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Usage of 119 emergency medical services by pediatric patients during the COVID-19 pandemic: A characteristic analysis

Miyoung Choi[1], Hyoju Lee[2*]
[1]Paramedicine Department, KangWon University, Samcheok, South Korea; emtmy117@kangwon.ac.kr (M.C.).
[2]Paramedicine Department, SunMoom University, Asan, South Korea; hjojs85@nate.com (H.L.).

Abstract: This study aimed to analyze the characteristics and trends in the use of 119 emergency medical services (EMS) by pediatric patients in Chungcheongnam-do, South Korea, during the COVID-19 pandemic to inform future EMS resource allocation. A retrospective analysis was conducted on emergency activity logs of 13,372 patients under 18 years of age transported by 119 ambulances from January 1, 2020, to December 31, 2021. The pandemic was divided into four phases for trend analysis. SPSS version 25 was used for statistical analysis. In 2020, EMS usage decreased to 6,112 cases, then increased to 7,260 in 2021. Patients under four primarily presented with respiratory symptoms, while older children mostly had musculoskeletal complaints. "Potentially urgent" was the most frequent severity level. Average prehospital time increased across pandemic phases, reaching 96 minutes in the fourth phase. Pediatric EMS usage patterns shifted during the pandemic, highlighting the need for adaptive EMS strategies. These findings provide foundational data to improve EMS preparedness and resource allocation in future infectious disease outbreaks.

Keywords: *COVID-19 pandemic, Emergency medical service, Musculoskeletal symptom, Pediatric patient, Respiratory symptom.*

1. Introduction

Coronavirus disease 2019 (COVID-19) was first reported in Wuhan, Hubei Province, China, in November 2019. The first confirmed case in South Korea occurred in January 2020. By March 2020, the virus had rapidly spread worldwide, prompting the World Health Organization (WHO) to declare a global pandemic. The widespread transmission of COVID-19 had serious social and economic consequences in South Korea and placed a significant burden on the healthcare system. The onset of the pandemic triggered profound changes throughout society, disrupting daily life and transforming government strategies for managing infectious diseases.

In response to the initial outbreak, the South Korean government implemented strong containment measures, including large-scale quarantines, strict social distancing, and mobility restrictions. COVID-19 was initially classified as a first-grade infectious disease and managed under strict regulations. However, on August 31, 2023, it was reclassified as a fourth-grade infectious disease, similar to seasonal influenza, to alleviate administrative burdens. This reclassification led to the easing of restrictive measures such as social distancing, contributing to economic recovery and the normalization of daily life. Nonetheless, the long-term impact of COVID-19 on the healthcare system persists, with the emergency medical system being no exception.

Following the pandemic, emergency medical systems in many countries experienced significant transformations, and the patterns of emergency department and prehospital service utilization changed markedly. In South Korea, as in many other countries, the number of emergency department visits declined sharply during the pandemic period [1-5]. This trend was observed not only among adults but

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* Correspondence: hjojs85@nate.com

also among pediatric patients [6-8]. In particular, fear of infection led many parents to delay or avoid hospital visits for their children, resulting in worsened conditions and increasing the risk of delayed emergency care. Because children are anatomically and physiologically less developed than adults, they are more vulnerable to negative health outcomes, making timely emergency care critical.

According to recent domestic and international studies, the COVID-19 pandemic has significantly influenced pediatric emergency medical service utilization worldwide. In South Korea, the number of pediatric emergency department visits declined during the pandemic, while the proportion of severe cases increased. This is attributed to parents avoiding or delaying hospital visits due to concerns over infection [9, 10]. Similar findings have been reported in the United States and Europe, where fewer pediatric patients visited emergency departments during the early pandemic, but more arrived in critical condition [11]. Delays in prehospital transport, hospital bed shortages, and heightened infection control measures were identified as major obstacles to the efficiency of emergency medical systems. Most domestic studies have focused on in-hospital emergency care patterns, while empirical research utilizing prehospital 119 EMS data remains extremely limited. To address this research gap, further analysis of prehospital emergency response patterns during pandemics is needed.

Prehospital emergency medical services (EMS) play a vital role before patients reach hospitals, especially for pediatric patients whose outcomes are highly dependent on timely and appropriate care. During the COVID-19 pandemic in South Korea, 119 EMS teams faced significant difficulties in selecting destination hospitals due to bed shortages and reinforced infection control protocols [12]. These delays in transport posed serious risks to pediatric patients requiring urgent intervention and highlighted the importance of improving both the speed and efficiency of EMS operations.

Despite the critical importance of prehospital EMS, most Korean studies to date have focused on hospital-based data, leaving a clear lack of research on 119 EMS utilization trends and structural changes. Given that response speed and operational efficiency at the prehospital stage are key factors influencing patient survival and prognosis, systematic research on this area is urgently needed.

