The Impact of Intervention to Routine Surveillance of Natural Focal Diseases During the Outbreak of COVID-19 in Jiangsu Province, China

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Research

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Abstract

Background: With the strength intervention of China, the outbreak of Severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV-2) had a great control effect. The measures may influence the development and progression of others infectious diseases.

Method: The data of daily coronavirus virus disease 2019 (COVID-19) confirmed cases from January 3, 2020 to April 30, 2020 and natural focal disease cases from January, 2005 to April, 2020 were collected from Jiangsu Provincial Center for Disease Control and Prevention (Jiangsu Provincial CDC). We describe and compare the data of natural focal diseases from January to April, 2020 with the same months from 2015 to 2019 in the four aspects: trend of incidence, regional, age and sex distribution. Nonparametric tests were used to analyzed to the difference between the duration from onset of illness to date of diagnosis of natural focal diseases and the same period of the previous year.

Results: The incidence of malaria in February (0.9 per 10,000,000 people), March (0.3 per 10,000,000 people) and April (0.1 per 10,000,000 people) 2020 less than the lower limit for range of February (1.6-4.5 per 10,000,000 people), March (0.8-3.3 per 10,000,000 people) and April (1.0-2.9 per 10,000,000 people) from 2015 to 2019 respectively. The incidence of brucellosis in February was 0.9 (per 10,000,000 people), less than the lower limit for the range from 2015 to 2019 (1.6-4.5 per 10,000,000 people). The incidence of hemorrhagic fever (HF) in March was 1.0 (per 10,000,000 people), less than the lower limit for the range from 2015 to 2019 (1.4-2.6 per 10,000,000 people). However, the incidence of Severe Fever with Thrombocytopenia Syndrome (SEFT) in March was 0.3 (per 10,000,000 people), higher than the upper limit for the range from 2015 to 2019 (0.0-0.1 per 10,000,000 people). Furthermore, we respectively observed the incidence with various degree of reduction in male, 20-60 years old and both rural and urban areas.

Conclusions: In Jiangsu province, the incidence of natural focal diseases decreased during the outbreak of COVID-19 in 2020, especially malaria, HF and SEFT. The impact of interventions were felt most by male individuals within the age group of 20-50 years. The interventions for COVID-19 may control the epidemics of natural focal diseases.

Introduction

The coronavirus disease 2019 (COVID-19), which is an acute respiratory infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, was first detected in Wuhan, Hubei Province of the People's Republic of China in December 2019[1, 2]. The movement of people between Jiangsu and Hubei Provinces led to the infinite burden in controlling the COVID-19 epidemic in Jiangsu Province[3], on January 22, 2020, the first confirmed case of COVID-19 was found in Jiangsu Province[4], soon followed by an outbreak of 631 cases as of May 1. These epidemiologic factors caused the Jiangsu government actively respond to the outbreak of the disease by: urging the population to keep social distancing, stopping production and shutting down to limit mobility of the population and so on, which resulted in a drastic reduction in COVID-19 cases[5, 6].

Several studies have shown that corresponding prevention and control measures were effective in controlling the growth of COVID-19 cases[7, 8], including social distancing, lockdowns and so on. However, these interventions were effective in not only containing the COVID-19 outbreak, but also influenced the surveillance and spread of other infectious diseases, including the natural focal diseases[9, 10]. A study in Japan shows that seasonal influenza activity in the country was lower than in previous years due to COVID-19 outbreak in 2020[11]. However, a study in Latin America also showed that failure to continue surveillance programs on concurrent diseases such as dengue and relocating excessive efforts and resources onto COVID-19 containment may severely impact the public health system as a result of healthcare downturn[12]. Therefore, there are some controversies when it comes to the impact of infectious disease with the interventions for COVID-19.

In this study, we compared the value of natural focal diseases from January to April 2020 with value from January to April 2019, and then explore the impact of COVID-19 on routine surveillance of natural focal diseases during COVID-19 outbreak in Jiangsu Province. This study can provide scientific evidence for the prevention and control of natural focal diseases during COVID-19.

Method

Study area

Jiangsu, in the eastern province of China, with an area of 40,000 square miles and a population of about 80 million (ranked fifth most populated amongst the provinces in China), is a representative district. As of May 1, Jiangsu Province had more than 600 confirmed cases of COVID-19, and several studies reported the presence of different types of natural focal diseases in the province[13, 14, 15, 16], therefore, it is great value to find the impact of COVID-19 on routine surveillance of natural focal diseases.

Data collection

We collected the reported cases of natural focal diseases (brucellosis, malaria, hemorrhagic fever [HF], dengue, Severe Fever With Thrombocytopenia Syndrome (SFTS), Rabies, Tsutsugamushi and Japanese encephalitis [JE]) from 2015–2020 and data of the confirmed COVID-19 patients from January 22, 2020 to May 1, 2020 in Jiangsu Province by referring to the Health Records of Jiangsu Provincial Center for Disease Control and Prevention (Jiangsu Provincial CDC). The confirmed patients of COVID-19 were diagnosed based on the criterion of World Health Organization (WHO) interim guidance[17]. This study was approved by the Ethical Committee of Jiangsu provincial CDC. All data analyzed were anonymized.

Statistical analysis

We have described the incidence trend, the regional, age and gender distribution of natural focal diseases. The data were entered in Microsoft Excel 2019 (Microsoft Crop., USA). Statistical analyses were conducted with SPSS 13.0 software (IBM Corp., Armonk, NY, USA), and GraphPad Prism 7.0 (GraphPad Software, La Jolla, CA). Nonparametric tests were used to analyze the difference between duration from illness onset to diagnosed date of natural focal diseases in January-April 2020 and the same period for the previous four years.

Result

The incidence trend of natural focal disease

The incidence of natural focal diseases was high between September and December each year, with an increasing trend from September and a decreasing trend after reaching its peak in November (Fig. 1). The incidence in November 2015, 2016, 2017, 2018 and 2019 reached 15.29, 12.10, 8.98, 9.49 and 16.11 (per 1,000,000 people) respectively. And the incidence in February 2020 (0.40 per 1,000,000 people) was lower than that in the same period during the previous four years (range: 0.65–0.95 per 1,000,000 people); the incidence in March 2020 (0.40 per 1,000,000) was lower than that in the same period in the previous four years (range: 0.60–1.05 per 1,000,000 people); the incidence in April 2020 (0.47 per 1,000,000) was lower than that in the same period for the previous four years (range: 0.64–1.01 per 1,000,000 people).

