

Change of disease distribution in pediatric neurology inpatients during the COVID-19 outbreak in southwest China

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Abstract

This study aimed to investigate the change of disease distribution in pediatric neurology inpatients during the COVID-19 outbreak in southwest China. We retrospectively extracted the demographic data and diagnosis of discharged patients registered at pediatric neurology department of Chengdu Women's and Children's Central Hospital from January 1 to July 31, 2019 and January 1 to July 31, 2020. Total number of inpatients decreased during COVID-19 outbreak. Children diagnosed as febrile seizure caused by infection (1799/60.7% vs 980/59%, $P = 0.141$), dyskinesia (31/1.0% vs 28/1.7%, $P = 0.075$) and benign intracranial hypertension (41/1.4% vs 21/1.3%, $P = 0.791$) did not change. While children diagnosed as epilepsy (304/10.3% vs 348/21%, $P < 0.001$), migraine (25/0.8% vs 31/1.9%, $P = 0.003$), mental disease (24/0.8% vs 43/2.6%, $P < 0.001$) and peripheral neuropathy (38/1.3% vs 43/2.6%, $P = 0.001$) increased in 2020. Children diagnosed as intracranial infection (535/18% vs 113/6.8%, $P < 0.001$) and myopathy (106/3.6% vs 22/2.0%, $P = 0.003$) reduced in 2020. *Conclusions:* We found a significant increase in the proportion of mood-related diseases, while disease caused by infection decreased. We should pay attention to children's mental state during the public health epidemic and the management of chronic disease.

Introduction

The novel coronavirus is the agent of coronavirus disease-2019 (COVID-19), that was first diagnosed on December 8, 2019 in a patient in Wuhan, China ¹ and quickly spread in China and other countries ². Most diagnosed COVID-19 patients had mild respiratory illness and were self-limited, while some patients developed severe progressive pneumonia and multiorgan failure ³⁻⁵. According to World Health Organization (WHO), to date, there are more than 23.63 million reported cases and more than 800,000 deaths of COVID-19 globally (World Health Organization; Aug 24, 2020).

In view of this alarming development and the rapid growth of cases after the epidemic outbreak in China, the government inhibited population mobility and asked people to stay at home in order to cut off the spread of the disease. Doctors from all over the country went to support Wuhan, and medical resources were redistributed. Internal medicine, emergency room, pulmonary/critical care and anesthesiology colleagues were at the frontlines, neurologists were playing a critical role in patient care. Although through our efforts, the disease has been basically under control now, there are still some small outbreak. For public population, the lack of effective treatment and excessive attention to media reports about disasters increase their anxiety and panic ^{6,7} and were afraid of going to hospital.

The present study compared the change of diseases distribution in pediatric neurology inpatients during the COVID-19 outbreak in southwest China. It also explored the possible reasons and provide some guidance when facing such sudden outbreak of disease.

Methods And Materials

This study was approved by the ethics committee of Sichuan University, since it was a retrospective study and did not involve participants' private information, thus patients' informed consent was not needed.

Participants

This is a retrospective cohort study. We extracted the demographic data, length of hospital stay (LOH) and the first three diagnosis of discharged patients registered at pediatric neurology department of Chengdu Women's and Children's Central Hospital from January 1 to July 31, 2019 and January 1 to July 31, 2020. Discharge diagnosis of all these patients was coded according to the International Classification Of Disease (ICD-10). Patients were grouped according to the first discharged diagnosis. Respiratory infection included children diagnosed with acute upper respiratory infection, pneumonia, acute tonsillitis, pharyngitis, rhinitis, bronchitis and influenza. Digestive infection included those diagnosed with acute gastroenteritis, acute gastritis, or diarrhea. Other infections composed of infection of skin and mucous membrane, urinary system, myocarditis.

Statistical analysis

A database was created in Excel, and statistical analysis was performed using SPSS 25.0 (SPSS Inc., Chicago, IL, USA). The continuous variables are presented as mean and standard deviation (SD), interquartile range (IQR), independent t-test or Mann-Whitney U-test were applied. The incidence rates are expressed in percentiles, to examine the difference of categorical variables between two years, Fisher's exact test or χ^2 -test were assessed.