Therefore, the aim of this study is to analyze the characteristics and changes in the utilization of 119 emergency medical services for pediatric patients in South Korea during the COVID-19 pandemic. This research seeks to provide foundational data for the development of an effective and resilient emergency medical system that can function under future pandemic conditions. The study especially focuses on improving the quality of emergency care for vulnerable populations, such as children, and is expected to contribute significantly to policy planning and strategic resource allocation in future public health crises.

2. Methods

2.1. Study Design and Patient Selection

This was a retrospective study conducted to analyze the trends in the utilization of 119 emergency services by pediatric patients during the COVID-19 pandemic. The study population consisted of pediatric patients aged 18 years or younger who were transported by 119 ambulances within the Chungcheongnam-do region in South Korea over a two-year period (January 1, 2020 to December 31, 2021) during the COVID-19 pandemic. Chungcheongnam-do covers an area of 8,226.32 km² and had a population of 2,198,358 people as of 2021. A total of 116 ambulances staffed by 990 emergency responders operate in this region. In 2021, 3,148,956 emergency dispatches were recorded in South Korea, with Chungcheongnam-do accounting for 187,251 (5.95%) of these [11].

2.2. Data Collection and Statistical Analyses

The data used in this study were extracted from the emergency activity logs of pediatric patients transported by 119 ambulances within the Chungcheongnam-do region between January 1, 2020, and December 31, 2021. The emergency activity logs contained detailed information, including the number of patients who used 119 emergency services each year, age, sex, location and type of emergency,

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consciousness status (AVPU scale), symptoms, and patient classification. These data were used to analyze the changes in the utilization of 119 emergency services by pediatric patients.

The pandemic period was divided into four phases according to the characteristics of the pandemic, as defined by the Korea Disease Control and Prevention Agency. Phase 1 (January 20, 2020 – August 11, 2020) was characterized by a rise in sporadic cases due to imported infections and the nationwide spread of COVID-19 caused by a specific religious group. Phase 2 (August 12, 2020 – November 12, 2020) was characterized by sporadic spread of the infection by small groups, mainly in certain regions, with vaccination beginning on February 26, 2021. Phase 3 (November 13, 2020 - July 6, 2021) was marked by group outbreaks traced to religious facilities and large urban gatherings, with an increase in the number of critically ill patients. Phase 4 (July 13, 2021 - January 19, 2022) was characterized by a nationwide spread centered around the metropolitan area and an increase in familial infections. In this study, the end of Phase 4 was set as December 31, 2021.

Various symptoms were reclassified into system-based categories to enable the comparison of the primary symptoms of the patients according to age group. Symptoms such as difficulty breathing, low oxygen saturation, coughing, and sore throat were reclassified as respiratory symptoms. Symptoms such as chest pain, cardiac arrest, and tightness in the chest were categorized as cardiovascular symptoms. Symptoms such as abdominal pain, vomiting, and bloody stools were classified as gastrointestinal symptoms. Symptoms such as dizziness, headache, seizures, and syncope were categorized as neurological symptoms. Other symptoms, including toothache, nosebleeds, COVID-19 testing, and related issues were classified as other symptoms.

The collated data were analyzed using the Statistical Package for the Social Sciences (SPSS) WIN 25.0. Frequency analyses were conducted to examine the general characteristics of each pandemic period and the primary symptoms of the patients according to age group. This study was conducted using publicly available and de-identified secondary data from the National 119 EMS database and was therefore exempt from IRB approval.

3. Results

3.1. Characteristics of the Study Population

During the COVID-19 pandemic in South Korea (January 1, 2020 to December 31, 2021), 13,372 pediatric patients under the age of 18 years were transported by 119 ambulances in the Chungcheongnam-do region. A total of 3,858 in were transported in Phase 1, 1,631 in Phase 2, 3,864 in Phase 3, and 4,019 in Phase 4. The general characteristics of the patients categorized according to pandemic phases are shown in Table 1.