The monthly distribution of natural focal disease

The incidence of January to April, 2020 was compared with the year from 2015 to 2019 (Fig. 2). The results showed that the incidence of brucellosis ranged from 0.5 to 3.1 (per 10,000,000 people) in February 2015–2019, while the incidence decreased to 0.3 (per 10,000,000 people) in February 2020. As for malaria, the incidence in February 2015–2019 ranged from 1.6 to 4.5 (per 10,000,000 people), while reduced to 0.9 (per 10,000,000 people) in February 2020; the incidence in March 2015–2019 ranged from 0.8 to 3.3 (per 10,000,000 people), while reduced to 0.3 (per 10,000,000 people) in March 2020; the incidence ranged from 1.0to 2.9 (per 10,000,000 people) in April from 2015–2019, while in April 2020, the incidence was dropped to 0.1(per 10,000,000 people). We also found that the incidence of HF ranged from 1.4 to 2.6 (per 10,000,000 people) in March from 2015 to 2019, while the incidence decreased to 1.0 (per 10,000,000 people) in March 2020. The incidence of SFTS in March, 2015–2019 ranged from 0 to 0.1 (per 10,000,000 people), while the incidence of SFTS increased to 0.3 (per 10,000,000) in March 2020. Moreover, the incidence of dengue, rabies, tsutsugamushi and JE in January-April 2020 were all within the range of previous years.

Distribution of duration from onset to date of diagnosis (DID) for natural focal diseases

The inter-quartile range (IQR) from January to April 2020 with January to April 2015/2016/2017/2018/2019 was compared. The results showed that the IQR of brucellosis, malaria and HF were still within the range as those during the same period for the previous four years. The IQR of Brucellosis from January to April 2020 was statistically different from that of 2015 and 2017 ($P < 0.05$).

The IQR of malaria and HF from January to April 2020 showed no statistically difference compared with the IQR of the previous four years (Table 1).

Table 1
Distribution of duration from onset of illness to date diagnosis for brucellosis, malaria and HF, Jiangsu Province, China, January to April, 2015–2020

Year	IQR(days)		
	Brucellosis	Malaria	HF
2015	11–57*	1–4	4–9
2016	4–61	2–4	4–9
2017	8–44*	2–6	4–11
2018	7–32	2–5	2–9
2019	1–23	2–4	3–9
2020	1–29	1–4	2–10

IQR inter-quartile range

**P* values have statistical significance.

The regional distribution of COVID-19, brucellosis, malaria and HF

Figure 3-A showed that the incidence of COVID-19 was high in Huai' an City (13.60 per 1,000,000 people), Nanjing City (11.74 per 1,000,000 people) and Changzhou City (11.21 per 1,000,000 people); the incidence of COVID-19 was low in Suqian City (3.05 per 1,000,000 people), Zhenjiang City (3.75 per 1,000,000 people) and Yancheng City (3.89 per 1,000,000 people).

The results also showed that the incidence of natural focal diseases (brucellosis, malaria and HF) in Wuxi city ranged from 0.14 to 0.60 (per 1,000,000 people) and 0.15 to 0.45 (per 1,000,000 people) in January and February from 2015 to 2019 respectively, but dropped to 0 (per 1,000,000 people) in January and February 2020; the incidence of natural focal diseases (brucellosis, malaria and HF) in Taizhou city and Yangzhou city ranged from 0.21 to 0.86 (per 1,000,000 people) and 0.44 to 0.89 (per 1,000,000 people) respectively in March 2015–2019, but dropped to 0 (per 1,000,000 people) in March 2020; the incidence of natural focal diseases (brucellosis, malaria and HF) in Nantong city ranged from 0.41 to 1.23 (per 1,000,000 people) in April, 2015–2019, but dropped to 0 (per 1,000,000 people) in April 2020 (Figure 3-B).

The gender distribution brucellosis, malaria and HF

In males, the incidence of brucellosis (Fig. 4-A) in January (0.49 per 100,000,000 people), February (0.49 per 10,000,000 people) and April (0.74 per 100,000,000 people) 2020 less than the lower limit for range of January (0.50–3.23 per 100,000,000 people), February (1.00-3.96 per 100,000,000 people) and March (1.00-5.47 per 100,000,000 people) from 2015 to 2019 respectively. The incidence of malaria (Fig. 4-C) in February (3.70 per 100,000,000 people), March (1.97 per 10,000,000 people) and April (0.74 per 100,000,000 people) 2020 less than the lower limit for range of February (4.97–10.21 per 100,000,000 people), March (3.21–9.47 per 100,000,000 people) and April (4.21–7.23 per 100,000,000 people) from 2015 to 2019 respectively. The incidence of HF (Fig. 4-E) in March (1.23 per 100,000,000 people) and April (0.98 per 100,000,000 people) 2020 less than the lower limit for range of March (1.99–4.98 per 100,000,000 people) and April (1.48–3.21 per 100,000,000 people) from 2015 to 2019 respectively.

However, the incidence of all the natural focal diseases in females were within the same range as of during previous four years (Fig. 4-B, D, F).

The age distribution of brucellosis, malaria and HF

We found that the incidence of brucellosis (Fig. 5) in the age group 20–30 years in March 2020 (0 per 100,000,000 people) was lower than that during the same period of the previous four years (range: 0.72–2.19 per 100,000,000 people); the incidence in the age group 30–40 years in February 2020 (0 per 100,000,000 people) was lower than that during the same period of the previous four years (range: 0.85–2.88 per 100,000,000 people); the incidence in the age group 50–60 years in January (0 per 100,000,000 people), February (0.81 per 100,000,000 people) and March (0.81 per 100,000,000 people) 2020 less than the lower limit for range of January (0.97–4.79 per 100,000,000 people), February (0.95–6.80 per 100,000,000 people) and March (2.85–5.74 per 100,000,000 people) from 2015 to 2019 respectively. The incidence in the age group ≥ 60 years in February 2020 (0.60 per 100,000,000 people) was lower than that during the same period of the previous four years (range: 1.37–6.18 per 100,000,000 people).

The results showed that the incidence of malaria (Fig. 6) in the age group of 20–30 years in March 2020 (0.85 per 100,000,000 people) was lower than that during the same period of the previous four years (range: 1.44–2.92 per 100,000,000 people); the incidence in the age group 30–40 years in February (0.85 per 100,000,000 people), March (0.85 per 100,000,000 people) and April (0.85 per 100,000,000 people) 2020 less than the lower limit for range of February (2.88–9.53 per 100,000,000 people), March (2.88–12.39 per 100,000,000 people) and April (1.94–3.88 per 100,000,000 people) from 2015 to 2019 respectively; the incidence in the age group of 40–50 years in April 2020 (0.74 per 100,000,000 people) was lower than that during the same period of the previous four years (range: 3.25–10.82 per 100,000,000 people); the incidence in the age group of 50–60 years in April 2020 (0 per 100,000,000 people) was lower than that during the same period of the previous four years (range: 3.24–6.80 per 100,000,000 people).

The results showed that the incidence of HF (Fig. 7) in the age group 20–30 years in March 2020 was lower than that in the same period previous four years (range: 0.72–1.46 per 100,000,000 people); the incidence in the age group of 30–40 years in February 2020(0 per 100,000,000 people) was lower than that during the same period of the previous four years (range: 0.95–3.84 per 100,000,000 people); the incidence in the age group of 40–50 years in January 2020(2.21 per 100,000,000 people) was lower than that during the same period of the previous four years (range: 3.20–5.18 per 100,000,000 people).

