ORIGINAL

Coronavirus disease 2019 pandemic related changes in pediatric patient numbers in Tokushima, Japan

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Abstract : In this study, we aimed to investigate the impact of the COVID-19 pandemic on the number of pediatric inpatients and outpatients visiting medical institutions in Tokushima Prefecture, Japan. We evaluated medical claims data of individuals aged <15 years insured by the National Health Insurance. We calculated the mean and 95% confidence interval (CI) of the monthly number of inpatient and outpatient medical claims per 1,000 children for fiscal year 2019 (FY2019), the pre-pandemic period, and fiscal year 2020 (FY2020), the pandemic period. The mean monthly number of inpatients aged <15 years (per 1,000 children) was 27.6 (95% CI : 24.7–30.4) in FY2019 and 16.9 (95% CI : 14.9–18.9) in FY2020. For outpatients, the corresponding numbers were 638.1 (95% CI : 610.6–665.6) in FY2019 and 501.1 (95% CI : 471.0–531.0) in FY2020. We applied multivariable negative binomial regression to calculate incident rate ratios (IRRs). The inpatient IRR was 0.58 (95% CI : 0.42–0.80), showing a significant decrease, while the outpatient IRR was 0.79 (95% CI : 0.57–1.09), showing no significant difference from FY2019. These results suggest that pediatric inpatient and outpatient visits decreased during the COVID-19 pandemic, with a larger impact observed for inpatients. The pandemic likely influenced healthcare-seeking behavior and medical service utilization among children. J. Med. Invest. 72 : 401-407, August, 2025

Keywords **:** *COVID-19 pandemic, pediatric inpatients, pediatric outpatients, pediatrician*

INTRODUCTION

Several countries have reported a shortage of pediatricians (1, 2). Furthermore, in Japan, many regional hospitals have closed their pediatric departments owing to a shortage of pediatricians (3). Moreover, the uneven distribution of pediatricians, particularly among medical departments, has been reported (3, 4, 5). Therefore, measures, such as pediatrician recruitment and retention, are needed to address the shortage of pediatricians (1, 6) We believe that to achieve this, the supply side, such as recruiting and retaining pediatricians, and the demand side, such as being aware of the number of pediatric patients, should be considered.

The emergence of the severe acute respiratory syndrome coronavirus 2 was reported in late 2019 (7), and on March 11, 2020, the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) a global pandemic (8). The spread of COVID-19 was also confirmed in Japan, and three different waves of the outbreak occurred in the country by March 2021 (9, 10). Additionally, during this period, the Japanese government declared a state of emergency twice, including a stay-at-home order (between April 7, 2020, and May 25, 2020, and between January 8, 2021, and March 2, 2021) (9, 10). The public health measures against COVID-19 in Japan included "avoiding the 3Cs" (close-contact settings, crowded places, and closed spaces with poor ventilation) (9, 10). Additionally, individual preventive measures included hand washing, disinfection, and wearing masks (9). In Japan, these measures contributed to the decrease of many communicable diseases during the COVID-19 intra-pandemic period (9). However, the occurrence of COVID-19 cases continued even after April 2021 (9, 10).

Pediatric patients with various diseases were affected during the COVID-19 pandemic. Specifically, a decrease in the number of pediatric emergency visits to hospitals during the pandemic has been reported (11, 12). According to medical claims data, the number of outpatient visits to specialized pediatric clinics (13) and in pediatric primary care settings (14) decreased. Moreover, decreased numbers of childhood asthma diagnoses (15), pediatric asthma emergency visits (16), pediatric surgeries, such as appendectomies (17), and pediatric patients with acute lymphoblastic leukemia (18) have been reported. However, to our knowledge, no study has analyzed the changes in the number of pediatric inpatients in a region or the relationship between the number of pediatric inpatients and the COVID-19 pandemic using a multivariate analysis. Promoting measures to address the pediatrician shortage requires an accurate understanding of the impact of the COVID-19 pandemic on the medical needs and demands of children in a region.

In this study, we aimed to investigate the impact of the COVID-19 pandemic on the number of pediatric inpatients and outpatients visiting medical institutions.