Regarding age distribution, the 15–18 years age group had the largest number of patients who used emergency ambulance transport in all phases, with 1,092 patients (28.3%) transported in Phase 1, 453 patients (27.8%) in Phase 2, 1,269 patients (32.8%) in Phase 3, and 1,223 patients (30.4%) in Phase 4. This indicates that of all the pediatric patients analyzed, adolescents in this age group were the most reliant on emergency medical services during the pandemic. The 1–4 years age group had the second largest number of patients who used emergency transport services, with 1,006 patients (26.1%) transported in Phase 1, 435 (26.7%) in Phase 2, 938 (24.3%) in Phase 3, and 977 (24.3%) in Phase 4. For the 5–9 years age group, 618 patients (16.0%) were transported in Phase 1, 278 (17.0%) in Phase 2, 624 (16.1%) in Phase 3, and 628 (15.6%) in Phase 4. For the 10–14 years age group, 614 patients (15.9%) were transported in Phase 1, 267 (16.4%) in Phase 2, 701 (18.1%) in Phase 3, and 907 (22.6%) in Phase 4. The below one-year age group had the lowest number of patients who used emergency transport services, with 528 patients (13.7%) transported in Phase 1, 198 patients (12.1%) in Phase 2, 332 patients (8.6%) in Phase 3, and 284 patients (7.1%) in Phase 4.

Regarding sex distribution, the number of males transported was higher than that of females in all phases. Specifically, 2,237 males (58.0%) were transported in Phase 1, 971 (59.5%) in Phase 2, 2,265 (58.6%) in Phase 3, and 2,297 (57.2%) in Phase 4, whereas 1,621 females (42.0%) were transported in Phase 1, 660 (40.5%) in Phase 2, 1,599 (41.4%) in Phase 3, and 1,722 (42.8%) in Phase 4.

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Analysis of the locations of incidents revealed that the most common location of emergencies was home. In Phase 1, 1,939 patients (50.3%), 782 patients (47.9%), 2,039 patients (52.8%), and 2,264 patients (56.3%) had emergency incidents at home in Phases 1, 2, 3, and 4, respectively. The second most common location of emergencies was the street, with 590 patients (15.3%), 313 patients (19.2%), 631 patients (16.3%), and 524 patients (13.0%) experiencing incidents in the street in Phases 1, 2, 3, and 4, respectively. Other locations included transportation areas, group housing facilities, medical facilities, and others, with varying frequencies of incidents recorded in these locations across the pandemic phases.

Regarding patient type, non-disease incidents were most common in Phases 1 to 3, whereas disease-related incidents were more prevalent in Phase 4. A total of 1,926 non-disease cases (49.9%) and 1,532 disease-related cases (39.7%) were recorded in Phase 1, whereas 949 non-disease cases (58.2%) and 543 disease-related cases (33.3%) were recorded in Phase 2. In Phase 4, the number of disease-related and non-disease related cases increased to 2,140 (53.2%) and 1,753 (43.6%), respectively.

Regarding patient classification, potentially urgent cases were the most common severity level across all phases. A total of 2,063 potentially urgent cases (53.5%) were recorded in Phase 1, 933 cases (57.2%) in Phase 2, 2,210 cases (57.2%) in Phase 3, and 2,388 cases (59.4%) in Phase 4. For semi-urgent cases, 759 (19.7%) cases were recorded in Phase 1, 307 (18.8%) in Phase 2, 793 (20.5%) in Phase 3, and 745 (18.5%) in Phase 4. A total of 497 (12.9%) emergency cases were recorded in Phase 1, 184 (11.3%) in Phase 2, 398 (10.3%) in Phase 3, and 359 (8.9%) in Phase 4.

The number of patients transported to hospitals showed an increasing trend across phases, with 3,171 patients (82.2%) transported in Phase 1, 1,353 (83.0%) in Phase 2, 3,320 (85.9%) in Phase 3, and 3,535 (88.0%) in Phase 4. The number of non-transported patients decreased accordingly, with 687 patients (17.8%) in Phase 1, 278 (17.0%) in Phase 2, 544 (14.1%) in Phase 3, and 484 (12.0%) in Phase 4.

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Table 1.
Characteristics of the study population.