Urban and rural distribution of brucellosis, malaria and HF

About brucellosis (Fig. 8-A),in urban, the number of cases in February 2020 (1 case) was within the range of that during the same period of previous four years (range: 1–12 cases); the number of cases in March 2020 (2cases) was within the range of that during the same period of previous four years (range: 2–17 cases). In rural, the number of cases in February 2020 (1 case) was lower than that during the same period of previous four years (range: 2–16 cases).

As for malaria (Fig. 8-B), in urban, the number of cases in March 2020 (2 cases) was within the range of that during the same period of previous four years (range: 2–17 cases). In rural, the number of cases in February 2020 (1 case) was lower than that during the same period of previous four years (range: 2–16 cases).

About HF (Fig. 8-C), in the urbans, the number of cases in March 2020(3 cases) was within the range for cases obtained during same period for the previous four years (range: 4–9 cases). In rural areas, the number of cases in January 2020 (11 cases) was lower than that documented during the same period for the past four years (range: 16–27 cases).

Discussion

A kind of pneumonia of unknown cause occurred in Wuhan, Hubei, China in December 2019[18], and was named coronavirus disease 2019 (COVID-19) on February 11[19] by the World Health Organization(WHO) .Following the confirmation of the first case of COVID-19 in Jiangsu Province, the provincial government has been striving and focusing on epidemic prevention and control, appropriate countermeasures, such as limiting population mobility, lockout and so on had been taken, as a result, the number of daily confirmed new cases peaked and then declined over time in Jiangsu Province[20]. It indicates that the public preventive measures in limiting transmission of COVID-19 is greatly effective. If these measures were effective in controlling COVID-19, they will also have an impact on other diseases[21, 22, 23].

In this study, we analyzed the changing trend, the regional, age and gender distribution of natural focal diseases, so as to explore the impact of COVID-19 on natural focal diseases. Alongside with the decrease in daily diagnosed cases of COVID-19 in Jiangsu Province, we also find that the incidence of natural focal diseases from February to April, 2020 were lower than that during the same period of previous four years. Although we cannot directly evaluate the effect of each measure, restriction of population mobility would by far be among the most influential methods for the reduction in natural focal diseases transmission. The results showed that the differences of natural focal diseases’ IQR between January and April, 2020 and the same periods for the past four years was almost not statistically significant, indicating that COVID-19 did not affect the surveillance system of natural focal diseases in Jiangsu Province.

The incidence of malaria in February, March and April were lower than that during the same period of previous four years, however, our finding was inconsistent with studies in other areas or countries[24],the reason may be that malaria is predominantly endemic in these countries and is mainly caused by the bite of anopheles mosquitoes, but in Jiangsu Province, most malaria cases were imported cases from abroad[25]. After the outbreak of COVID-19, various prevention and control measures limited population mobility and reduced the import of malaria cases in Jiangsu Province. About the brucellosis, sheep/goat were the main contacted animals [26]. In our study, the incidence of brucellosis in February 2020 decreased, the reason maybe that since the COVID-19 outbreak, restrictions such as lockout and shutdowns may have reduced pastoralists' access to livestock and prevented the spread of brucellosis.

What's different is that we also found that the incidence of SEFT increased in March 2020 compared with the same period for the past four years, the reason may include: a) in the first half of this year, the temperature was relatively warm, due to the impact of COVID-19, the government adopted prevention and control measures such as restriction of people gathering or huddling, isolation of residents at home, ensuring there was little outdoor work. Some conditions that may be conducive to tick breeding, causing an increase in tick density and the virus rate are; b) since March, Jiangsu province has achieved initial success in the prevention and control of COVID-19, farmers have gradually resumed production and started to work in the field, increasing the risk of exposure; c) health education and publicity on ticks and tick infectious diseases were limited, and high-risk workers lacked the protection awareness of SEFT.

The results of regional distribution of natural focal diseases (brucellosis, malaria and HF) showed that the incidence in Wuxi city in January and February 2020, in Taizhou city and Yangzhou city in March 2020 and in Nantong city in April 2020 dropped to 0 (per 1,000,000 people). However, the incidence of COVID-19 in these four cities were not the highest in Jiangsu Province, but were in the middle range of cities, it may be related to that the incidence of natural focal diseases varies among cities in Jiangsu province, as a result, the disease affected by COVID-19 outbreaks were different. Moreover, we also found a decreasing in the incidence of brucellosis, malaria and HF in both urban and rural areas during COVID-19, suggesting that the incidence of natural focal diseases in both urban and rural areas were affected by the COVID-19 epidemic.

As a result of the COVID-19 outbreak, we found that the incidence of malaria in the age group 20–60 years was lower than during the same period of the previous four years, while the incidence of malaria in the < 20 and ≥ 60 age group was still within the range of that obtained during the same period of the previous four years. This may be due to the fact that most of the population entering the province from abroad is the working population who aged 20–60, so the incidence of malaria in this age group is significantly affected by COVID-19. The results also showed that the incidence of brucellosis in the age group > 20 years was lower than during the same period of previous four years, while the incidence of brucellosis in the age group < 20 years was still within the range of that documented during the same period of previous four years,This may be due to the higher prevalence of brucellosis among farmers[27], and the age of farmers are mainly > 20 years, so the people in this age group were more likely to be affected by COVID-19. Moreover, we found that the incidence of HF in the age group of 20–50 years was lower than that of the same period during the previous four years, this is because the incidence of HF is mainly in the age group of 20–60 years, young and middle-aged farmers have more field work and have greater exposure to rats and their pollutants. Since the outbreak of the COVID-19 epidemic, the frequency of field work of farmers has decreased, so the incidence of the HF in this age group was greatly affected.

Another interesting finding is that our analysis shows that the incidence of brucellosis from January to April 2020 was lower than during the same period of the previous four years, while the incidence of female diseases was still within the range for the previous years. This maybe relate to that slaughtering of animals and assisting in animal parturition is the risk factors of brucellosis[28], most of the workers doing these jobs are men, under the influence of COVID-19 and the prevention and control measures, most workers have been quarantined at home, and their exposure risk has dropped sharply. We also found that from January to April 2020, the incidence of malaria in men was lower than during the same period for the previous four years, while in women it was within the previous years' range. The majority of imported malaria cases in Jiangsu province are males[25], so reduced population mobility as a result of COVID-19 will lead to fewer imported cases of malaria, this may have a greater impact on incidence of men.