MATERIALS AND METHODS

We aimed to investigate the impact of the COVID-19 pandemic on the number of pediatric inpatients and outpatients visiting medical institutions. This is an ecological study of the medical claims data in the Tokushima National Health Insurance Database (Tokushima KDB database). These medical claims were created when the people insured by the National Health Insurance in Tokushima Prefecture, Japan, visited medical facilities. National Health Insurance is public medical insurance for all people aged <75 years, except company employees. Specifically, self-employed, agricultural, and part-time workers and their

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families are enrolled. Medical claims data are compiled by each medical facility by summarizing the monthly visits for each patient and classifying these visits as inpatient and outpatient visits. The data include patient ID, age at the end of the fiscal year, year and month of medical examination, medical institution code, and name of the main and secondary illnesses and injuries. Because the WHO issued a state of emergency declaration on March 11, 2020 (8), in this study, the fiscal year 2019 (FY2019) and 2020 (FY2020) were considered the pre-pandemic and pandemic periods, respectively.

Inpatient and outpatient medical claims data for FY2019 and FY2020 contained in the Tokushima KDB database (N = 344,331) were analyzed by month and categorized into inpatient and outpatient cases. Cases with multiple main illnesses were tabulated by the main illness. Thereafter, the number of visits per month was used as the numerator, and the number of insured individuals at the end of the fiscal year to which that month belonged was used as the denominator to calculate the incidence rates (per 1,000 children). Thereafter, the mean monthly incidence rates (per 1,000 children) and 95% confidence intervals (CIs) were calculated for three age groups (0–4, 5–9, and 10–14 years). Furthermore, the percent change in the number of pediatric patients in FY2020 compared with that in FY2019 was determined.

Next, multivariable negative binomial regression models were used to analyze the inpatient and outpatient IRRs in FY2019 compared with those in FY2020. Based on a previous study, the other explanatory variables were sex (boys and girls), age group (three categories), and month of claims (for 12 months) (15). Statistical tests were based on two-sided probabilities, and a p-value of <0.05 was considered significant. All statistical analyses were performed using IBM SPSS Statistics version 28.0 for Windows.

Patient names, birth dates, addresses, and medical institutions were anonymized by removing them from the medical claims data for personal information protection.

Ethical considerations

The implementation of this study was announced on the homepage of Tokushima Prefecture and the Department of Public Health, Tokushima University Faculty of Medicine. Participants and their parents/guardians were asked to contact the authors if they did not wish to participate in the study. Additionally, this study was conducted in accordance with the tenets of the Declaration of Helsinki and national ethical guidelines. This study protocol was approved by the Ethics Committee of Tokushima University Hospital (approval number : 4336).

RESULTS

Tables 1 and 2 show the mean monthly incidence rates and 95% CIs per fiscal year and age groups, respectively. The mean total rates of hospitalized inpatients aged <15 years (per 1,000 children, 95% CI) were 27.6 (95% CI : 24.7–30.4) and 16.9 (95% CI : 14.9–18.9) in FY2019 and FY2020, respectively. Based on sex, the mean rate of inpatients was, respectively, 28.4 (95% CI : 26.0–30.8) for boys and 26.6 (95% CI : 21.8–31.4) for girls in FY2019 and 18.7 (95% CI : 16.4–21.0) for boys and 15.0 (95% CI : 12.5–17.5) for girls in FY2020. The mean total rates of outpatients aged <15 years (per 1,000 children, 95% CI) were 638.1 (95% CI : 610.6–665.6) and 501.1 (95% CI : 471.0–531.0) in FY2019 and FY2020, respectively. Based on sex, the mean rates of outpatients were, respectively, 669.0 (95% CI : 639.9–698.0) for boys and 605.1 (95% CI : 587.7–631.5) for girls in FY2019 and 539.3 (95% CI : 507.2–571.3) for boys and 460.5 (95% CI : 432.3–488.7) for girls in FY2020.

Figure 1 shows the percent change in the number of pediatric patients in FY2020 and the number of new COVID-19 cases in Tokushima Prefecture, Japan, as a time series. The information published by the Japanese Health Ministry was used to determine the incidence of COVID-19 cases (19).