Results

Demographic data of inpatients in two years

A total of 2,964 inpatients discharged between January 1 and July 31, 2019, while there were only 1,660 inpatients discharged between January 1 and July 31, 2020, which reduced greatly during COVID-19 outbreak. Comparison of demographic data between discharged patients within two years was listed in **Table 1**. The mean age of discharged inpatients in 2019 was 3.09 years (range, 10-16 years, IQR 1-5 years), which was similar to children discharged in 2020 (mean, 3 years; range, 0-17 years, IQR 0.8-4 years; $P = 0.380$). Patients in two years had similar distribution of sex (male: 1708 [57.6%] in 2019, 921 [55.5%] in 2020, $P = 0.164$). Length of hospital stay of inpatients in 2019 (median 7.01, range, 2-48 days, IQR 5-7 days) was longer than that in 2020 (median 6.52, range, 2-48 days, IQR 5-9 days; $P < 0.01$).

Disease distribution in 2019 and 2020

By analyzing the discharge diagnosis of patients, we found that the disease distribution of hospitalized patients in two years was basically consistent (**Fig. 1**). According to the patient's first discharge diagnosis, we divided the diseases into 10 categories. The most common disease was febrile seizure caused by infection, followed by epilepsy and intracranial infection. Pediatric inpatients diagnosed as myopathy, peripheral neuropathy, benign intracranial hypertension, dyskinesia, mental disease and

migraine occupied only about 10%. The rarest diagnoses were grouped together, such as demyelinating diseases of the central nervous system, toxin, development disorders, metabolic disorders, trauma and cerebrovascular disease.

Diagnosis of myopathy mainly included myositis, myasthenia gravis (MG) and myodystrophy. Diagnosis of peripheral neuropathy consisted of disorder of facial nerve (facial neuritis and peripheral facial palsy), Guillain-Barre syndrome (GBS) and intercostal neuralgia.

Change of disease distribution during COVID-19 outbreak

When we compared the discharged diagnosis of inpatients in 2019 and 2020, we found that the disease distribution changed between two years, which might be influenced by COVID-19 outbreak. The results showed that proportion of children diagnosed as febrile seizure caused by infection (1799/60.7% in 2019, 980/59% in 2020, $P = 0.141$), dyskinesia (31/1.0% in 2019, 28/1.7% in 2020, $P = 0.075$) and benign intracranial hypertension (41/1.4% in 2019, 21/1.3% in 2020, $P = 0.791$) was similar between two years. As for febrile seizure caused by infection, the most popular reason was respiratory infection, which was reduced in 2020 (1677/56.6% in 2019; 887/53.4% in 2020; $P = 0.042$), then was digestive system infections, which was similar between two years (86/2.9% in 2019; 51/3.1% in 2020; $P = 0.786$) and the less common infection occupied 1.2% in 2019 and increased to 2.5% in 2020 ($P = 0.001$).

While proportion of children diagnosed as epilepsy (1799/60.7% in 2019, 980/59% in 2020, $P = 0.141$), migraine (31/1.0% in 2019, 28/1.7% in 2020, $P = 0.075$), mental disease (41/1.4% in 2019, 21/1.3% in 2020, $P = 0.791$) and peripheral neuropathy in 2020 (38/1.3%) was higher than that in 2019 (43/2.6%, $P = 0.001$). For those diagnosed with peripheral neuropathy, the proportion of patients with GBS was similar within two years (5/0.2 in 2019; 3/0.2 in 2020; $P = 1.000$), while children diagnosed with disorder of facial nerve in 2020 were more than that in 2019 (33/1.1% in 2019; 39/2.3% in 2020; $P = 0.002$). On the contrary, children diagnosed as intracranial infection (535/18% in 2019; 113/6.8% in 2020; $P < 0.001$) and myopathy (106/3.6% in 2019; 22/2.0% in 2020; $P = 0.003$) was lower in 2020 than that in 2019. As for myopathy, the proportion of children diagnosed with MG was similar between two years (26/0.9% in 2019; 25/1.5% in 2020; $P = 0.056$), the proportion of children diagnosed with myositis also decreased in 2020 (80/2.7 in 2019; 4/0.2 in 2020; $P < 0.001$), only 4 patients were diagnosed as myodystrophy in 2020. The rare diseases in 2019 were more than that in 2020 (61/2.1% in 2019; 20/1.2% in 2020; $P = 0.035$), since there were more hospitalized patients, we had more opportunities to encounter rare diseases. Results were shown in **Table 1** and **Fig. 2**

Discussion

Several cases of pneumonia were reported in Wuhan, China in late December 2019 and quickly spread to most countries around the world⁸. The World Health Organization declared COVID-19 a global pandemic as of March 11, 2020. This study describes disease distribution in pediatric neurology inpatients during the COVID-19 outbreak in southwest China, compares it with the same period in 2019. To our knowledge,

this is the first study that investigates the impact of COVID-19 on the disease distribution in pediatric neurology inpatients and may provide some hints for clinician during a global public health emergency.