Limitation

This study has limitations. First, we limited to pinpoint the real reason for the decrease of natural focal disease activity, it may be related to: a) decrease in hospital visits and decrease in testing of the people might have attributed to decrease in testing; b) the incidence of natural focal diseases has indeed decreased. Second, we have not established a model to predict the trends of natural focal diseases in the future. Other studies have used mathematical models to assess the level of risk for re-transmission in the region[29, 30]. In the future, we can carry out further relevant researches by establishing mathematical models of diseases. Third, some other factors, such as climatic factors, economic factors, social factors and so on, which may affect the spread of the disease[31, 32], were not considered in this study.

Conclusion

During the period of COVID-19, the surveillance of natural focal diseases has been affected in Jiangsu Province, the incidence of natural focal diseases decreased compared with that during the same period of the previous four years, especially in malaria, HF and SEFT. The most impact of interventions was on individual males and the age group 20–50 years. The interventions of COVID-19 may control the epidemics of natural focal diseases. The intervention measures of COVID-19, such as limiting population mobility, shutdown, halt in production and so on may influence the incidence of natural focal diseases.

Abbreviations

CDC: Center for Disease Control and Prevention; SARS-CoV-2:Severe Acute Respiratory Syndrome-Coronavirus 2; HF: hemorrhagic fever, SFTS: Severe Fever With Thrombocytopenia Syndrome, JE:

Japanese encephalitis

Declarations

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Ethics approval and consent to participate

This effort of disease control was part of CDC's routine responsibility in Jiangsu Province, China. Therefore, institutional review and informed consent were not required for this study. All data analyzed were anonymized.

Consent for publication

Not applicable.

Availability of data and material

Data supporting the conclusions of this article are included within the article.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

TMC, CJB, LL and ZZZ designed research; JLH, LL, ZZZ, CL, JFH, ZYL, WKL, LL, PHL, TLY and XQC analyzed data, TMC, LL, ZZZ, NZ, MNH, RJ, MY, YZZ, YW, JWX, JFH, ZYL, SNL, SYL and JLH conducted the research and analyzed the results; TMC, JLH, XQC, LL and ZZZ wrote the manuscript. All authors read and approved the final manuscript.

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Figures

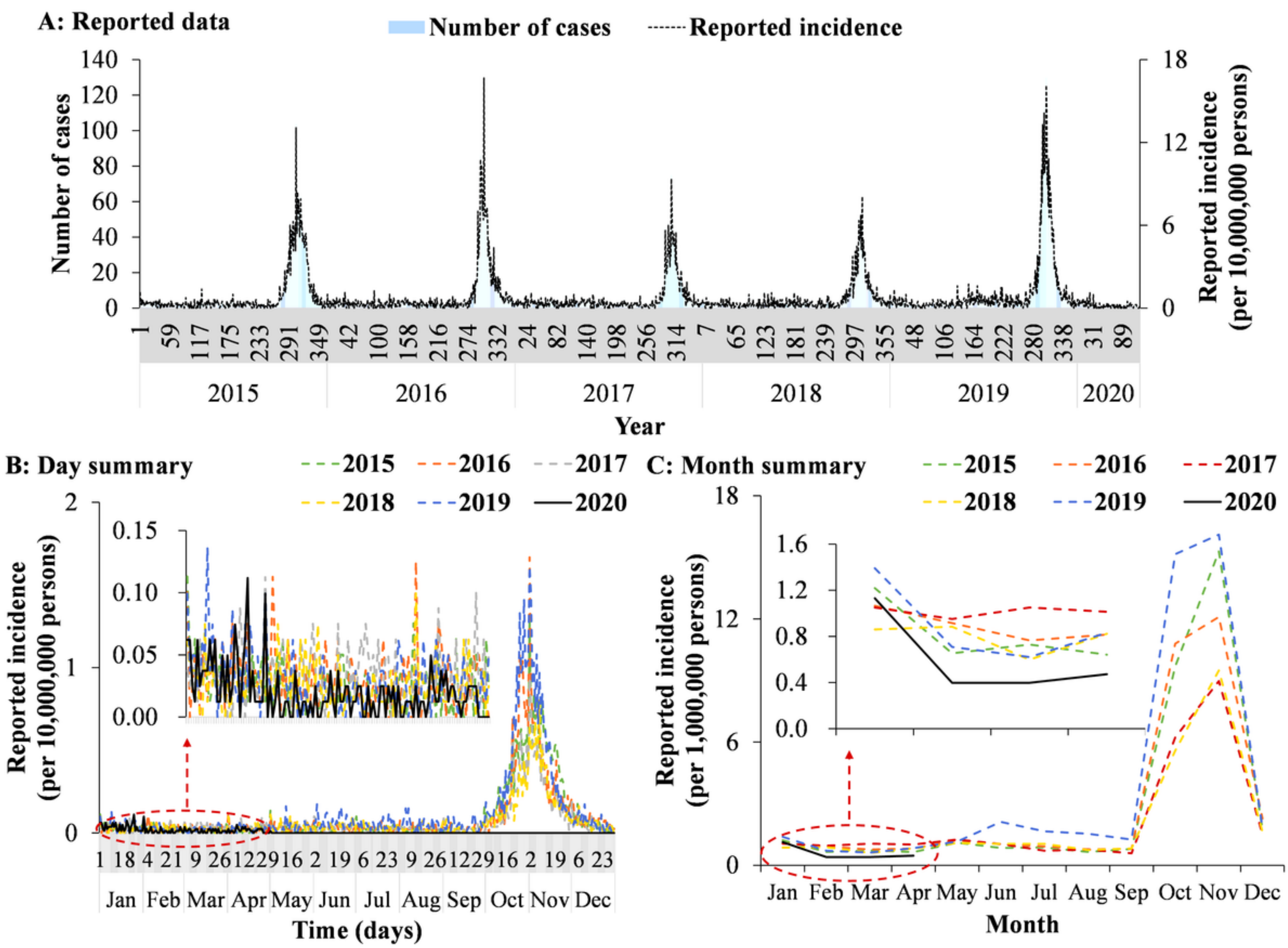

Figure 1

Number of cases and reported incidence of natural focal diseases from 2015 to 2020. (A) Reported data; (B) Day summary; (C) Month summary.