Finally, Table 3 shows the inpatient and outpatient IRRs in FY2020 compared with those in FY2019 using multivariable negative binomial regression models. Compared with that in FY2019, the IRR values in FY2020 significantly decreased for inpatients (0.58 [95% CI : 0.42–0.80]), whereas that of the outpatient did not differ significantly (0.79 [095% CI : 0.57–1.09]).

DISCUSSION

The results of this study showed that the number of medical claims for both inpatient and outpatient care decreased in the first year of the COVID-19 pandemic compared with the pre-pandemic period. As shown by the multivariable negative binomial regression analysis result, the inpatient IRR during the pandemic significantly decreased compared with that of pre-pandemic (IRR : 0.58 [95% CI : 0.42–0.80]). The results of this study suggested that the number of pediatric inpatients and outpatients both decreased during the COVID-19 pandemic. The pandemic may have had a larger effect on inpatients than outpatients.

The decrease in pediatric medical facility visits during the COVID-19 pandemic period does not appear to be related to the incidence of COVID-19 cases. Particularly in the first trimester of FY2020, the number of medical facility visits decreased even before the peak of COVID-19 cases. The observed lack of relationship between the number of COVID-19 cases and pediatric medical visits in this study was consistent with the results of previous studies (11, 12). Public health measures, including the government's state of emergency declaration, for controlling the spread of COVID-19 may have influenced pediatric medical facility visits.

One major reason for the decline in pediatric medical visits may be the reduced incidence of respiratory infections and related conditions such as asthma and otitis media. Previous studies have reported decreases in pediatric emergency visits for respiratory infections (12), asthma (12, 16, 20), and otitis media (12, 21). In Japan, many communicable diseases declined during the pandemic compared to the pre-pandemic period (9), likely due to public health interventions such as school and daycare closures, avoidance of the 3Cs, and individual preventive behaviors including handwashing, disinfecting, and mask-wearing.

In addition, pediatric patients and their families may have refrained from visiting medical institutions owing to concerns that they may be exposed to COVID-19 and to comply with public health measures. A previous study has shown that the number of pediatric emergency visits decreased for almost all diseases, although the extent varied depending on the disease (12). If such behavior contributed to decreased healthcare use, further investigation is needed to assess its impact on children's health outcomes, including potential excess morbidity and mortality.

It is also possible that medical institutions may have restricted patient care, postponed diagnostic tests, or prescribed medications for long periods to adequately respond to patients with COVID-19 and avoid its spread within facilities. A previous study has shown that the follow-up, control, screening, and vaccination of patients, including adults, by primary care physicians during the COVID-19 pandemic decreased (22).

Beyond these specific factors, several broader elements may have influenced pediatric healthcare utilization during the COVID-19 pandemic. First, although COVID-19 vaccination for children in Japan was not implemented until after FY2020,

Table 1. Incidence rates of medical claims of inpatients aged<15 years (per 1,000 children)