Categories		Phase 1 (January 20, 2020 – August 11, 2020)	Phase 2 (August 12, 2020 – November 12, 2020)	Phase 3 (November 13, 2020 - July 6, 2021)	Phase 4 (July 13, 2021 - December 31, 2021)
Age (years)	<1	528 (13.7)	198 (12.1)	332 (8.6)	284 (7.1)
	1–4	1,006 (26.1)	435 (26.7)	938 (24.3)	977 (24.3)
	5–9	618 (16.0)	278 (17.0)	624 (16.1)	628 (15.6)
	10–14	614 (15.9)	267 (16.4)	701 (18.1)	907 (22.6)
	15–18	1,092 (28.3)	453 (27.8)	1,269 (32.8)	1,223 (30.4)
Sex	Male	2,237 (58.0)	971 (59.5)	2,265 (58.6)	2,297 (57.2)
	Female	1,621 (42.0)	660 (40.5)	1,599 (41.4)	1,722 (42.8)
Location of incident	Home	1,939 (50.3)	782 (47.9)	2,039 (52.8)	2,264 (56.3)
	Street	590 (15.3)	313 (19.2)	631 (16.3)	524 (13.0)
	Transportation area outside of roads	209 (5.4)	78 (4.8)	204 (5.3)	156 (3.9)
	Group housing facility	63 (1.6)	25 (1.5)	67 (1.7)	116 (2.9)
	Medical facility	155 (4.0)	65 (4.0)	46 (1.2)	93 (2.3)
	Construction facility	5 (0.1)	0 (0.0)	1 (0.0)	2 (0.0)
	Commercial facility	178 (4.6)	72 (4.4)	146 (3.8)	150 (3.7)
	Ocean/River /Mountain/Field	48 (1.2)	41 (2.5)	34 (0.9)	69 (1.7)
	Entertainment and cultural facilities	99 (2.6)	39 (2.4)	86 (2.2)	94 (2.3)
	Sports facilities	47 (1.2)	15 (0.9)	43 (1.1)	36 (0.9)
	Educational facilities	379 (9.8)	130 (8.0)	398 (10.3)	324 (8.1)
	Others	90 (2.3)	37 (2.3)	105 (2.7)	108 (2.7)
	Unknown	56 (1.5)	34 (2.1)	64 (1.7)	83 (2.1)
Patient Type	Disease	1,532 (39.7)	543 (33.3)	1,655 (42.8)	2,140 (53.2)
	Non-disease	1,926 (49.9)	949 (58.2)	2,031 (52.6)	1,753 (43.6)
	Other	400 (10.4)	139 (8.5)	178 (4.6)	126 (3.1)
Triage	Emergency	497 (12.9)	184 (11.3)	398 (10.3)	359 (8.9)
	Semi-emergency	759 (19.7)	307 (18.8)	793 (20.5)	745 (18.5)
	Potential-emergency	2,063 (53.5)	933 (57.2)	2,210 (57.2)	2,388 (59.4)

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	Death (estimated)	6 (0.2)	1 (0.1)	9 (0.2)	3 (0.1)
	Others	108 (2.8)	34 (2.1)	144 (3.7)	271 (6.7)
	Unknown	425 (11.0)	172 (10.5)	310 (8.0)	253 (6.3)
Transportation status	Transportation	3,171 (82.2)	1,353 (83.0)	3,320 (85.9)	3,535 (88.0)
	Non-Transportation	687 (17.8)	278 (17.0)	544 (14.1)	484 (12.0)

3.2. Primary Symptoms of the Pediatric Patients According to Age Group

The primary symptoms of pediatric patients in each age group categorized according to pandemic phases are summarized in Table 2.

Respiratory symptoms were the most common symptoms in patients younger than one year old across all periods. In Phase 1, 58 of 528 patients (11.0%) reported respiratory symptoms, whereas in 19 of 198 patients (9.6%), 63 of 332 patients (19.0%), and 61 of 284 patients (21.5%) reported respiratory symptoms in Phases 2, 3, and 4, respectively. Other symptoms were reported as follows: 54 patients (10.2%) in Phase 1, 17 patients (8.6%) in Phase 2, 29 patients (8.7%) in Phase 3, and 47 patients (16.5%) in Phase 4. Neurological symptoms were observed in 15 patients (2.8%) in Phase 1, 5 patients (2.5%) in Phase 2, 26 patients (7.8%) in Phase 3, and 28 patients (9.9%) in Phase 4.

In the 1–4 years age group, respiratory symptoms were the most common in Phase 1, with 158 of 1,006 patients (15.7%) experiencing these symptoms. However, neurological symptoms were more prevalent in Phases 2 and 3, and were observed in 59 of 435 patients (13.6%) and 152 of 938 patients (16.2%), respectively. In Phase 4, respiratory symptoms became the most common symptoms, with 229 of 977 patients (23.4%) reporting these symptoms. Other symptoms were reported as follows: 28 patients (2.8%) in Phase 1, 13 (3.0%) in Phase 2, 44 (4.7%) in Phase 3, and 70 (7.2%) in Phase 4. Musculoskeletal symptoms were observed in 67 patients (6.7%) in Phase 1, 34 (7.8%) in Phase 2, 89 (9.5%) in Phase 3, and 45 (4.6%) in Phase 4.

In the 5–9 years age group, musculoskeletal symptoms were most common in Phases 1, 2, and 3, and were observed 105 of 618 patients (17.0%), 47 of 278 patients (16.9%), and 93 of 624 patients (14.9%), respectively. In Phase 4, other symptoms were the most common and were observed 122 of 628 patients (19.4%). Neurological symptoms were observed in 64 patients (10.4%) in Phase 1, 22 (7.9%) in Phase 2, 54 (8.7%) in Phase 3, and 50 (8.0%) in Phase 4. Respiratory symptoms were reported by 43 patients (7.0%) in Phase 1, 12 (4.3%) in Phase 2, 33 (5.3%) in Phase 3, and 30 (4.8%) in Phase 4.

