

The Asymptomatic Infection of COVID-19 Risen in Imported Population in Shenzhen, China

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Short Report

Keywords: COVID-19, SARS-CoV-2, imported cases, asymptomatic infection

Posted Date: July 29th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-48824/v1>

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Abstract

Background

As of July 24 2020, the global reported number of COVID-19 cases was > 15.4 millions, with over 640,000 deaths. The present study aimed to carry out an epidemiological analysis of confirmed cases and asymptomatic infections in Shenzhen City to provide scientific reference for the prevention and control of COVID-19.

Methods

The epidemiological information of the 462 confirmed cases and 45 asymptomatic infections from January 19th to June 30th was collected in Shenzhen City, Southern China, and a descriptive analysis was performed.

Results

A total of 462 confirmed COVID-19 cases from January 19 to April 30, 2020 were reported in Shenzhen City, including 423 domestic cases (91.56%) and 39 imported cases (8.44%) who came back from other countries. Among domestic cases, the majority were cases imported from Hubei Province ($n = 312$, 67.53%), followed by local ones ($n = 69$, 14.94%). During the same period, a total of 45 asymptomatic infections were reported in Shenzhen City, including 31 local ones (68.89%) and 14 imported from abroad (31.11%). The proportion of asymptomatic infections in Shenzhen City was increasing over time ($Z = 13.1888$, $P < 0.0001$). The total number of local asymptomatic infections in Shenzhen City exceeded as the same pattern as that in other provinces ($\chi^2 = 118.830$, $P < 0.0001$). The proportion of asymptomatic infections among cases imported from abroad was higher than that of the same in domestic cases ($\chi^2 = 22.5121$, $P < 0.0001$, $OR = 4.8983$, 95%: 2.4052, 9.9756). No statistical significance was noted in the proportions of asymptomatic infections among imported cases from different countries ($\chi^2 = 7.7202$, $P = 0.6561$).

Conclusions

The majority of COVID-19 cases in Shenzhen City were imported cases who came back from Hubei Province in the early stage (before 1st March, 2020) and from abroad in the later stage (after 1st April, 2020). Scientific and effective prevention and control measures have resulted in only a few local infections in Shenzhen City. Asymptomatic infections accounted for an increasing proportion among cases imported from abroad, indicating that the prevention measures carried out in Shenzhen City did avoid the import of infected cases. Improving the detection capability to identify asymptomatic infections as early as possible will be of significance for the control outbreak of COVID-19.

Background

In early December 2019, Wuhan City of Hubei Province reported a novel coronavirus disease (Coronavirus disease 2019, COVID-19)[1–3], caused by the pathogen identified as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)[1–3]. Since the outbreak and spread of COVID-19, patients harboring the virus were the most prominent sources of infection[5], followed by asymptomatic infections (especially those in the latency)[5]. Thus, delayed identification and isolation resulted in the continuous accumulation of infection sources in communities, making it difficult to prevent and control the epidemic[6]. Furthermore, patients in the latency and convalescence might continue to spread the virus[6], making them sources of infection. SARS-CoV-2 is transmitted mainly through respiratory droplets and contact as well as by fecal-oral transmission and mother-to-fetus transmission[8], albeit rarely. Aerosol transmission of the virus under specific conditions is yet to be studied[8]. The novel coronavirus is an emerging pathogen to which humans are not yet immune and are generally susceptible. The novel coronavirus can infect people of all ages, as long as the conditions for transmission are optimal[11]. The close contacts of COVID-19 patients and asymptomatic infections are at a high risk of being infected by novel coronavirus[12].

The clinical performance of COVID-19 varies greatly[13, 14]. Mild patients, account for the vast majority (about 80.9%) of the cases[15, 16], have no symptoms of pneumonia, but fever, fatigue, and dry cough, with a stuffy nose, running nose, sore throat, and diarrhea are noted in a few cases, these present gentle progression and good prognosis. However, a few developed into severe and critical cases (about 19.1%) with continuous high fever, and then into pneumonia cases with a severe acute respiratory syndrome, renal failure, and hypoxemia that were difficult to treat and cure in the absence of specific drugs, resulting in high mortality in gerontal patients with underlying diseases (such as cardiovascular disease and diabetes)[15, 16].

The high virulence and contagious nature, SARS-CoV-2 made COVID-19 spread rapidly worldwide[17]. As of July 24, 2020, the global reported number of COVID-19 cases had reached more than 15.4 millions with over 640,000 deaths. To date, COVID-19 has been labeled as a disease of “global pandemic”. The rapid spread of COVID-19 posed great challenges to the medical, healthcare, and social emergency management of the countries and regions across the world. The rapid spread threatens the life safety and makes a significant impact on the economy and society such that no disease in the past 100 years could surpass it, making it a great concern for all state governments and all sectors of society.