			n (% change)												
Sex	Age	FY	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Average (95%CI)
All	Total	2019	27.3	27.6	24.0	33.8	36.1	32.8	24.0	28.7	25.9	24.3	23.7	22.6	27.6 (24.7–30.4)
		2020	17.8	16.5	13.5	17.7	19.9	21.6	20.6	13.0	19.9	14.3	15.7	12.3	16.9 (14.9–18.9)
			(–34.6)	(–40.3)	(–43.8)	(–47.5)	(–44.8)	(–34.3)	(–14.0)	(–54.7)	(–23.2)	(–41.2)	(–33.7)	(–45.5)	
	0–4 years	2019	16.9	19.5	18.2	22.8	25.8	22.8	17.3	19.5	17.3	16.5	17.3	14.0	19.0 (16.9–21.1)
		2020	10.8	11.8	9.4	12.7	15.5	16.5	14.6	9.9	15.5	10.8	11.3	6.6	12.1 (10.2–14.0)
			(–36.0)	(–39.5)	(–48.3)	(–44.4)	(–39.8)	(–27.9)	(–15.9)	(–49.2)	(–10.5)	(–34.4)	(–34.9)	(–52.8)	
	5–9 years	2019	5.7	2.8	3.5	5.3	4.7	4.4	3.1	6.6	4.4	3.1	2.5	6.0	4.3 (3.5–5.2)
		2020	3.7	1.7	1.3	2.0	1.7	2.7	3.3	1.0	1.0	1.7	1.7	2.7	2.0 (1.5–2.6)
			(–35.1)	(–41.0)	(–61.4)	(–62.5)	(–64.6)	(–39.3)	6.2	(–84.8)	(–77.2)	(–46.9)	(–33.6)	(–55.3)	
	10–14 years	2019	4.7	5.3	2.4	5.6	5.6	5.6	3.5	2.6	4.1	4.7	3.8	2.6	4.2 (3.4–5.0)
		2020	3.3	3.0	2.7	3.0	2.7	2.4	2.7	2.1	3.3	1.8	2.7	3.0	2.8 (2.5–3.0)
			(–29.1)	(–42.7)	16.0	(–45.7)	(–51.1)	(–56.6)	(–22.6)	(–19.8)	(–18.9)	(–61.3)	(–28.6)	14.6	
Boys	Total	2019	24.0	26.6	25.6	34.6	29.1	36.2	28.8	27.7	24.4	30.3	27.7	26.3	28.4 (26.0–30.8)
		2020	18.0	17.9	15.2	22.9	21.6	23.8	19.8	11.7	22.5	19.0	16.3	15.8	18.7 (16.4–21.0)
			(–25.1)	(–32.6)	(–40.6)	(–33.6)	(–25.8)	(–34.2)	(–31.4)	(–57.8)	(–7.8)	(–37.4)	(–41.0)	(–40.0)	
	0–4 years	2019	14.0	17.3	17.3	22.2	19.8	22.2	20.6	16.5	15.7	19.8	18.9	15.7	18.3 (16.6–20.0)
		2020	11.2	13.1	12.1	18.7	16.8	17.7	11.2	7.5	17.7	14.0	10.3	8.4	13.2 (10.8–15.6)
			(–20.0)	(–24.4)	(–29.8)	(–16.0)	(–15.0)	(–20.2)	(–45.6)	(–54.7)	13.4	(–29.2)	(–45.8)	(–46.3)	
	5–9 years	2019	5.4	3.6	5.4	6.6	3.6	4.8	4.8	7.2	4.2	4.2	3.0	7.8	5.1 (4.1–6.0)
		2020	3.8	1.9	1.3	1.9	0.6	2.5	4.4	1.3	0.6	3.2	1.9	4.4	2.3 (1.5–3.2)
			(–29.6)	(–47.2)	(–76.5)	(–71.2)	(–82.4)	(–47.2)	(–7.6)	(–82.4)	(–84.9)	(–24.6)	(–36.6)	(–43.1)	
	10–14 years	2019	4.6	5.7	2.9	5.7	5.7	9.1	3.4	4.0	4.6	6.3	5.7	2.9	5.0 (3.9–6.2)
		2020	3.0	3.0	1.8	4.1	4.1	3.5	4.1	3.0	4.1	1.8	4.1	3.0	3.2 (2.6–3.7)
			(–35.3)	(–48.3)	(–37.9)	(–58.6)	(–27.6)	(–61.2)	20.7	(–26.1)	(–9.4)	(–71.8)	(–27.6)	3.5	
Girls	Total	2019	30.8	28.5	22.2	43.5	43.5	29.2	18.9	29.7	27.4	18.0	19.4	18.5	26.6 (21.8–31.4)
		2020	17.7	15.0	11.8	18.3	18.3	19.2	21.4	14.3	17.2	9.5	15.0	8.6	15.0 (12.5–17.5)
			(–42.5)	(–47.6)	(–47.0)	(–62.0)	(–58.0)	(–34.2)	13.3	(–52.0)	(–37.2)	(–47.6)	(–22.9)	(–53.8)	
	0–4 years	2019	20.0	21.7	19.1	32.1	32.1	23.5	13.9	22.6	19.1	13.0	15.6	12.2	19.7 (16.1–23.3)
		2020	10.4	10.4	6.6	14.2	14.2	15.2	18.0	12.3	13.3	7.6	12.3	4.7	11.0 (8.4–13.5)
			(–47.8)	(–52.0)	(–65.3)	(–71.7)	(–55.8)	(–35.3)	29.6	(–45.5)	(–30.6)	(–41.8)	(–21.2)	(–61.0)	
	5–9 years	2019	5.9	2.0	1.3	5.9	5.9	3.9	1.3	5.9	4.6	2.0	2.0	3.9	3.6 (2.4–4.7)
		2020	3.5	1.4	1.4	2.8	2.8	2.8	2.1	0.7	1.4	0.0	1.4	0.7	1.7 (1.1–2.3)
			(–40.6)	(–28.7)	7.0	(–46.5)	(–52.5)	(–28.7)	60.5	(–88.1)	(–69.4)	100.0	(–28.7)	(–82.2)	
	10–14 years	2019	4.9	4.9	1.8	5.5	5.5	1.8	3.6	1.2	3.6	3.0	1.8	2.4	3.3 (2.4–4.3)
		2020	3.7	3.1	3.7	3.7	1.2	1.2	1.2	1.2	2.5	1.9	1.2	3.1	2.3 (1.6–3.0)
			(–22.9)	(–35.7)	105.6	(–31.5)	(–77.2)	(–31.5)	(–65.7)	2.8	(–31.5)	(–38.3)	(–31.5)	28.5	