In our study, we found that the total number of inpatients in pediatric neurology department decreased dramatically during the COVID-19 outbreak. We thought this was related with a series of precautions we have taken during the COVID-19 period. Since the outbreak of COVID-19, many extreme measures have been taken to prevent the spread of the disease, especially in China. For medical service, some hospitals have become designated hospitals to accept confirmed patients, general medical wards were converted to quarantine wards for contracted patients, routine outpatient clinics were suspended and fever clinics were set up and general wards only received patients in urgent need in many areas across China. Beyond that, more than 40000 doctors from all over the China had been sent to Wuhan. These clinicians include all subspecialties, such as neurologists and anesthesiologists, specialist in critical care medicine, respiratory physician and general physician, greatly reducing medical resources for other disease conditions. For public, they were suggested to stay indoors, especially for children who were at high-risk of being infected. As a result, the total number of inpatients decreased significantly.

We also noticed that the proportion of children diagnosed with epilepsy, mental disease, migraine and peripheral neuropathy rose during COVID-19 outbreak. A number of mental health surveys on adults associated with the COVID-19 outbreak had been conducted, Liu et al.⁹ reported that the prevalence of depression and anxiety among medical staff was 51% and 45%, respectively and Zhou et al.¹⁰ reported the mental disease increased among outpatients during COVID-19 outbreak in China. During the epidemic, children mainly lived with their families, so the poor emotional state of their families will also have a negative impact on the children's mental health¹¹. Kindergartens and schools have been closed, social contacts were curbed and outdoor leisure activities canceled, all these changes would had some effect on children's mental status^{12,13}. Studies on children and adolescent also indicate that the COVID-19 epidemic had a significant psychosocial impact on them¹⁴. In our study we also found the proportion of pediatric inpatients diagnosed as mental disease increased during COVID-19 outbreak, which was consistent with their results. We all know that the onset of migraine and epilepsy is closely related to mood¹⁵⁻¹⁷. During COVID-19 outbreak, children were restricted in home, their patients would ask them to take some measures to prevent infection, and they also heard a good deal of disaster-related information, which brought anxiety and panic to them¹⁸. Thus we supposed that the increasing of these diseases was associated with the emotional instability caused by COVID-19. Studies also proposed that epilepsy patients showed significantly higher 6-item Kessler Psychological Distress Scale scores than healthy controls, suffering from psychological distress, in turn, can induce seizure attack¹⁹. Furthermore, like other chronic diseases, epilepsy management requires regular follow-up and sustainable medicine supply²⁰. During the COVID-19 epidemic, some transportation was cut off, population flow was controlled, people was restricted in their community, and patients were also afraid of going to hospital, as a result, many epilepsy patients were short of antiepileptic drugs and forced stopping treatment and seizure attack increased. Facing an epidemic, we need to explore some new and convenient ways to strengthen the management of chronic diseases. For example, during the COVID-19 outbreak, telemedicine network

is widely used in Sichuan Province in Western China, which includes a 5G service, a smartphone app, and an existing telemedicine system ²¹. Digital technology can help epilepsy control and online pharmacy with non-contact express delivery service can help epilepsy patients get antiepileptic drugs in time ²².

Conversely, patients diagnosed with intracranial infection decreased and even though the proportion of patients diagnosed with febrile seizure had no difference between two years, febrile seizure caused by respiratory infection decreased during COVID-19 outbreak. This might be due to the personal precautions we took during the COVID-19 epidemic, such as washing hands, wearing masks and ventilating frequently. Patients diagnosed with myopathy also decreased, especially those with myositis. We considered that measures took to prevent this epidemic restrict patient access to medical resources and some patients might be treated in local hospital. While some other diseases, such as dyskinesia and benign intracranial hypertension, did not changed during the COVID-19 epidemic.