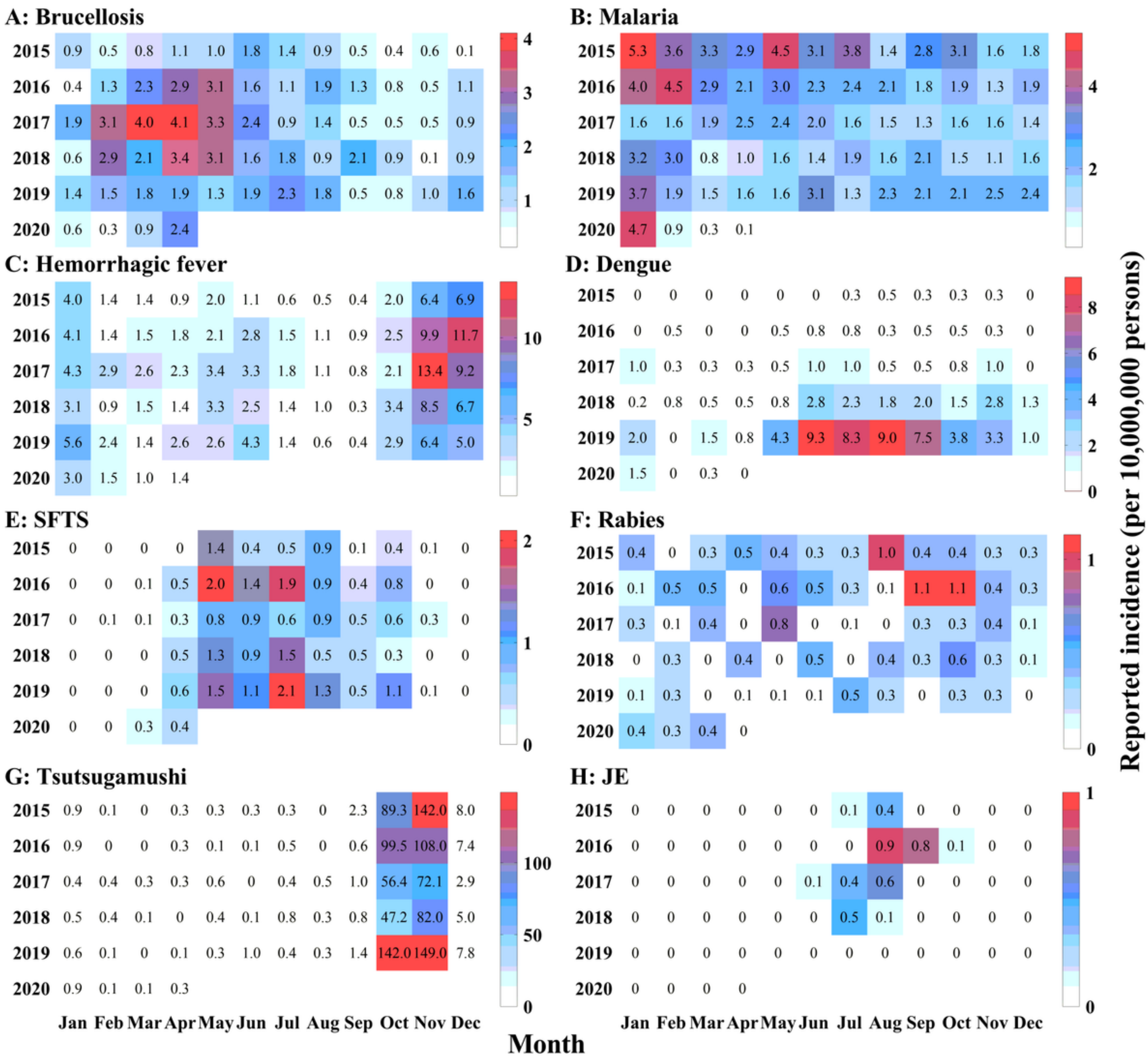

Figure 2

Month distribution of natural focal diseases, Jiangsu province, China, 2015–2020. (A) Brucellosis; (B) Malaria; (C) Hemorrhagic fever; (D) Dengue; (E) SFTS; (F) Rabies; (G) Tsutsugamushi; (H) JE.

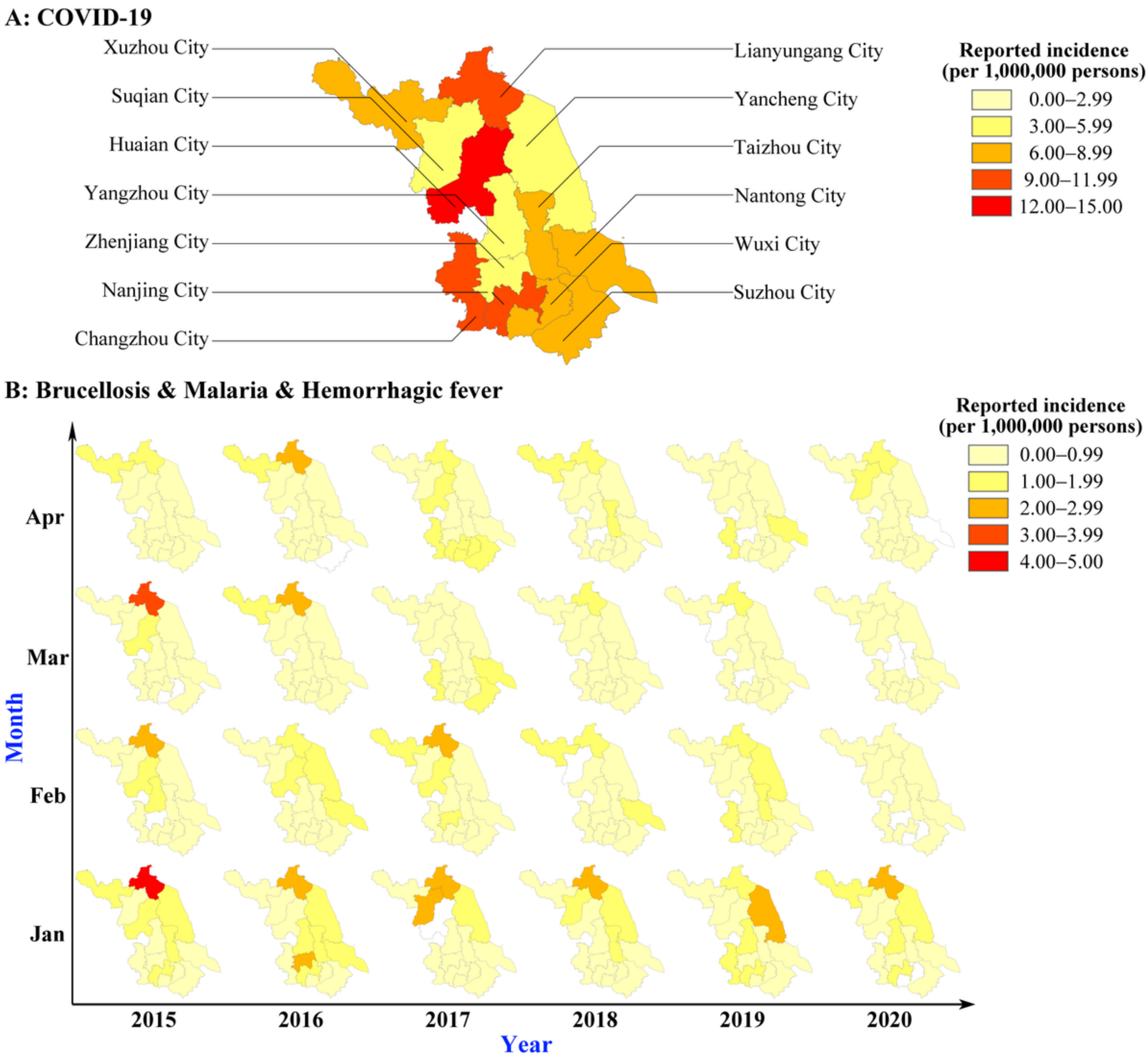

Figure 3

Geographical distribution of COVID-19 and natural focal diseases, Jiangsu province, China, 2015 – 2020. (A) COVID-19; (B) Brucellosis and malaria and hemorrhagic fever. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