CI : confidence interval

Table 2. Incidence rates of medical claims of outpatients aged<15 years (per 1,000 children)

			n (% change)												
Sex	Age	FY	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Average (95%CI)
All	Total	2019	662.1	656.5	663.9	663.9	596.5	630.6	629.9	661.0	674.0	617.7	646.9	528.0	638.1 (610.6–665.6)
		2020	448.7	409.9	530.8	530.8	480.7	465.1	562.3	521.2	532.1	456.3	528.1	545.1	501.1 (471.0–531.0)
			(–32.2)	(–37.6)	(–20.0)	(–22.9)	(–19.4)	(–26.2)	(–10.7)	(–21.1)	(–21.1)	(–26.1)	(–18.4)	3.2	
	0–4 years	2019	889.6	869.3	856.2	856.2	835.1	912.9	863.4	880.3	911.6	838.5	909.9	780.1	875.0 (846.1– 903.9)
		2020	609.6	544.2	653.8	653.8	569.6	623.7	772.3	731.9	761.5	675.0	684.4	765.3	668.5 (619.5–717.5)
			(–31.5)	(–37.4)	(–23.6)	(–33.8)	(–31.8)	(–31.7)	(–10.5)	(–16.9)	(–16.5)	(–19.5)	(–24.8)	(–1.9)	
	5–9 years	2019	681.2	648.9	665.2	665.2	578.2	605.2	612.1	676.5	683.4	593.9	613.4	503.5	628.0 (593.5–662.4)
		2020	478.5	412.7	530.9	530.9	475.8	437.8	554.2	505.5	503.5	413.7	513.5	526.2	491.1 (460.5–521.7)
			(–29.8)	(–36.4)	(–20.2)	(–19.8)	(–17.7)	(–27.7)	(–9.5)	(–25.3)	(–26.3)	(–30.3)	(–16.3)	4.5	
	10–14 years	2019	485.9	515.6	528.8	528.8	447.6	457.9	484.1	493.8	500.0	486.5	495.3	375.6	482.9 (456.6–509.1)
		2020	318.0	320.7	451.5	451.5	427.8	387.7	434.2	399.6	410.2	354.1	440.5	420.2	402.1 (371.4–432.8)
			(–34.6)	(–37.8)	(–14.6)	(–11.9)	(–4.4)	(–15.3)	(–10.3)	(–19.1)	(–18.0)	(–27.2)	(–11.1)	11.9	
Boys	Total	2019	703.6	687.4	685.0	726.5	616.5	666.7	660.8	695.4	704.3	649.4	675.5	556.3	669.0 (639.9–698.0)
		2020	486.5	440.0	570.4	573.6	526.8	509.1	611.0	561.0	564.6	480.5	566.3	581.2	539.3 (507.2–571.3)
			(–30.9)	(–36.0)	(–16.7)	(–21.0)	(–14.5)	(–23.6)	(–7.5)	(–19.3)	(–19.8)	(–26.0)	(–16.2)	4.5	
	0–4 years	2019	931.6	904.4	869.0	988.5	867.4	951.4	869.0	938.2	939.9	887.1	936.6	817.1	908.4 (878.0–938.7)
		2020	662.9	592.9	712.4	679.7	620.9	679.7	862.7	799.3	821.7	712.4	739.5	817.9	725.2 (671.3–779.1)