Methods

Research design

A retrospective study was performed to observe and analyze COVID-19 confirmed cases and asymptomatic infections in Shenzhen City, Southern China.

Data source

The epidemiological investigation reports of all COVID-19 confirmed cases and asymptomatic infections in Shenzhen City from January 1 to June 30, 2020, were collected and investigated, and the demographic information, date of onset, date of report, date of entry, country or region of residence or travel before entry, the region of the report, track of entry, and course of identification of all research subjects were collected.

Definitions of cases

For the definition of COVID-19 confirmed cases and asymptomatic infections, please refer to the *Guidelines on Prevention and Control of COVID-19 (6th Revision)*. Domestic imported cases referred to those with a travel and residential history in Hubei Province (including Wuhan City) or in other provinces in China 14 days before the onset of symptoms, as well as their contacts. Cases without a travel and residential history in cities other than Shenzhen City at 14 days before onset were defined as domestic local cases. In addition, cases imported from abroad referred to the COVID-19 cases residing in Shenzhen, with a travel and residential history 14 days before onset and subject to no defined domestic source of infection according to epidemiological investigations. The local cases were associated with those imported from abroad or had a history of contact with such travelers; however, no defined domestic source of infection was detected by the epidemiological investigations.

Statistical analysis

Excel was used to build a case library of confirmed cases and asymptomatic infections, and SPSS 26.0 software (IBM, US) was used to conduct a statistical analysis. Information of the cases was input and verified in both software. Odds ratio (OR) and 95% confidence intervals (CIs) of categorical variables were calculated using two tailed Chi-square or Fisher's exact test. If, in terms of overall comparison, independent sample rates of multiple groups were statistically significant, the samples were compared with each other using chi-square test of independence, in which the test level $\alpha = 0.05$ is corrected with Bonferroni method to obtain $\alpha' = 0.05/k$ (k indicates the number of comparisons).

Results

Confirmed cases in Shenzhen City

Shenzhen City reported the first COVID-19 case on January 19, 2020. The first COVID-19 case imported from abroad on March 1, 2020 and the last case was on April 30, 2020, with no new cases from May 1 to June 30, 2020 (Fig. 1). From January 19 to April 30, 2020, Shenzhen City reported a total of 462 COVID-19 confirmed cases, including 423 domestic events (91.56%) and 39 imported from abroad (8.44%). Among domestic cases, the majority were imported from Hubei Province ($n = 312$, 67.53%), followed by local incidents ($n = 69$, 14.94%) and those imported from provinces other than Hubei Province ($n = 42$, 8.87%) (Table 1, Additional file 1).

Table 1
The cases source in Shenzhen City from January 19 to April 40, 2020

Case Source	Total n = 462 N (%)	Before February 12, 2020 n = 391 N (%)	After February 13, 2020 n = 71 N (%)	χ^2	<i>P</i>
Shenzhen (Local)	69 (14.94)	62 (15.86)	7 (9.86)	181.2698	< .0001
Other provinces	42 (8.87)	33 (8.44)	9 (12.68)		
Hubei Province	312 (67.53)	296 (75.70)	16 (22.54)		
Imported cases from abroad	39 (8.84)	0 (0.00)	39 (54.93)		

During the epidemic of COVID-19, Shenzhen City reported up to 393 imported cases, indicating that the COVID-19 cases in the city were primarily imported (85.04%, 393/462), with only 69 local infections (14.94%, 69/462) induced by imported cases under the effective prevention and control measures by Shenzhen City.

As shown in Table 1, from January 19 to February 12, 2020 and from February 13 to April 30, 2020, the development of COVID-19 in Shenzhen City changed significantly. From January 19 to February 12, 2020, COVID-19 cases in Shenzhen City were mainly imported from Hubei Province (75.70%), followed by local cases and those imported from provinces other than Hubei Province, while none were imported from abroad. However, from February 13 to April 20, 2020, cases imported from abroad accounted for the majority (54.93%) of the reported cases in Shenzhen City, followed by those imported from Hubei Province (22.54%) and those from other provinces (12.68%), while local cases accounted for only 9.68% of the total number of occurrences. This further indicated that the intensive community prevention, control measures, other comprehensive blocking strategies, and measures adopted by Shenzhen achieved significant results.

Asymptomatic infections and confirmed cases

Shenzhen City reported a total of 45 asymptomatic infections from January 19 to April 30, 2020, including 31 local ones (68.89%) and 14 imported from abroad (31.11%), while none were imported from Hubei or other provinces (Table 2). From January 19 to February 12, 2020, Shenzhen City reported only local asymptomatic infections (n = 6, 100.0%), while from February 13 to April 30, 2020, the proportion of asymptomatic infections imported from abroad rose to 35.90%. Taken together, the confirmed cases in Shenzhen during the development of COVID-19 were mainly imported (85.06%, 393/462), while the asymptomatic infections were mainly local (68.88%, 31/45), and both were statistically significant ($\chi^2 = 7.8372$, $P = 0.0051$, $OR = 2.5722$, 95% *CI*: 1.3018–5.0823).