Our study surveyed the change of disease distribution in pediatric neurology inpatients during the COVID-19 outbreak in southwest China. While this was a single center study and there may be some bias in the results. In rural regions, the low socioeconomic status and a sharp decline in income can also affect people's awareness of the disease and access to health care. Our analysis of the reasons for this change is mostly based on studies on adult, there were few researches on children. Our results should be verified and extended in larger patient samples.

Conclusions

Our study was the first one to survey the change of disease distribution in pediatric neurology inpatients during the COVID-19 outbreak. We found a significant increase in the proportion of mood-related diseases, such as epilepsy, migraine, mental diseases and peripheral neuropathy, while disease caused by infection decreased, such as intracranial infection. This reminded us we should pay some attention to children's mental state during the public health epidemic and develop some new approaches for the management of chronic disease, such as telemedicine and smartphone application on epilepsy management.

Declarations

Compliance with Ethical Statements

Conflict of Interest: The authors declare that they have no conflicts of interest.

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Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Author contribution:

1. Xueping Wang and Wenguang Hu contributed equally to this work, Xueping Wang and Wenguang Hu extracted and analyzed data, wrote this paper.
2. Ling Liu conceived and guided this study and revised the paper.
3. Jialei Chen helped us extracted the data.

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Table

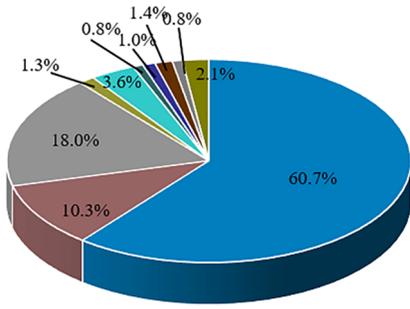
Table 1. Comparison of discharge diagnosis of pediatric neurology inpatients between January to July, 2019 and 2020

Variable	2019	2020	P value
Total number of inpatients	2964	1660	< 0.001
Age (mean±SD, years)	3.09±2.94	3.0±3.27	0.380
Sex (male, n, %)	1708 (57.6%)	921 (55.55)	0.164
LOH (mean±SD, days)	7.01±4.54	6.52±3.91	< 0.001
Febrile seizure caused by infection	1799 (60.7%)	980 (59%)	0.141
Respiratory system infection	1677 (56.6%)	887 (53.4%)	0.042
Digestive System Infections	86 (2.9%)	51 (3.1%)	0.786
Other sites infection	36 (1.2%)	42 (2.5%)	0.001
Epilepsy	304 (10.3%)	348 (21%)	< 0.001
Intracranial infection	535 (18%)	113 (6.8%)	< 0.001
Peripheral neuropathy	38 (1.3%)	43 (2.6%)	0.001
GBS	5 (0.2%)	3 (0.2%)	1.000
Disorder of facial nerve	33 (1.1%)	39 (2.3%)	0.002
Intercostal neuralgia	0	1 (0.06%)	0.359
Myopathy	106 (3.6%)	22 (2.0%)	0.003
MG	26 (0.9%)	25 (1.5%)	0.056
Myositis	80 (2.7%)	4 (0.2%)	< 0.001
Myodystrophy	0	4 (0.2%)	0.017
Mental disease	24 (0.8%)	43 (2.6%)	< 0.001
Dyskinesia	31 (1.0%)	28 (1.7%)	0.075
Benign intracranial hypertension	41 (1.4%)	21 (1.3%)	0.791
Migraine	25 (0.8%)	31 (1.9%)	0.003
Other disease	61 (2.1%)	20 (1.2%)	0.035

NOTES: LOH = length of hospital stay, SD = standard deviation, GBS = Guillain-Barre Syndrome, MG = migraine gravis.

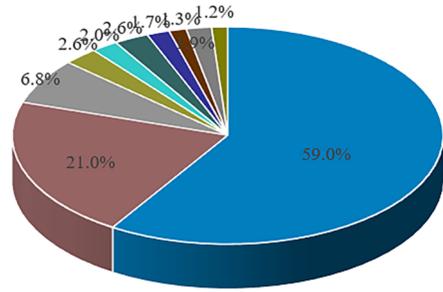
Figures

A



- Febrile seizure caused by infection
- Intracranial infection
- Myopathy
- Dyskinesia
- Migraine
- Epilepsy
- Peripheral neuropathy
- Mental disease
- Benign intracranial hypertension
- Other disease

B



- Febrile seizure caused by infection
- Intracranial infection
- Myopathy
- Dyskinesia
- Migraine
- Epilepsy
- Peripheral neuropathy
- Mental disease
- Benign intracranial hypertension
- Other disease

Figure 1

Composition of discharge diagnosis of pediatric neurology inpatients in 2019 (A) and 2020 (B).