In the 10–14 years age group, musculoskeletal symptoms were most common in Phases 1, 2, and 3, and were observed 112 of 614 patients (18.2%), 57 of 267 patients (21.3%), and 136 of 701 patients (19.4%), respectively. In Phase 4, other symptoms were the most common, affecting 174 of 907 patients (19.2%). Neurological symptoms were observed by 70 patients (11.4%) in Phase 1, 22 (8.2%) in Phase 2, 70 (7.7%) in Phase 3, and 142 (15.7%) in Phase 4. Gastrointestinal symptoms were reported by 48 patients (7.8%) in Phase 1, 18 (6.7%) in Phase 2, 64 (9.1%) in Phase 3, and 43 (4.7%) in Phase 4.

In the 15-18 years age group, musculoskeletal symptoms were the most common in Phases 1, 2, and 3, and were observed in 172 of 1,092 patients (15.8%), 75 of 453 patients (16.6%), and 214 of 1,269 patients (16.9%), respectively. In Phase 4, other symptoms were the most common, observed in 184 of 1,223 patients (15.0%). Neurological symptoms were observed in 106 patients (9.7%) in Phase 1, 49 (10.8%) in Phase 2, 110 (8.7%) in Phase 3, and 113 (9.2%) in Phase 4. Gastrointestinal symptoms were reported by 104 patients (9.5%) in Phase 1, 40 (8.8%) in Phase 2, 111 (8.7%) in Phase 3, and 94 (7.7%) in Phase 4.

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Table 2.
Primary symptoms of the pediatric patients who used emergency ambulance transport during the pandemic period.

Age Group	Phase 1 (January 20, 2020 – August 11, 2020)		Phase 2 (August 12, 2020 – November 12, 2020)		Phase 3 (November 13, 2020 - July 6, 2021)		Phase 4 (July 13, 2021 - December 31, 2021)	
	CC	N(%)	CC	N(%)	CC	N(%)	CC	N(%)
<1	RS	58(11.0)	RS	19(9.6)	RS	63(19.0)	RS	61(21.5)
	Others	54(10.2)	Others	17(8.6)	Others	29(8.7)	Others	47(16.5)
	NS	15(2.8)	GS	5(2.5)	NS	26(7.8)	NS	28(9.9)
	MS	14(2.7)	NS	3(1.5)	GS	8(2.4)	GS	9(3.2)
	GS	8(1.5)	MS	1(0.5)	MS	8(2.4)	MS	4(1.4)
	Total	528(100)	Total	198(100)	Total	332(100)	Total	284(100)
1-4 y	RS	158(15.7)	NS	59(13.6)	NS	152(16.2)	RS	229(23.4)
	NS	145(14.4)	RS	54(12.4)	RS	158(16.8)	NS	171(17.5)
	MS	67(6.7)	MS	34(7.8)	MS	89(9.5)	Others	70(7.2)
	GS	32(3.2)	GS	15(3.4)	GS	49(5.2)	MS	45(4.6)
	Others	28(2.8)	Others	13(3.0)	Others	44(4.7)	GS	37(3.8)
	Total	1,006(100)	Total	435(100)	Total	938(100)	Total	977(100)
5-9 y	MS	105(17.0)	MS	47(16.9)	MS	93(14.9)	Others	122(19.4)
	NS	64(10.4)	NS	22(7.9)	Others	56(9.0)	MS	68(10.8)
	RS	43(7.0)	GS	17(6.1)	NS	54(8.7)	NS	50(8.0)
	GS	41(6.6)	RS	12(4.3)	GS	40(6.4)	GS	46(7.3)
	Others	23(3.7)	Others	6(2.2)	RS	33(5.3)	RS	30(4.8)
	Total	618(100)	Total	278(100)	Total	624(100)	Total	628(100)
10-14y	MS	112(18.2)	MS	57(21.3)	MS	136(19.4)	Others	174(19.2)
	NS	70(11.4)	NS	22(8.2)	CS	64(9.1)	MS	142(15.7)
	GS	48(7.8)	RS	19(7.1)	GS	64(9.1)	NS	70(7.7)
	RS	45(7.3)	GS	18(6.7)	Others	44(6.3)	RS	66(7.3)
	CS	14(2.3)	CS	5(1.9)	RS	25(3.6)	GS	43(4.7)
	Total	614(100)	Total	267(100)	Total	701(100)	Total	907(100)
15-18y	MS	172(15.8)	MS	75(16.6)	MS	214(16.9)	Others	184(15.0)
	RS	116(10.6)	NS	49(10.8)	GS	111(8.7)	MS	152(12.4)
	NS	106(9.7)	GS	40(8.8)	NS	110(8.7)	NS	113(9.2)
	GS	104(9.5)	RS	23(5.1)	RS	61(4.8)	GS	94(7.7)
	Others	25(2.3)	CS	8(1.8)	Others	49(3.9)	RS	75(6.1)
	Total	1,092(100)	Total	453(100)	Total	1,269(100)	Total	1,223(100)