Table 2
The sources of confirmed cases and asymptomatic infections in Shenzhen City, China

Date	Case source	Confirmed case	Asymptomatic infection	χ^2	<i>P</i>
Total	Shenzhen (Local) (n = 100) (N(%))	69 (14.94)	31 (68.89)	118.83	< .0001
	Hubei province (n = 312) (N(%))	312 (67.53)	0 (0.00)		
	Other provinces (n = 42) (N(%))	42(9.91)	0 (0.00)		
	Imported cases from abroad (n = 53) (N(%))	39 (8.44)	14 (31.11)		
From 2020-1-19 to 2020-2-12	Shenzhen (Local) (n = 68) (N(%))	62 (15.85)	6 (100.0)	21.63	< .0001
	Hubei province (n = 296) (N(%))	296 (92.79)	0 (0.00)		
	Other provinces (n = 33) (N(%))	33 (8.44)	0 (0.00)		
	Imported cases from abroad (n = 0) (N(%))	0 (0.00)	0 (0.00)		
From 2020-2-13 to 2020-4-30	Shenzhen (Local) (n = 32) (N(%))	7 (8.64)	25 (64.10)	41.09	< .0001
	Hubei province (n = 16) (N(%))	16 (19.75)	0 (0.00)		
	Other provinces (n = 9) (N(%))	9 (11.11)	0 (0.00)		
	Imported cases from abroad (n = 53) (N(%))	39 (48.15)	14 (35.90)		

Table 3
The time distribution of confirmed cases and asymptomatic infections in Shenzhen City, China

Month	Confirmed case n = 462 N (%)	Asymptomatic infection n = 45 N (%)	Total	χ^2	<i>P</i>
January	170 (100.00)	0 (0.00)	170	121.8704	< .0001
February	247 (96.11)	10 (3.89)	257		
March	34 (72.34)	13 (27.66)	47		
April	11 (33.33)	22 (66.67)	33		
Total	462	45	507		

As shown in Fig. 2, in terms of time distribution (by day), the proportion of asymptomatic infections in Shenzhen from January 19 to April 30, 2020 kept increasing (day by day) (according to Cochran–Armitage test for trend, $Z = 13.1888$, $P < 0.0001$). Similarly, the proportion of confirmed cases in Shenzhen from January to April 2020, declined every month, while that of asymptomatic infections showed a continuously rising trend (Cochran-Armitage test for trend, $Z = 11.7896$, $P < 0.0001$). The change in the proportion of asymptomatic infections indicated a statistical significance in the four months ($\chi^2 = 121.8704$, $P < 0.0001$). As there were differences as a whole, 6 ($k = n(n-1)/2 = 6$, n indicates the number of groups) pair comparisons were conducted, and the P -value was 0.008333 (the corrected test level $\alpha = \alpha/6 = 0.05/6 = 0.008333$ by Bonferroni). Thus, it could be deduced that asymptomatic infections in April accounted for a higher proportion than those in March ($\chi^2 = 11.9911$, $P = 0.0005$, $OR = 5.2308$, 95% *CI*: 1.9917–13.7374), those in February ($P < 0.0001$, $OR = 9.4441$, 95% *CI*: 3.8436–23.2053), and those in January ($P < 0.0001$), while those in March accounted for a higher proportion than those in February ($P < 0.0001$, $OR = 9.4441$, 95% *CI*: 3.8436–23.2053).

Therefore, the ratio of all asymptomatic infections to confirmed cases in Shenzhen was 1:10.27 (45/462), the same of asymptomatic domestic infections to confirmed cases was 1:13.61 (31/423), and that of asymptomatic infections imported from abroad to confirmed cases was 1:2.79 (14/39). The proportion of asymptomatic infections in cases imported from abroad was higher than that of the same in domestic cases ($\chi^2 = 22.5121$, $P < 0.0001$, $OR = 4.8983$, 95% *CI*: 2.4052–9.9756).

Confirmed cases and asymptomatic infections in Shenzhen imported from abroad

Shenzhen City reported the first confirmed case imported from abroad on March 1, 2020, and 39 confirmed cases and 14 asymptomatic infections imported from abroad on April 30, 2020 (Table 4). The UK, the USA, and France were the primary source nations of confirmed and asymptomatic cases. The

proportion of asymptomatic infections did not differ significantly among different countries of import ($\chi^2 = 7.7202, P = 0.6561$).