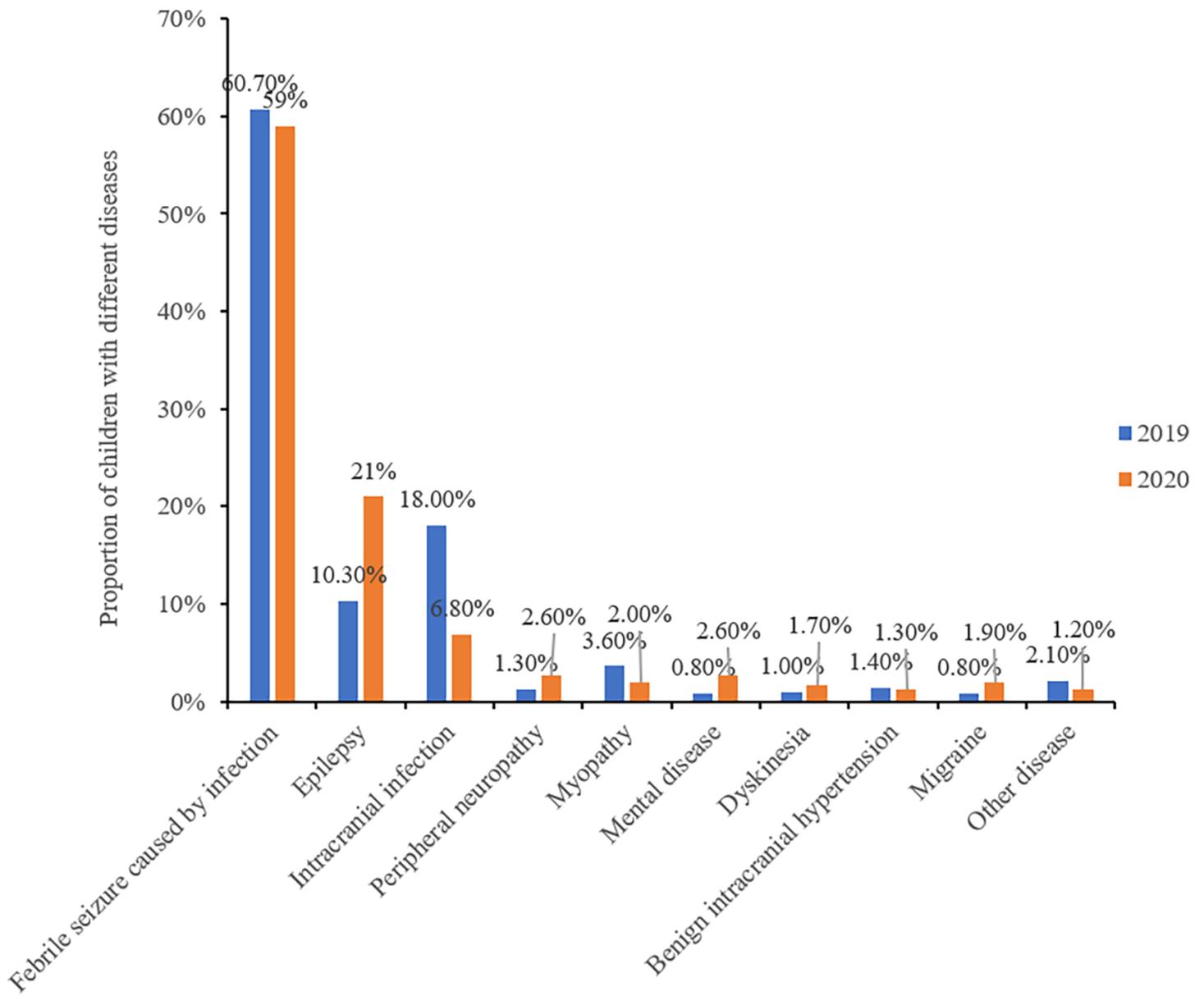


Figure 2

Comparison of the proportion of different diseases between 2019 and 2020.