			(–28.8)	(–34.4)	(–18.0)	(–31.2)	(–28.4)	(–28.6)	(–0.7)	(–14.8)	(–12.6)	(–19.7)	(–21.0)	0.1	
	5–9 years	2019	742.8	691.7	685.1	739.8	597.4	647.2	688.1	714.5	712.7	624.4	643.0	538.5	668.8 (630.0–707.5)
		2020	513.3	445.4	553.3	590.1	527.9	488.6	598.4	543.8	536.8	444.2	541.9	564.1	529.0 (497.6–560.4)
			(–30.9)	(–35.6)	(–19.2)	(–20.2)	(–11.6)	(–24.5)	(–13.0)	(–23.9)	(–24.7)	(–28.9)	(–15.7)	4.8	
	10–14 years	2019	508.3	532.8	557.4	532.3	460.9	487.7	490.6	508.9	532.8	508.3	525.4	392.3	503.1 (475.6, 530.6)
		2020	349.9	338.1	496.5	491.1	466.3	420.2	463.4	426.1	427.9	367.6	479.3	447.4	431.1 (396.8, 465.5)
			(–31.2)	(–36.6)	(–10.9)	(–7.7)	1.2	(–13.8)	(–5.5)	(–16.3)	(–19.7)	(–27.7)	(–8.8)	14.0	
Girls	Total	2019	617.6	623.4	641.2	652.1	575.0	561.9	596.8	624.1	641.7	583.8	616.2	497.7	605.1 (578.7–631.5)
		2020	408.6	377.9	488.7	488.5	431.6	418.4	510.5	478.9	497.5	430.6	487.5	506.6	460.5 (432.3–488.7)
			(–33.8)	(–39.4)	(–23.8)	(–25.1)	(–24.9)	(–29.3)	(–14.4)	(–23.3)	(–22.5)	(–26.2)	(–20.9)	1.8	
	0–4 years	2019	845.4	832.3	842.7	915.7	801.0	872.3	857.5	819.3	881.8	787.1	881.8	741.1	839.8 (809.4–870.3)
		2020	555.5	494.8	594.3	581.0	517.5	566.8	680.6	663.5	700.5	637.0	628.4	711.8	611.0 (566.0–656.0)
			(–34.3)	(–40.6)	(–29.5)	(–36.5)	(–35.4)	(–35.0)	(–20.6)	(–19.0)	(–20.6)	(–19.1)	(–28.7)	(–3.9)	
	5–9 years	2019	613.8	602.0	643.4	602.6	557.2	559.2	528.9	634.9	651.3	560.5	580.9	465.1	583.3 (549.5–617.2)
		2020	439.8	376.5	506.0	486.3	418.0	381.4	505.3	463.1	466.6	380.0	482.1	484.2	449.1 (418.0–480.1)
			(–28.3)	(–37.5)	(–21.4)	(–19.3)	(–25.0)	(–31.8)	(–4.5)	(–27.1)	(–28.4)	(–32.2)	(–17.0)	4.1	
	10–14 years	2019	462.1	497.3	498.5	513.6	433.6	426.3	477.3	477.9	465.1	463.3	463.3	357.8	461.3 (435.2–487.5)
		2020	284.3	302.4	404.0	429.6	387.2	353.5	403.4	371.6	391.5	339.8	399.6	391.5	371.5 (343.8–399.3)
			(–38.5)	(–39.2)	(–19.0)	(–16.4)	(–10.7)	(–17.1)	(–15.5)	(–22.2)	(–15.8)	(–26.7)	(–13.7)	9.4	