Table 4
Imported nations of confirmed cases and asymptomatic infected persons in Shenzhen, city

Nations	Total n = 53 N (%)	Confirmed case n = 39 N (%)	Asymptomatic infection n = 14 N (%)
The United Kingdom	18 (33.96)	14 (35.90)	4(28.57)
The United States	13 (24.53)	9 (23.08)	4(28.57)
France	8 (15.09)	4 (10.26)	4(28.57)
Philippine Islands	4 (7.55)	3 (7.69)	1(7.14)
Spain	2 (3.77)	2 (5.13)	0(0.00)
Brazil	2 (3.77)	2 (5.13)	0(0.00)
Switzerland	2 (3.77)	1 (2.56)	1(7.14)
Russia	1 (1.89)	1 (2.56)	0(0.00)
Netherlands	1 (1.89)	1 (2.56)	0(0.00)
Thailand	1 (1.89)	1 (2.56)	0(0.00)
Cambodia	1 (1.89)	1 (2.56)	0(0.00)

In terms of the time trend, the number of asymptomatic infections in Shenzhen imported from abroad did not decrease or increase daily (according to the Cochran-Armitage test for trend, $Z = 1.205, P = 0.2282$; Fig. 3). However, the proportion of asymptomatic infections increased significantly in April although the number of cases imported from abroad in April (45.4%, 5/11) and March (21.4%, 9/42) did not differ significantly ($\chi^2 = 2.3966, P = 0.1216, OR = 0.3273, 95\% CI: 0.0809-1.3233$).

Discussion

COVID-19 is an emerging infectious disease to which humans are generally susceptible as effective vaccines, specific therapeutic drugs, and methods of treatment are yet lacking[18, 19]. The infection spreads easily from person to person with convenient transmitting media. Therefore, taking strong control measures against the sources of infection, cutting off the routes of transmission, enhancing social distancing, and improving the protection capability of all people are optimal strategies to combat

the infection[20]. WHO has termed this approach as “Non-pharmacological Intervention,” or the “Blocking Strategy”[21, 22].

The present study performed a descriptive and exploratory analysis of COVID-19 confirmed cases and asymptomatic infections in Shenzhen City, and demonstrated that the spread of infection in the city was mainly via through two stages, the early stage (from January 9 to February 12, 2020) in which the cases were mainly those imported from Hubei Province (including Wuhan City) and the late stage (from February 13 to April 30, 2020) in which the cases were mainly those imported from abroad[8], while local cases in Shenzhen were at a low level of incidence and prevalence[8]. As of January 14, 2020, when the first suspected case (imported from Wuhan City) was reported, confirmed cases imported from Hubei Province accounted for 75.70% of all the confirmed cases in the early stage (296/391), while the same accounted for only 22.54% in the late stage, indicating that the control measures of the Wuhan city (from January 22, 2020 onwards) reduced the risk of an increase in the number of cases in other cities[21], thereby reducing the pressure of prevention and control of infection in other cities[21].

The number of confirmed cases in Shenzhen imported from other provinces in the late stage (12.68%) increased over those in the early stage (8.44%), indicating that targeted prevention and control measures should be improved and enhanced among the population that migrated to Shenzhen from other provinces at the early stage (from February 14, 2020). The ceased local outbreak of COVID-19 in Shenzhen indicated that Shenzhen municipal government implemented intensive joint prevention and control measures across the community to facilitate the legal tracing of the migration and flow tracks of key persons using advanced technology. These measures and the obtained data enable precise prevention and control, which made up for the defective prevention and control in the early stage and improved the faulty tolerance rate of the containment mechanism. In the late stage, the development of COVID-19 in Shenzhen changed fundamentally with the global pandemic as the cases imported from abroad accounted for the majority of the confirmed cases in the city, suggesting the need for timely adjustment of prevention and control measures (for instance, shutting down international flights). Moreover, precise and scientific prevention and control are effective strategies for coping with the dynamic development of COVID-19 internationally. The local cases in Shenzhen accounted for 15.86% in the early stage and 9.86% in the late stage, which indicated effective, comprehensive blocking strategies and measures such as community prevention and control that were continuously upgraded according to the dynamic development of COVID-19: timely severance of the routes of transmission, stoppage of the local outbreak, and reducing the prevalence among the population. These effective tools are the key measures that timely curbed and effectively quelled the development of COVID-19 in Shenzhen.

COVID-19 asymptomatic infections refer to those positive in nucleic acid testing with nasopharyngeal swabs but developing no novel coronavirus-related symptoms, such as fever, upper respiratory symptoms (cough and sore throat), fatigue, and gastrointestinal symptoms (for example, diarrhea). They are not referred to as “patients” due to the lack of symptoms[6], but they spread the virus easily while keeping frequent contact with others due to their unawareness of the infection[6, 23]. The main reasons for asymptomatic infections might be that the infections are yet to develop clinical manifestations in the

early stage of disease treatment or the individuals are strongly immune and develop no clinical manifestations after infection[24]. Such individuals recover after a period or continue to be a carrier. Due to the absence of clinical symptoms, such as cough or sneeze, asymptomatic infections are less prone to discharge their pathogens than confirmed cases, and hence, less prone to spread the virus theoretically.