*CC, chief complaint; RS, respiratory symptoms; NS, neurological symptoms; MS, musculoskeletal symptoms; GS, gastrointestinal symptoms; CS, cardiovascular symptoms.

3.3. Trends in 119 Emergency Ambulance Service Usage During the Pandemic

The monthly trends in the utilization of 119 emergency services during the COVID-19 pandemic by pediatric patients in the Chungcheongnam-do region are illustrated in Figure 1.

In Phase 1 (January 2020 – August 2020), the utilization of 119 emergency services was relatively consistent overall, but peaked in June 2020. In June 2020, the total number of users approached 700, with a particularly high number of non-disease-related cases compared to the other months. The number of users was lower in January and February, but began to increase steadily from March, reaching its highest point in June. The number of users began to decline slightly in July and August.

In Phase 2 (August 2020 – November 2020), there was a gradual decline in the utilization of 119 emergency services. From August onward, the number of users fell below 400, and decreased further in October and November, indicating a different trend compared with the early pandemic period. The number of disease-related and non-disease-related emergency cases decreased during this phase.

In Phase 3 (November 2020 – July 2021), the utilization of 119 emergency services began to increase again, starting in January 2021. The use of emergency services increased during the winter months, with a steady increase in the number of users from March onwards. In June and July, the number of users exceeded 600, with an increase in both disease- and non-disease-related cases.

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In Phase 4 (July 2021 – December 2021), the utilization of 119 emergency services continued to increase, reaching a peak in October 2021. From August to October, the number of users increased steadily each month, surpassing 700 in October. Although a slight decline was observed in November and December, the number of users remained high. During this phase, in the number of disease-related emergency cases significantly increased, whereas the number of non-disease-related cases peaked in October before decreasing in the following months.

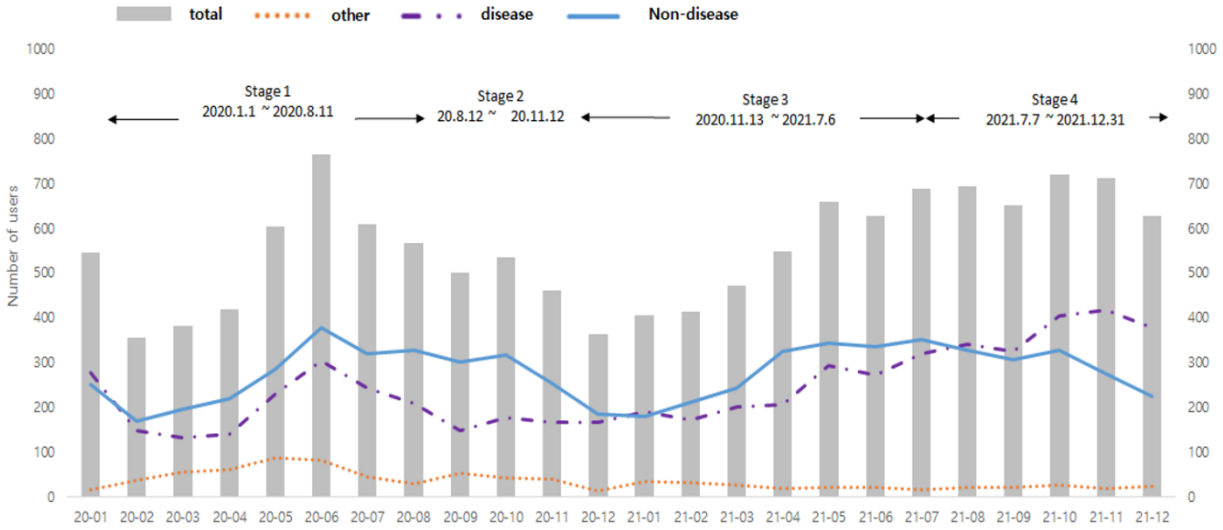

Figure 1.
Trends in 119 Emergency Ambulance Service Usage During the Pandemic.