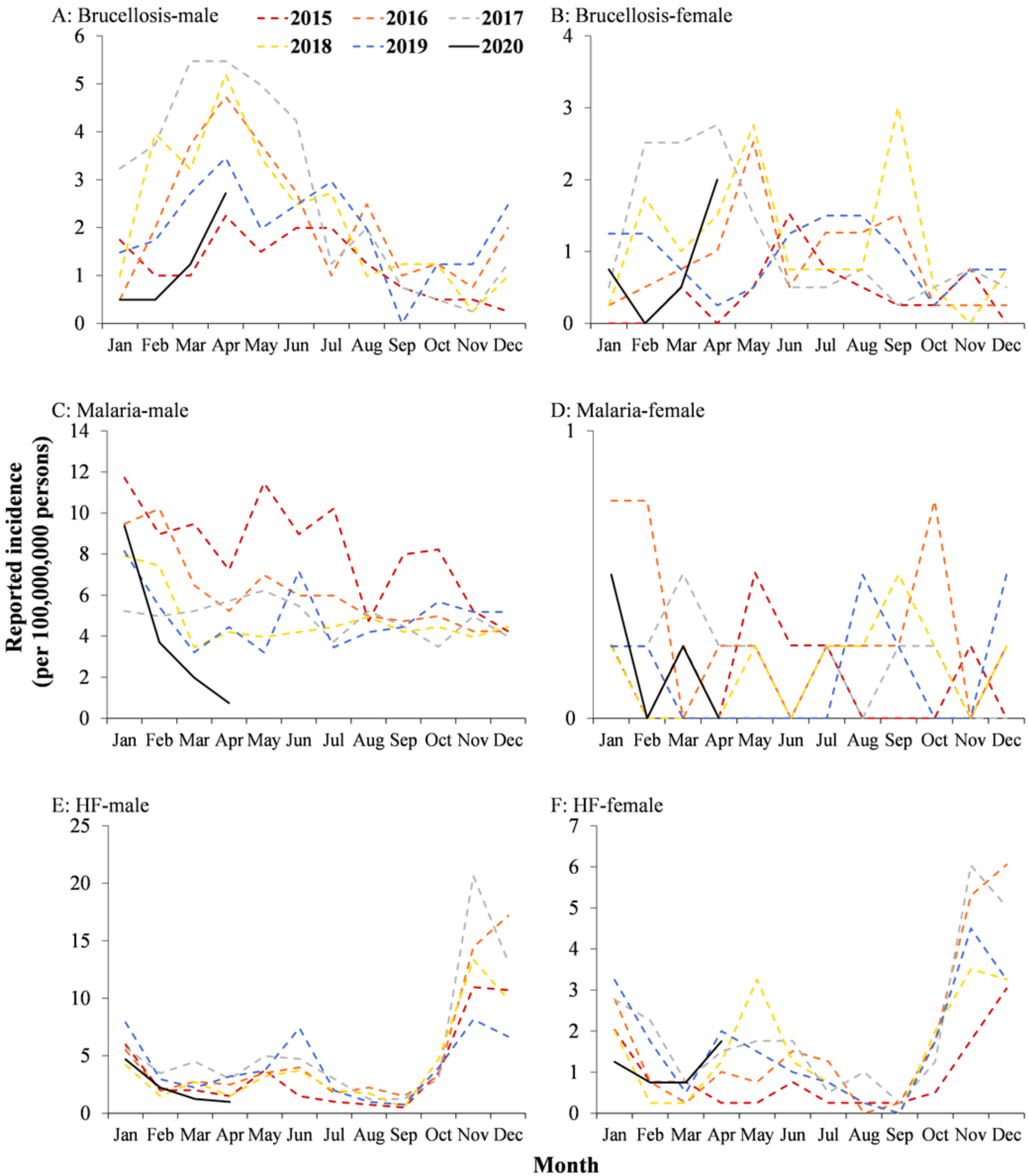

Figure 4

Gender distribution of brucellosis, malaria and HF, Jiangsu province, China, 2015 – 2020. (A, C, E) Male distribution of brucellosis, malaria and HF; (B, D, F) Female distribution of brucellosis, malaria and HF.