Asymptomatic infections are difficult to be identified, and lack awareness of protection as they do not know about their infection; so their close contacts might result in the same or higher actual infectivity than confirmed cases[25]. Some studies have found that about 11% of asymptomatic infections turned out to be confirmed cases. According to the studies, in key epidemic areas of COVID-19 (for example, Wuhan City), asymptomatic infections amounted to 30,300/100,000 individuals, and in cities where imported cases accounted for the majority, the ratio of asymptomatic infections to confirmed cases was 1:2.17, the infection rate of COVID-19 in close contacts of asymptomatic infections was 4.11%, and the infection rate of close contacts of COVID-19 confirmed cases from asymptomatic infections showed no statistical significance. In the current study, the proportion of asymptomatic infections in Shenzhen increased continuously over time, indicating that our epidemic prevention measures did avoid the import of cases and that our monitoring system was strongly sensitive and capable of identifying early cases and infections yet developing symptoms.

The asymptomatic infections are the most insidious and leaky source of infection[26]; thus, the capability to identify these should be improved for such a virulent pathogen that enjoys routes of easy transmission. With less virulence discharge and no clinical symptoms, asymptomatic infections cannot be identified spontaneously, thereby rendering it necessary to improve the detection capability (with quantitative fluorescence PCR method, trace sequencing method, serum antibody testing method, and multi-method joint diagnosis method) to recognize the asymptomatic infections, which is crucial for controlling the outbreak of COVID-19.

Asymptomatic infections may be identified as follows: Among close contacts of COVID-19 cases; during active detection in the investigation of cluster outbreaks; during active detection of the exposed populations when tracing the infection sources of COVID-19 cases; during active detection of COVID-19 cases and persons with travel or residential history in regions of constant transmission.

Another study demonstrated that in Shenzhen City, the proportion of asymptomatic infections from January 19 to April 30, 2020 increased over time (day-by-day), which might be because of the following reasons: 1. We focused mainly on treating symptomatic infections (especially severe and critical ones) in the early stage of the outbreak and paid great attention to the prevention and treatment of asymptomatic infections only when the progress was consolidated in domestic epidemic prevention and control; 2. The continuous improvement of the detection capability and level and testing intensity enhanced the active identification of asymptomatic infections; 3. The pathogen might become less virulent and more insidious after infecting people. Asymptomatic infections as a more insidious source of infection accelerated the spread of COVID-19. Therefore, multiple nucleic acid testing stations were set up based on the active identification and screening, allowing those should be tested and those willing to be tested

both to be tested. Moreover, the measures to avoid imported cases, such as carrying out pre-examination at fever clinics and in inpatients, were taken to identify as many asymptomatic infections as possible and prevent the local outbreak of COVID-19.

The number of asymptomatic infections in Shenzhen in April showed a significant increase over that in March, according to our study, although the proportion of the entrants to the city did not increase over time. If international flights were gradually allowed to land in Shenzhen, the proportion of asymptomatic infections in entrants to the city might increase. To this end, it is critical to take strict prevention and control measures, strictly isolate and test the entrants to the city, screen out asymptomatic infections, implement strict medical quarantine and observation measures, and perform active and early treatment, so as to avoid further spread of COVID-19.

Confirmed cases and asymptomatic infections entering Shenzhen from abroad originated mainly from 11 countries, and the ratio of asymptomatic infections to confirmed cases (between 0.00% and 50.00%) had no statistical significance. This finding suggested that all individuals imported to Shenzhen from different countries regardless of the severity of COVID-19 in such countries have to be treated indistinguishably and conscientiously, without ignoring the entrants from countries with less severe development of COVID-19. In addition, stringent medical quarantine measures need to be exercised over all entrants to Shenzhen from abroad, which might extend the duration of medical observation of entrants engaging in people-intensive service industries (such as restaurant workers and market and supermarket workers) (quarantine of 21 days, i.e., allow them to work only after 14 days centralized medical observation plus 7 days of home observation) and increase the frequency of nucleic acid testing, in order to identify as many asymptomatic infections as possible.

At present, with the global pandemic of COVID-19[27], which has no defined duration, there is always a risk of imported sources of infection and China will always face the risk of imported cases as long as the pandemic is not under effective control, and as insidious sources of transmission, asymptomatic infections may also be one of the major risks in the future development of COVID-19[28]. Thus, normalized prevention and control measures are required for the prevention and control of COVID-19 at such a time when there are few local cases and a few imported cases and asymptomatic infections[27]. The professional institutions are required to perform effective disease detection and monitoring, build a sensitive, efficient, long-lasting, and well-run monitoring system, identify the epidemic as early as possible and take timely and scientific emergency disposal measures, and continue effective publicity and education on the prevention and control of COVID-19 while maintaining social distancing and wearing masks in crowded places to avoid the second outbreak of COVID-19 due to slack[29].