3.4. Utilization Hours of 119 Emergency Ambulance Services by Pediatric Patients in Each Pandemic Period

The average duration of the transportation of pediatric patients from the location of emergency incidents to the hospital during the pandemic are shown in Table 3. In Phase 1, the average duration of transportation was 67 minutes, ranging from a minimum of 4 minutes to a maximum of 783 minutes. In Phase 2, the average duration of transportation increased to 71 minutes, ranging from 8 minutes to 375 minutes. In Phase 3, the average duration of transportation increased further to 74 minutes, ranging from 7 minutes to 585 minutes. In Phase 4, the average duration of transportation significantly increased to 96 minutes, ranging from 11 minutes to 608 minutes.

Table 3.
Utilization Hours of 119 Emergency Ambulance Services by Pediatric Patients in Each Pandemic Period.

	Phase 1 (January 20, 2020 – August 11, 2020)	**Phase 2 (August 12, 2020 – November 12, 2020)**	**Phase 3 (November 13, 2020 - July 6, 2021)**	**Phase 4 (July 13, 2021 - December 31, 2021)**
Average (Min–Max)	67 min (4–783 min)	71 min (8–375 min)	74 min (7–585 min)	96 min (11–608 min)

4. Discussion

This study was conducted to analyze the characteristics of and trends in the usage of 119 emergency services by pediatric patients during the COVID-19 pandemic in Korea, with the aim of providing basic data to facilitate effective allocation of emergency medical resources.

In 2020, which marked the onset of the COVID-19 pandemic, the total number of emergency transports recorded nationwide was 1,594,390, a 12.7% decrease compared with that recorded in 2019. However, the number of transports increased to 1,775,395 in 2021, nearly returning to pre-pandemic

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levels. The data analyzed in the present study showed a similar pattern, with the number of pediatric emergency transports decreasing to 6,112 in 2020 and increasing to 7,260 in 2021. These results suggest that the use of emergency medical services was initially suppressed during the early stages of the pandemic, but increased as time progressed and normalcy was gradually restored in 2021.

Although social distancing and lockdown measures were implemented in June 2020, the increase in the number of confirmed COVID-19 cases within specific religious groups and the occurrence of cluster infections in religious facilities and medical institutions appeared to directly affect the use of the emergency medical system in South Korea. This effect is reflected in the significant decrease in the number of 119 ambulance transports recorded starting from February 2020. During the subsequent second and third nationwide infection waves, which lasted from mid-August 2020 to January 2021, the number of pediatric patients who used 119 emergency services declined. However, the number of pediatric emergency transports increased again in Phase 4 of the pandemic 2021, when 70% of the population had been vaccinated and phased restoration of normalcy was implemented. These results highlight the positive impact of expanded vaccination coverage and recovery measures on the emergency medical system, emphasizing the importance of such strategies in future public health crises.

According to the statistics reported by the National Fire Agency, pediatric patients younger than the age of 10 accounted for approximately 6.9% (111,333 cases) and 7.0% (129,162 cases) of all emergency transports in 2020 and 2021, respectively [9, 10]. The data analyzed in the present study indicated that the number of pediatric transports recorded in 2020 was 6,112, whereas that recorded in 2021 was 7,260. Although the rate of emergency transport was lower than that of adult patients, pediatric emergency patients are a critical group that must receive care in a timely manner to ensure their overall health and safety. This is largely because the physical and physiological characteristics of pediatric patients differ from those of adults, and the medical approach to their treatment varies according to their developmental stage. Moreover, unlike in fully developed adults, early treatment of diseases or injuries in pediatric patients can significantly influence their prognoses. Therefore, it is essential to strengthen early response strategies and establish a systematic approach to allocation of emergency medical resources in consideration of the unique characteristics of pediatric patients.

Kang conducted a study on changes in pediatric emergency department visits and reported that pediatric patients in the 1–4 years age group accounted for 39.8% of all pediatric emergency department visits, which was the highest proportion, whereas those in the 15–18 years age group accounted for only 15.4%. However, in the present study, the 15–18 years age group had the highest proportion emergency department visits in all pandemic phases, with 28.3% recorded in Phase 1, 27.8% in Phase 2, 32.8% in Phase 3, and 30.4% in Phase 4. The 1–4 years age group accounted for the second highest proportion of visits, with 26.1% recorded in Phase 1, 26.7% in Phase 2, 24.3% in Phase 3, and 24.3% in Phase 4. These results suggest that among pediatric patients, adolescents used emergency medical services the most during the pandemic. Therefore, increased attention to healthcare management in this age group is necessary.