CI : confidence interval

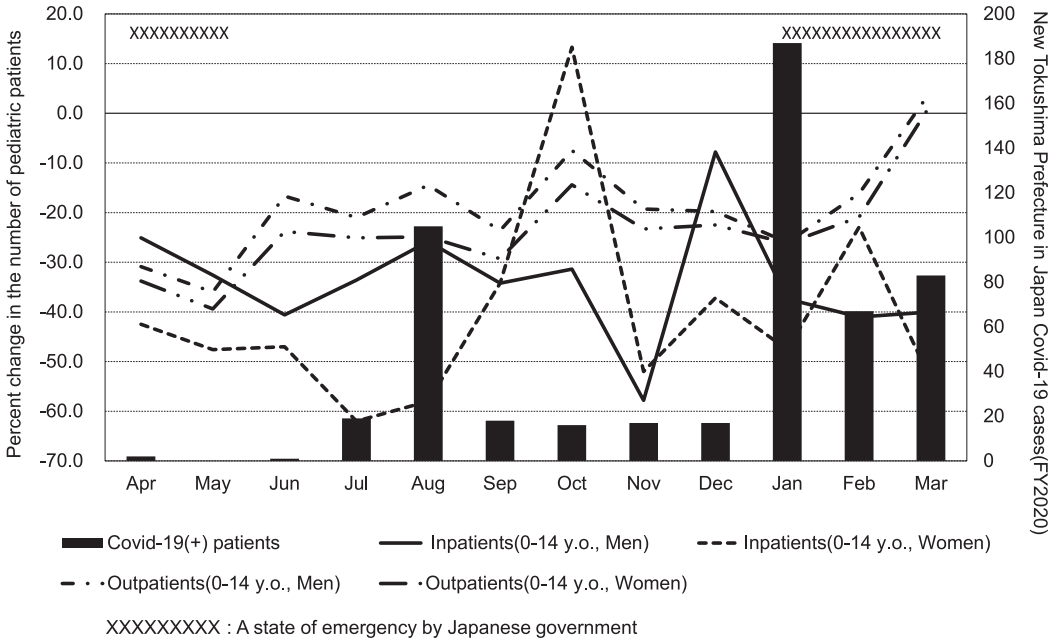

Figure 1. Changes in the number of pediatric patients and new COVID-19 cases

Table 3. Incidence rate ratios of medical claims of patients aged <15 years

Chracteristic	Level	Inpatient		Outpatient	
		IRR[a]	95%CI	IRR[a]	95%CI
Year	FY 2019 (Prepandemic)	Reference		Reference	
	FY 2020 (Pandemic)	**0.58**	**0.42 - 0.80**	0.79	0.57 - 1.09
Age group	0-4 years	Reference		Reference	
	5-9 years	**0.19**	**0.13 - 0.28**	**0.72**	**0.48 - 1.08**
	10-14 years	**0.22**	**0.15 - 0.33**	**0.58**	**0.39 - 0.86**
Sex	Boys	Reference		Reference	
	Girls	0.76	0.55 - 1.06	0.88	0.63 - 1.22
Month	Apr	Reference		Reference	
	May	0.79	0.35 - 1.76	0.96	0.43 - 2.14
	Jun	0.65	0.29 - 1.45	1.09	0.49 - 2.44
	Jul	0.94	0.42 - 2.10	1.12	0.50 - 2.48
	Aug	0.96	0.43 - 2.14	0.99	0.44 - 2.19
	Sep	0.94	0.42 - 2.10	0.99	0.45 - 2.21
	Oct	0.83	0.37 - 1.85	1.10	0.49 - 2.44
	Nov	0.73	0.32 - 1.62	1.08	0.48 - 2.40
	Dec	0.82	0.37 - 1.83	1.10	0.49 - 2.45
	Jan	0.65	0.29 - 1.46	0.98	0.44 - 2.18
	Feb	0.68	0.30 - 1.52	1.08	0.48 - 2.39
	Mar	0.75	0.34 - 1.68	0.99	0.45 - 2.21