Limitation Of This Study

There were several shortcomings in this study needed to be addressed. It was a cross-sectional study and cannot be obtained causal conclusion. At the same time, the cases imported from abroad and with asymptomatic infection was not big, and the results may be unstably. Hence, the large-sample study

will be needed in the future, and the asymptomatic and pre-symptomatic COVID-19 merits additional research.

Conclusions

Asymptomatic infectors accounted for an increasing proportion among cases imported from abroad, indicating that improving the detection capability to identify asymptomatic infections as early as possible, it will be of significance for the control outbreak of COVID-19. Furthermore, the detection measures and strategies at airports, seaports, and land ports should be adjusted constantly according to the new changes in COVID-19 development in foreign countries, so as to timely identify the sources of infection and ensure that imported cases do not cause local infections.

Abbreviations

ARDS

Acute respiratory distress syndrome;

OR

Odds ratio;

CI

Confidence interval;

COVID-19

Coronavirus Disease 2019;

SARS-CoV-2

Severe acute respiratory syndrome coronavirus 2;

Declarations

Acknowledgements

We thank all patients, close contacts, and their families involved in the study, as well as the medical staff and public health workers who collected these important data.

Authors' contributions

MX-C and SX-Z drafted the manuscript, LA and DN-H performed the statistical analysis. RL-Z and JX-C conceived and designed the study. TJ-F, GG-Y, JH-C, SJ-M, YL-H and YS collected the basic data. JM, LH-X, XM-Z, BP and SS-F drafted tables and figures.

Funding

This study was financially supported by the Key scientific and technological project of Shenzhen Science and Technology Innovation Committee (Grant No. 202002073000003), the Shenzhen San-Ming Project for

prevention and research on vector-borne diseases (Grant No. SZSM201611064) , the Program for the Shanghai Natural Science Foundation of China (Grant No. 18ZR1443500).

Availability of data and materials

Data of the study can be freely available in additional file of this manuscript.

Ethics approval and consent to participate

The study was approved by the ethical review committee of the Chinese Clinical Trial Registry (ChiCTR2000033284).

Consent for publication

Not applicable.

Competing interests

All authors declare that they have no competing interests.