Analysis of the patients' symptoms revealed that respiratory symptoms were the primary reason for the use of 119 emergency services by pediatric patients under four years of age, whereas musculoskeletal symptoms were the main reason for use of emergency services by pediatric patients in the older age groups. This is consistent with the findings of Nam et al., who reported that the rate of injury among pediatric patients remained high even during the COVID-19 pandemic. Pediatric patients older than five years of age are of school age and experience rapid growth at this developmental stage, which can lead to lack of coordination and increased susceptibility to injury. Notably, previous studies have indicated that injured patients frequently use 119 emergency services [12-14]. Similar to previous reports, the present study indicated that a high proportion of the patients older than five years experienced musculoskeletal symptoms. These results suggest that the restriction of activities during the pandemic may have influenced the health statuses and symptom patterns of pediatric patients, leading to a shift in the primary reasons for utilization of emergency medical services. Therefore, in addition to considering the activities and health status of children in the implementation of infection prevention measures, it is

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crucial to develop appropriate emergency response strategies that can be used effectively during public health crises such as pandemics.

The national statistics on the utilization of emergency service by the entire patient population in South Korea, including adults, indicated that potential emergencies accounted for 40.8%, 40.8%, and 41.8% of emergency cases in 2019, 2020, and 2021, respectively, the highest in the those years, followed by semi-emergencies (30.5%, 31.0%, and 30.3%) and emergencies (27.4%, 26.7%, and 25.1%) [10, 11, 15]. Similar results were obtained after the analysis of pediatric patients in the present study, with potential emergencies, semi-emergencies, and emergencies ranking highest in 2020 and 2021 in that order. These findings are consistent with those of the study by Lee, et al. [16] which was conducted before the COVID-19 pandemic. Classification of severity during the prehospital stage of emergency transport is an objective and important step based on the evaluation of patients before selecting an appropriate medical institution for patient management. Potential emergencies often have a lower priority than semi-emergencies and emergencies and are more likely to be treated directly at a primary care institution. In the study by Kwak and Jang [17] potential emergencies were defined and analyzed as mild cases. In crisis situations, such as the COVID-19 pandemic, systematic management of potential emergencies may directly affect the capacity and prognoses of semi-emergencies and emergencies. Therefore, it is necessary to strengthen appropriate resource allocation and hospital selection systems for the management of potential emergencies.

According to the statistics reported by the National Fire Agency, the average duration from the time of dispatch to hospital arrival was approximately 28 minutes in 2020 and 40.40 minutes in 2021. However, an increasing trend was observed in the present study, with an average of 67 minutes in Phase 1, 71 minutes in Phase 2, 74 minutes in Phase 3, and 96 minutes in Phase 4. In addition, Kang reported an increase in the overall duration of emergency transport service after the onset of the COVID-19 pandemic. Furthermore, Seo et al. found that the time from dispatch to return increased from an average of 53.61 minutes before the COVID-19 pandemic to 66.19 minutes afterward. This increase is likely due to the additional time and effort required for protection against infection, infection control, hospital selection, and patient handover following the COVID-19 outbreak. In particular, the difficulty in selecting hospitals due to the shortage of isolation rooms after the onset of the COVID-19 pandemic is believed to have contributed significantly to the increase in transport time. As the duration of emergency transport is a critical factor that affects patient outcomes [18-20] exploring measures that can reduce the overall transport time is necessary for improving the efficiency of the emergency transport service.

This study has several limitations. First, we analyzed data from the emergency activity logs of Chungcheongnam-do region only. Therefore, generalizing our findings to the entire country may be challenging. Second, as this was a retrospective study conducted using emergency activity logs, it was not possible to compare the outcomes of treatment at emergency medical centers. Finally, although we analyzed different phases of the COVID-19 pandemic period, we did not account for changes that occurred owing to the prolonged nature of the pandemic. Despite these limitations, this study provides important basic data that could facilitate the efficient allocation of resources and the development of emergency response strategies that can be incorporated into pediatric emergency medical systems during pandemic situations.

5. Conclusion

In summary, this study indicated that the number of pediatric emergency transports recorded in South Korea decreased in 2020 during the COVID-19 pandemic but increased again in 2021. Notably, the pediatric patients in the 15–18 years age group showed the highest rate of emergency service utilization. Patients younger than four years of age mainly required 119 emergency services for respiratory symptoms, whereas those older than five years old most commonly needed them for musculoskeletal symptoms. Potential emergencies were the most common severity classification observed in all pandemic phases. In addition, the duration from the time of dispatch to hospital arrival

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increased during the pandemic period. This study provides important baseline data on the patterns of the utilization of emergency medical services by pediatric patients, which can facilitate the implementation of preparatory measures for infectious disease outbreaks in the future. Future research on the analysis and comparison of emergency transport data from various regions and countries is needed for better understanding the impact of COVID-19 on the utilization of emergency medical services. In addition, further research could provide a foundation for the development of important criteria for optimizing the distribution of emergency medical resources during infectious disease outbreaks, such as the COVID-19 pandemic.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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