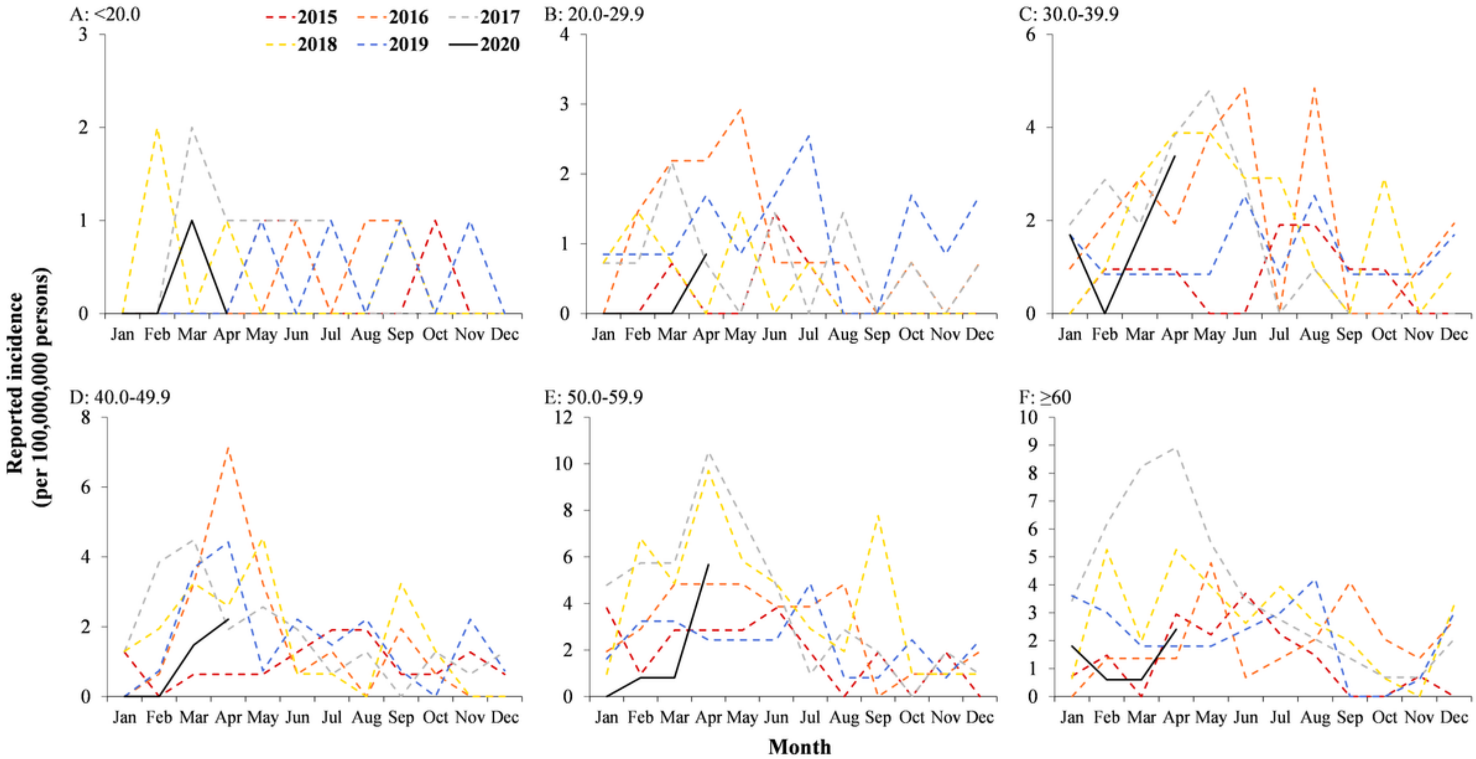

Figure 5

Age distribution of Brucellosis, Jiangsu province, China, 2015 – 2020. (A) <20.0 years old; (B) 20.0-29.9 years old; (C) 30.0-39.9 years old; (D) 40.0-49.9 years old; (E) 50.0-59.9 years old; (F) ≥60 years old.

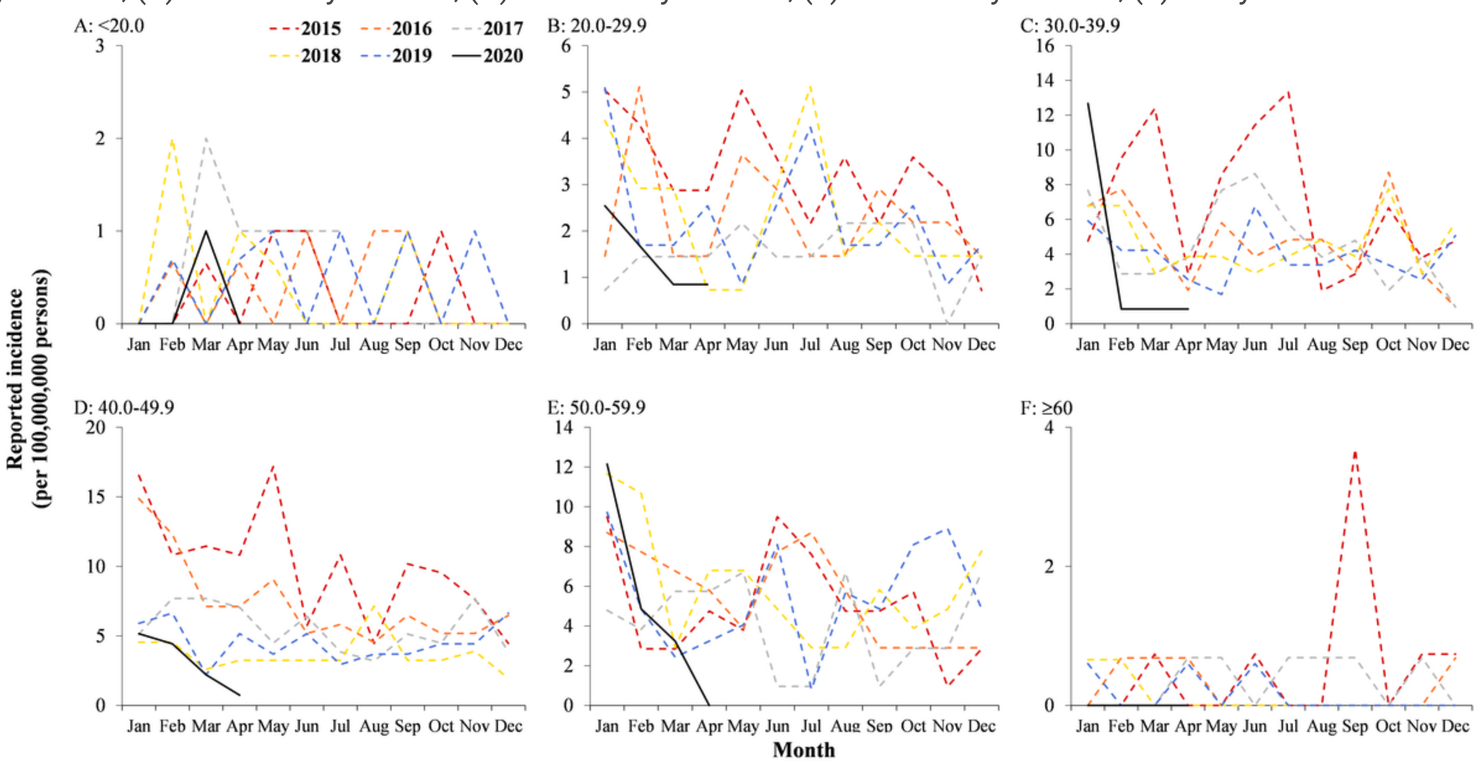

Figure 6

Age distribution of Malaria, Jiangsu province, China, 2015 – 2020. (A) <20.0 years old; (B) 20.0-29.9 years old; (C) 30.0-39.9 years old; (D) 40.0-49.9 years old; (E) 50.0-59.9 years old; (F) ≥60 years old.