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Figures

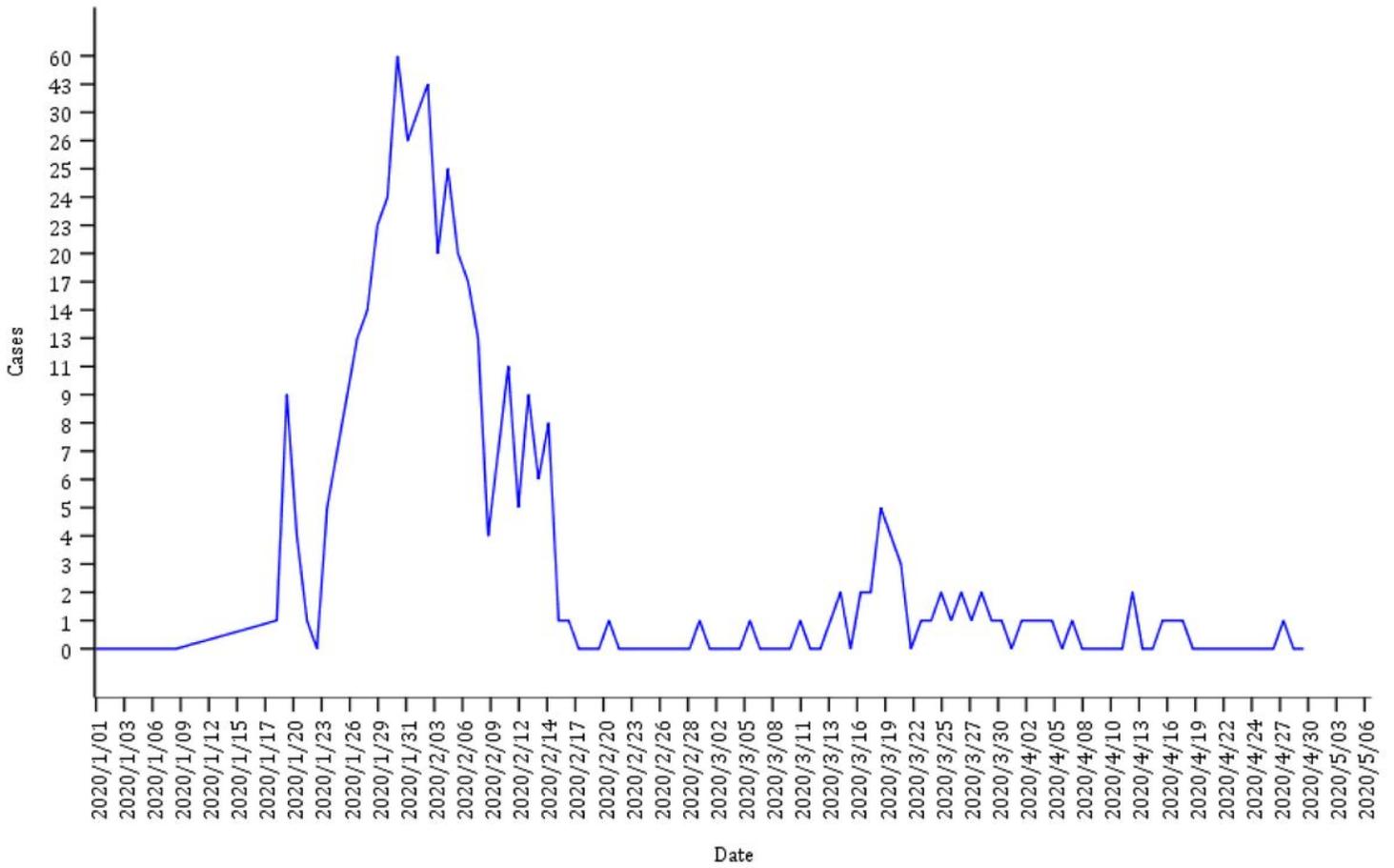


Figure 1

The time trend of COVID-19 confirmed cases in Shenzhen City, China

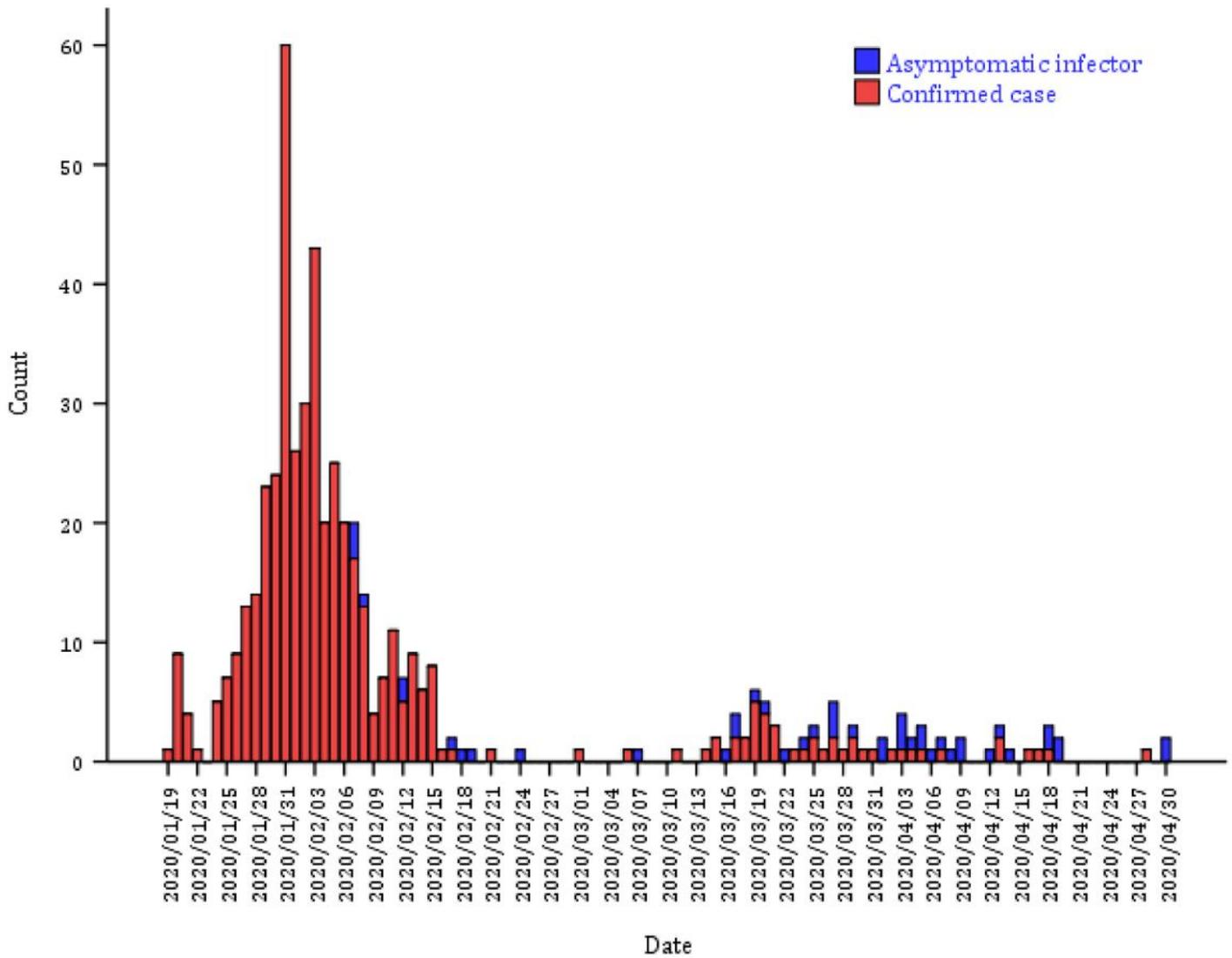


Figure 2

The time trend of COVID-19 confirmed cases and asymptomatic infection in Shenzhen City, China

