(21.8)	45(27.4)
30∼60 min	26(18.3)	41(25.0)
1∼3 h	22(15.5)	32(19.5)
3∼6 h	8(5.6)	7(4.3)
Over 6 h	0(0)	5(3.0)
P value	0.0094	

Notes: Values are presented as N (%).

medical care among patients with different severity of symptoms. Using the Wilcoxon rank sum test, the difference in waiting time between the two groups was statistically significantly different ($p = 0.0094$). Specifically, patients with non-mild symptoms were more likely to be subject to at least an hour of waiting than mild patients (26.8% vs. 21.1%).

Discussion

In this investigation, an online survey was employed to gather data pertaining to the prevalence of COVID-19 symptoms, healthcare accessibility, and pharmaceutical procurement among residents of Shenzhen, China during the apex of the COVID-19 infection wave from December 7, 2022, to January 29, 2023 caused by the omicron variant. The findings revealed that a significant proportion (76.8%) of respondents manifested common COVID-19 symptoms within this time frame. The number aligns with a previous study conducted in Macau, China, which reported that approximately 70% of participants contracted the SARS-CoV-2 virus within the three-week period following December 7, 2022 (Liang et al., 2023).

The study further documented that nearly half (49%) of the respondents who endeavoured to access medical services due to COVID-19 symptoms

encountered barriers in overwhelmed healthcare facilities. Moreover, 72.8% of those attempting to procure medication faced pharmaceutical shortages. These findings underscore a nontrivial deficit in healthcare resource accessibility in Shenzhen during the height of the COVID-19 pandemic. On top of the challenges in securing healthcare resources, the current findings also suggest that limited healthcare access might be associated with prolonged illness-induced absenteeism and exacerbated symptoms. Accordingly, the accessibility of healthcare resources during such infectious disease outbreaks warrants considerable attention. Of note, the study also discovered that over half (63.4%) of those requiring medical attention for conditions unrelated to COVID-19 reported to have experienced difficulties. This suggests that the healthcare resource accessibility issues precipitated by the omicron wave had far-reaching ramifications, extending to the routine medical care of other health conditions.

Furthermore, patients who perceived their symptoms as mild were more likely not to seek medical treatment and less likely to go to the hospital compared to those who perceived their symptoms as severe. This suggests that early public education and guidance may have had some effect, leading some people to no longer view COVID-19 as a severe disease that must be treated in a hospital. However, there were still almost 40% of patients with mild symptoms chose to seek medical treatment, which may affect the timeliness of medical treatment for patients with non-mild symptoms to the extent that medical resources were extremely limited. This might have aggravated the inaccessibility to healthcare resources among patients with non-mild symptoms, who waited longer for medical attention than mild patients based on the results. As such, the allocation of medical resources during a public health emergency and the correlated attention for patients with relatively severe symptoms should be improved in future. At the same time, the proportion of respondents who wanted to stockpile medications remains substantial, which may directly exacerbate the shortage of medicines during the peak of the wave. Emergent regulations of pharmaceutical dispensing and enhanced emergency preparedness may help to alleviate shortages in future.

Notably, our survey results indicate that almost a quarter of respondents who sought medical attention due to symptoms of COVID-19 had engaged with online consultations. Telemedicine, with its inherent capacity to enhance diagnostic efficiency and mitigate the risk of disease transmission during the diagnostic process, could serve as an effective strategy to alleviate the strain on medical resources during infectious disease outbreaks (Hollander & Carr, 2020; Mann et al., 2020; Smith et al., 2020; Wosik et al., 2020). Consequently, systematic developments of telemedicine towards its integration into the primary care and public health networks may help to strengthen the capacity and resilience of the healthcare system.

This study focused on pharmaceutical and medical resource accessibility of COVID-19 treatment, and examined its influence on clinical outcomes. As

such, it closely circumscribes pharmaceutical storage and distribution policies in anticipation of infectious disease outbreaks. It also indirectly relates to the essential drug list given the importance of infectious disease control and the scope of the disturbance caused by inappropriate management. Therefore, this research holds significant implications for the development and enhancement of public health strategies, as it sheds light on the imperative need for thorough and adaptable approaches to pharmaceutical management, ensuring the timely availability and efficient distribution of essential medications during infectious disease crises.

This study, while providing valuable insights, is not without its limitations. Firstly, for patients with mild symptoms who have not been admitted to a hospital, the self-perceived severity of symptoms serves as a crucial metric for condition evaluation. However, this measure carries an inherent degree of subjectivity. Certain individuals who have encountered difficulties in accessing medical treatment or procuring medication may be predisposed to perceive their symptoms as relatively severe due to psychological factors such as anxiety or frustration. Second, during the administration of the questionnaire, a subset of respondents might have been in the progression phase of the disease not yet sustaining the full course of the illness. Consequently, their reported duration of absence from work or daily activities due to illness might not accurately reflect the complete timeline of their disease experience. This factor should be taken into account when interpreting the findings related to disease duration and its impact on daily life. More, the generalizability of our study is limited by the restriction of sample recruitment in Shenzhen, which has a favourable economic and social development profile compared to most cities in China. Therefore, our findings may not be directly applicable to other settings. Despite these limitations, our findings provide critical implications for the planning of pharmaceutical and medical care resources in preparation for pandemics.

Conclusion

In summary, this study found that there was a lack of accessibility to medical resources in Shenzhen during the peak of COVID-19 infections from December 2022 to January 2023, and found that the lack of accessibility to medical resources may exacerbate the condition or delay recovery. Future endeavours are necessary to prepare the healthcare, public health, and emergency response systems for the next challenge of infectious diseases.

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Disclosure statement

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

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Ethics approval and consent to participate

The study protocol was approved by the Medical Ethics Committee of School of Public Health (Shenzhen), Sun Yat-sen University [no. 2023(10)]. Informed consent was obtained from all individual participants included in the study.

Authors' contributions

JC conducted literature review, analysed the data, wrote the manuscript and contributed to data collection. HF contributed to data collection and assisted with data analysis. JS contributed to data collection. YJ conceptualised and designed the study, was in charge of the overall study implementation, and contributed to the revision of the manuscript. All authors read and approved the final manuscript.

Data availability

The datasets generated or analysed during the current study are not publicly available due to the protection of the participants' privacy, but are available from the corresponding author on reasonable request.

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