IRR : incident rate ratio, CI : confidence interval
[a] IRR modeled by multivariable negative binomial regression

the anticipation and rollout of vaccination programs may have affected health-seeking behaviors among families (23, 24). Second, the generally low risk of severe disease in children without underlying health conditions has been well documented in recent studies (25, 26), possibly contributing to a reduced urgency to seek care. Third, Age-specific differences in pediatric COVID-19 exposure and disease dynamics may have influenced healthcare utilization patterns. A CDC report indicated that COVID-19 incidence increased with age among children and adolescents, with older age groups (≥10 years) showing higher infection rates and healthcare contacts compared to younger children (27). Such differences in exposure and care-seeking behavior may partially explain variation in medical claims by age group. Fourth, nationwide data have shown a decline in overall healthcare service use during the pandemic across all age groups and disease categories (28), likely reflecting broader systemic changes such as postponed procedures and altered health-seeking behavior. Lastly, while the Omicron variant emerged after our study period, its association with milder disease in children may reflect an ongoing trend toward reduced pediatric inpatient admissions, which warrants further study in future surveillance (29).

In this study, we found that the decrease in the IRR of medical claims was significant among inpatients but not in outpatients, and possible reasons could include the following : first, there was a decrease in severe respiratory diseases, such as severe asthma. Previous studies have reported a decrease in acute inpatients with asthma (30, 31). The decrease in visits for respiratory infections and diseases may have also reduced the occurrence of such severe cases.

Second, medical institutions may have postponed scheduled operations and procedures to secure hospital beds and staff for patients with COVID-19. A previous study reported a decrease in the number of appendectomies for acute simple and non-acute appendicitis in pediatric patients compared with acute complex appendicitis (17). In the future, we plan to confirm the securing of hospital capacity by analyzing changes in the number of hospital receipts by medical institutions.

Third, some of the decline in pediatric visits may reflect reductions in low-severity or potentially unnecessary consultations. Prior studies have reported that such care can lead to harm and waste of resources (32, 33), and that visits during the pandemic declined most among patients with milder conditions (34). While this study could not determine whether unnecessary visits decreased, ensuring appropriate use of pediatric care is critical, especially given the shortage of pediatricians in Japan (1-4). Further research is needed to better understand children's healthcare needs in the post-pandemic context.

This study has some limitations. First, this is an ecological study, which cannot establish causality. Second, the participants of this study were individuals who were insured under the National Health Insurance in Japan. They differed from the general population in terms of health and socio-demographic status. Third, this study used medical claims data, which are administrative records and differ from clinical data such as medical charts. Since claims are issued for each institution visited, even multiple visits in the same month can result in duplicate records per patient. While this may limit the precision in estimating infectious disease cases (35), we addressed this by analyzing annual trends. Fourth, public medical insurance in Japan covers visits to medical institutions owing to illnesses. It does not cover visits for vaccinations or other health-related visits. Vaccinations and problem-focused visits by family physicians reportedly decreased during the COVID-19 pandemic (36) ; however, this was not investigated in this study. Fifth, the number of people insured under the National Health Insurance was based on end-of-year values due to the lack of monthly data, which is a common approach in previous studies (37).

CONCLUSIONS

In this study, the monthly rates of medical claims of inpatients and outpatients aged <15 years (per 1,000 children) for both boys and girls decreased in FY2020 (pandemic period) compared with those during FY2019. Results of the multivariable analysis showed that the IRR values in FY2020 compared with those in FY2019 significantly decreased for inpatient visits only. The COVID-19 pandemic may have had a larger impact on the number of inpatient visits than on the number of outpatient visits. Further research is necessary to confirm the effect of the disease and reasons for the decrease in pediatric visits, the rebound in medical visits post-COVID-19 pandemic, and pediatric health outcomes.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest concerning the publication of this manuscript.

AUTHOR CONTRIBUTIONS

AT, YM and HM conceptualized and designed the study. AT and HM analyzed the data. AT, YM, KN, MN, RF, and HM interpreted the data. AT, YM, KN, MI, KI and HM conceptualized the manuscript. All authors read and approved the final manuscript.

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