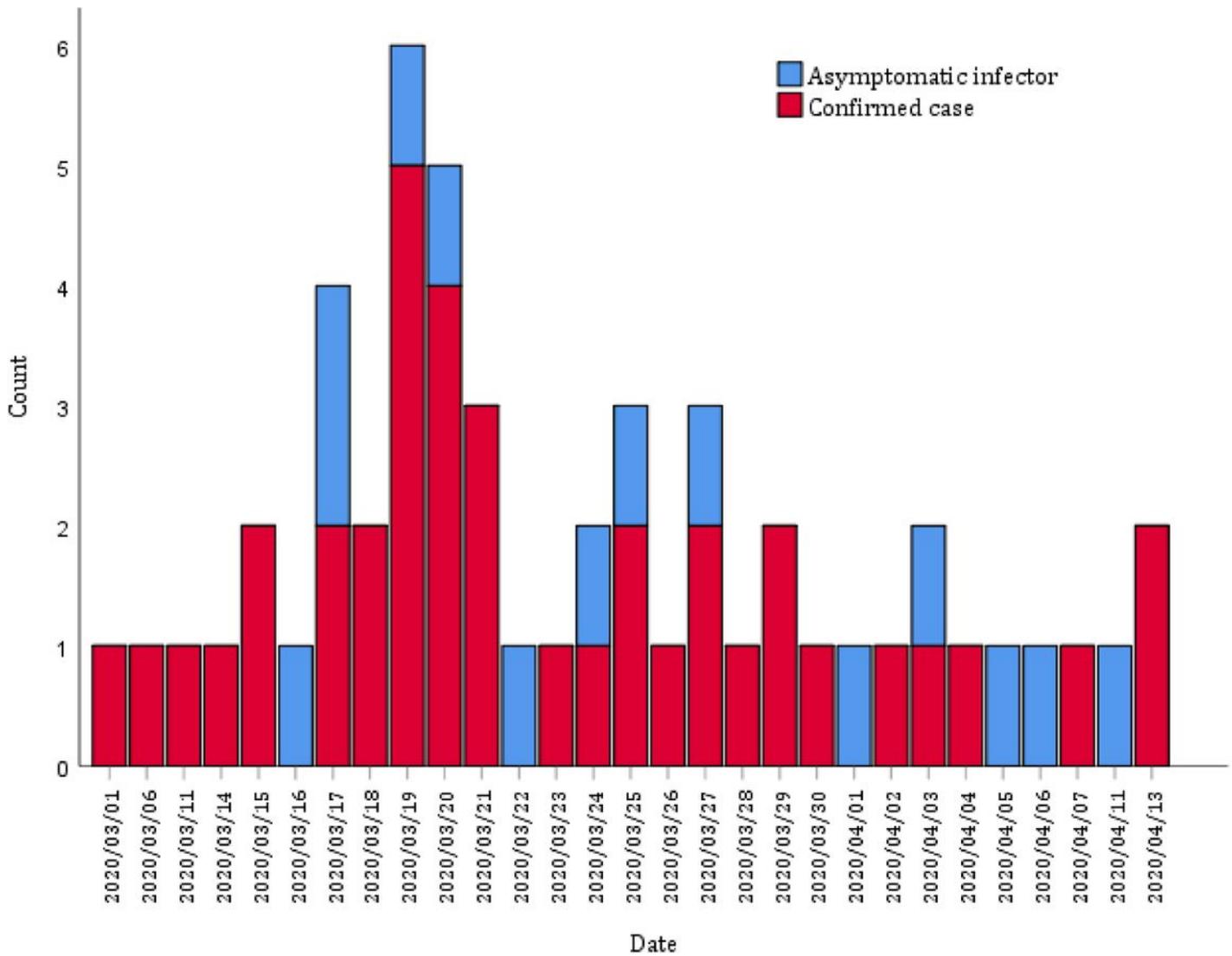


Figure 3

Time trend of COVID-19 confirmed cases and asymptomatic infections imported from other nations to Shenzhen city, China

Supplementary Files

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- [Additionalfile1data.xls](#)