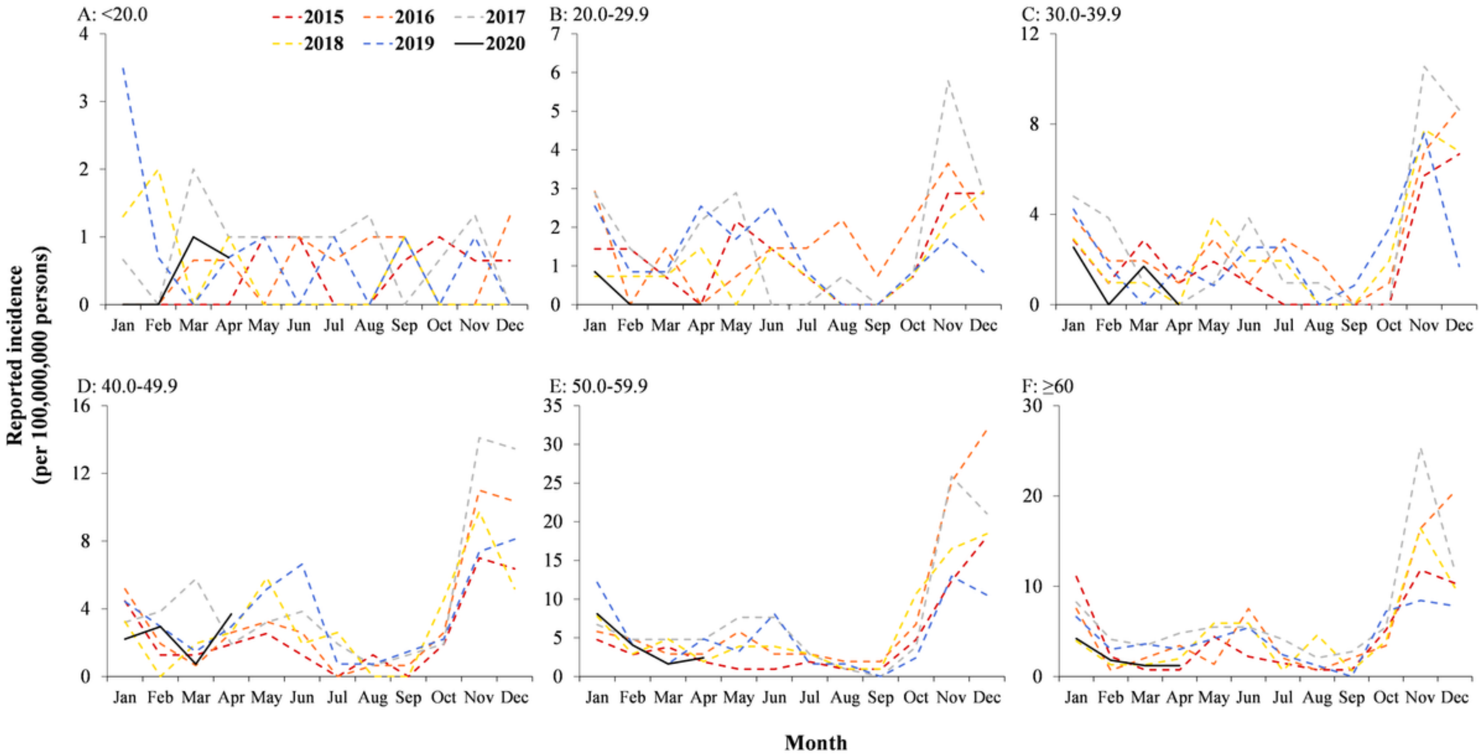

Figure 7

Age distribution of HF, Jiangsu province, China, 2015 – 2020. (A) <20.0 years old; (B) 20.0-29.9 years old; (C) 30.0-39.9 years old; (D) 40.0-49.9 years old; (E) 50.0-59.9 years old; (F) ≥60 years old.

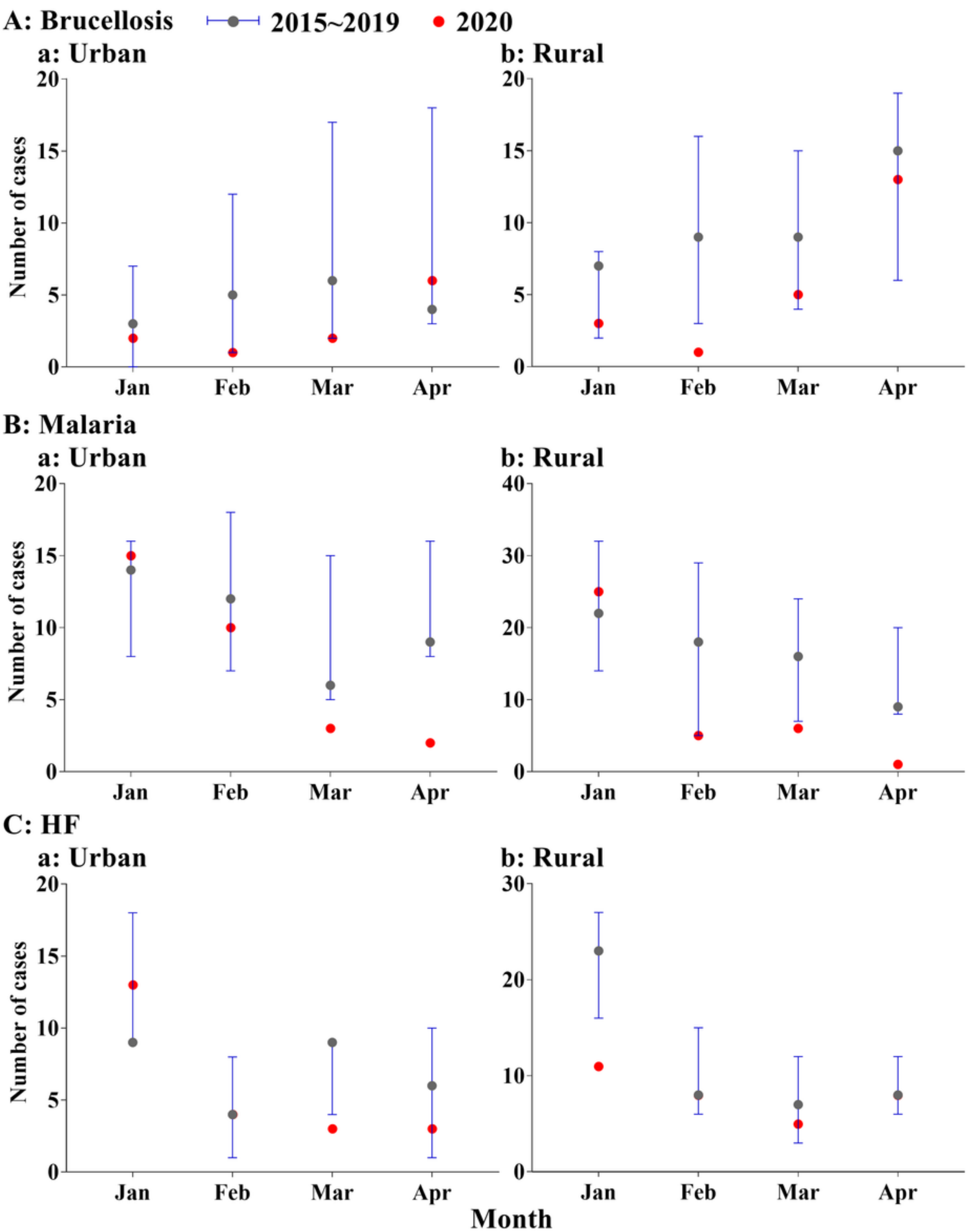

Figure 8

Urban and rural distribution of brucellosis, malaria and HF, Jiangsu province, China, 2015 – 2020. (A) Brucellosis, (A-a) Urban, (A-b) Rural; (B) Malaria, (B-a) Urban, (B-b) Rural; (C) HF, (C-a) Urban, (C-b) Rural.

Supplementary Files

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